REVIEW.

Researches on the Composition and the Significance of the Egg, based on the Study of its Mode of Formation, and of the first Embryonic Phenomena—(*Mammifers, Birds, Crustacea, Worms*). By EDOUARD VAN BENEDEN, Doctor of Natural Sciences. Presented August 1, 1868; crowned by the Royal Academy of Belgium in public assembly December 16, 1868. Brussels, 1870.

THE very valuable Memoir of Dr. Van Beneden is at length published, consisting of nearly 280 pages quarto, and twelve excellent plates. It is impossible for us here to give an adequate sketch of so extensive and valuable a work. The numerous details and observations which it contains are, however, all directed to establish certain conclusions concerning the signification of the egg, and the various parts which compose it, which we shall state, referring the reader with great confidence to the clear, logical, and interesting details of observation given in the Memoir. "It was not," remarks Dr. Van Beneden, "until after the appearance of the memorable works of Von Baer, Purkinje, R. Wagner, Coste, Prevost, Dumas, and Rusconi on the Vertebrata, of Rathke, Hérold, von Siebold, and P. J. Van Beneden on the lower animals, that the bases of comparative ovology and embryogeny were definitely established. The constitution of the egg of the superior animals, and of a certain number of inferior animals, was known, and it was perceived that throughout the egg consists of the same essential parts: of a membrane, of a vitellus, and of a germinal vesicle, holding in suspension one or several refringent corpuscles. On the other hand, the breaking up or cleavage which Prevost and Dumas had established in the Batrachia came to be discovered in Fishes by Rusconi and Von Baer; Von Siebold pointed it out in certain Nematods; Dumortier, Van Beneden, and Windischman in some Gasteropods.

But what a mystery this segmentation was—manifesting itself everywhere with the same characters! What relation could it have to the formation of the embryo, and what could be its object? This was, indeed, an enigma which seemed to be impenetrable, and one knew no more why the vitellus divided itself up into bits, than one could guess why the egg contained a vesicle destined to disappear. Nothing tended to explain the signification of the egg.

But in 1839 appeared the book of M. Schwann, and the discovery that all the tissues of animals proceed from cells was destined to effect a radical revolution in science; the cell-theory of M. Schwann was destined to throw an entirely new light on anatomy and physiology, as well as on embryogeny, and suffices to immortalise the name of its author. The cell-theory became established, and the profound obscurity which surrounded the question of the signification of the egg and the object of yelk-cleavage disappeared at the same time. Relying on his study of its constitution, M. Schwann was the first to proclaim that the egg is a cell; and since all the tissues are but a mass of cells, it became obvious that the object of the cleavage was to multiply the cell-egg. Bergmann, Reichert, and Remak contributed principally to the demonstration of the part which yelk-cleavage plays in the production of cells.

But although a great number of physiologists—following Schwann—consider the egg as a simple cell, others, with Henle, regard the egg as a combination of cells, and see in the germinal vesicle a complete cell. Among these we may cite Bischoff, Steinlein, Stein, &c.

It is necessary to take the mean between the two opinions, and to consider certain eggs as simple cells, others as complex cells. Can one, for instance, consider as a simple cell the egg of the Trematods, or of the Cestoids, when it is seen to form, by the union in a common shell, of a protoplasmic cell and of other cells, formed by distinct glands, which have wrongly borne the name 'vitellogenous'?"

The study which Dr. Van Beneden has made of the formation of the egg, and of the first embryonic phenomena, clearly gives the solution of the problem.

In every egg, whether of Mammifer or of Bird, of Crustacean or of Trematod, we find a protoplasmic cell, of which the germinal vesicle is the nucleus, the corpuscle of Wagner (germinal spot), the nucleolus. This cell, which Dr. Van Beneden calls the germ or cell-egg (cellule-œuf), and which may be considered as being the first cell of the embryo, arises everywhere throughout the animal series in the same manner; it presents always the same characters; and gives origin by division to the first cells of the embryo.

But the vitellus of the egg is made up of two elements: the one, protoplasmic, represents the mass of the cell-egg; the other, nutritive, forms what Dr. Van Beneden has designated the *deutoplasm* of the egg. This deutoplasm is the accessory part of the vitellus; and so we see it is wanting sometimes, arises in different ways, presents very various relations with the protoplasm, and behaves itself very differently in the course of the first embryonic phenomena, according to the particular case.

Formation.—Sometimes it takes birth in the interior itself of the protoplasm, and is elaborated by the cell-egg itself; at other times it is formed by certain special cells, either in a particular gland (deutoplasmogen of Van Beneden—vitellogenous gland of previous authors), or in the same gland in which the germs are formed, but in a special part of this organ.

Relations to the Protoplasm of the Cell-egg.—Sometimes it is found in the ripe egg, in suspension in the protoplasm; sometimes it does not get mixed up with it. In certain cases it is formed of well-marked cells; more often it is composed of drops or of refringent granules, or even of vesicular elements, which have nothing in common with true cells.

Rôle in Development.—We have now seen that the deutoplasm behaves very variously during the first embryonic phenomena; but its function is always the same. It plays a purely passive part; it serves to nourish the blastoderm and the embryo, and to furnish, by the combustion of the elements of which it consists, the force necessary for the production of all the elements of the embryo, and for the accomplishment of all the phenomena of fœtal life. This deutoplasm, which is sometimes wanting, can be formed of distinct cells, and take origin in a special organ; and although it makes a part of the *egg*, it cannot be regarded as an integral part of the *cell-egg*.

It follows from this that the proposition generally admitted, "*every egg is a cell*," has not that stamp of exactitude which should characterise any principle of science.

But *in every egg there exists a cell-egg, a germ which is the first cell of the embryo.*

Side by side with this cell there exists in the egg a mass of nutritive matters, possibly mixed with the protoplasm of the cell-egg, and formed in its interior, as is seen in many vertebrate animals. In that case, we may embrace it in the cell, and say, with Schwann, that the egg is a cell as far as Vertebrates are concerned.

But when the deutoplasm is found outside the cell-egg, it cannot be considered as forming an integral part of the germ, and itself may be composed of cells, of which we have examples in many lower animals, which are remarkable for their extreme fecundity. In this case the egg is clearly not a cell, but an aggregate of cells.

In the preceding paragraphs we have the summary of Dr. Van Beneden's view of the structure of the animal ovum—his main point being the recognition of this Deutoplasm, which his detailed observations and figures, comprising minutes tudies of the ovogeny of Trematods, Cestoids, Turbellaria, Nematods, Rotifers, Copepods, Isopods, Amphipods, Mysids, Mammals, and Birds, clearly establish.

The mass of important observations contained in this part of the work well deserve careful perusal.

The tubular structure of the Mammalian ovary has been observed by the author, confirming Pflüger; but he differs from that author as to the mode of origin of the *cell-egg* in this case. Dr. Van Beneden has established in a variety of cases, and in that of Mammals (and man himself), that the cell-egg originates in a mass of protoplasm, contained in the ovigerous tubes in the case of Mammals. Several distinct nuclei arising by free development, these enlarge, and each developes a nucleolus; they are, in fact, germinal spot and germinal vesicle respectively; around each germinal vesicle the protoplasm then segregates, and the cell-egg is complete. Its vitelline membrane, bounding the segregated protoplasm, develops later, and in most cases after the addition of the dentoplasm, or vitellogenous matter, as it used to be called.

The very perplexing question of the disappearance of the germinal vesicle at the time of or after fertilization in some eggs—*e.g.*, those of Mammifers, Birds, some Crustacea, and some Mollusca—is discussed by Dr. Van Beneden. It disappears also in marine Annelids, according to Claparède and Mecznikow; and in Batrachia, according to Stricker, who, as well as other workers, has very carefully searched for it in the frog's and toad's ovum at the time of fertilization, but in vain. On the other hand, we have to put against this disappearance in the cases cited the observation of its division into two, causing the first yelk-furrow, as observed by Müller in *Entoconcha*, by Leydig in Rotifers, by Leuckart in *Puppipara*, by Mecznikow in *Cecidomyia* and *Aphides*, by Pagenstecker in *Oxyuris*, by Keferstein in marine *Planariæ*, by Bessels in *Lumbricus* and Leeches, by Van Beneden and Bessels in many Crustacea, by Van Beneden in certain Trematods figured in this work. We particularly refer the English reader to an important paper by Professor Huxley on the ovum of Pyrosoma, to which we are sorry Dr. Van Beneden has not had his attention directed ('Annals of Natural History,' Third Series, vol. 5, 1860, p. 29). Certain authors, building on the first set of facts, have declared that the germinal vesicle and spot are very important for the first stages of egg growth, but that at the period when the egg is ready for fertilisation their function is ended, and they are no more wanted. Others, again, with equal force, pointing to the latter set of facts, declare that the germinal vesicle by its division furnishes the nuclei of the first embryonic cells, and would regard the disappearance as only apparent in the first cases, since a pair of nuclei exactly like the divided germinal vesicle appear immediately after the first cleft is complete in all those cases where the germinal vesicle is found to be wanting at the time of fertilisation.

Dr. Van Beneden lays some stress on this, as well as on the fact that in some observations of his on rabbits, he found a sort of irregularity in the perceptibility or apparent absence of nuclei in the two first cells, due to yelk cleavage. Thus, in one case observed two hours after copulation, the yelk was found cleft into two cells, each with a nucleus, although at the time of fertilization it is not possible to observe a germinal vesicle. In another case, on the contrary, twenty-four hours after copulation, he found the two cells but no nucleus in either. He has also fully established the same sudden disappearance of the nuclei in the cells of the 3rd or 4th generation, reappearing as in the first cleavage, after the process. He also confirms Weismanm's observation of the similar disappearance of the nuclei in the cells of the blastoderm of dipterous insects when they were about to undergo division. He also makes a point, in observing that if the nucleus or germinal vesicle did really break up and perish, there would not suddenly appear in each half of the divided mass, a nucleus equal in size to the bulk of the lost vesicle; if new nuclei were produced by endogenous formation, they would form by degrees, and as small points at first, and would not suddenly jump into existence fully grown. Dr. Van Beneden belongs to that party which would regard the disappearance of the germinal vesicle in the case of Mammifers, Birds, Batrachia, Annelids, &c., as apparent rather than real. We are quite of his opinion here, and in any case would hesitate to accept the assertion of the *death* of the germinal vesicle before fertilisation. The host of cases in which its active life has been clearly traced as the original nucleus of the embryo-cells demands some other explanation than this. On this ground, we wonder that Mr. Hutchinson Stirling in an essay on Protoplasm, which is, if we may say it, overladen with references to the knowledge and wisdom of the Germans—the author accepting all that is presented to him in German gilt, but refusing to admit English work or thought as of the same value at all—should refer to the germinal vesicle as though it were an accepted fact that it dies upon impregnation: "In the egg, on impregnation, it seems to me natural (I say it with a smile) that the old sun that ruled it should go down, and that a new sun, stronger in the combination of the new and the old, should ascend into its place" (p. 33). Had Mr. Stirling never studied the works of Leydig, Mecznikow, and others, he yet might have found in Professor Huxley's paper on Pyrosoma facts entirely discordant with his view of the case. But error is to be expected when bibliographical knowledge only is brought to bear on such a question as the signification of Protoplasm, and the authority of Professor Stricker is quoted as conclusive against that of Professor Huxley.

Dr. Van Beneden does not, however, entirely clear up this question of the disappearance in some eggs and the important cleavage-function in others of the germinal vesicle. We wish Dr. Van Beneden had found it within the scope of his work to look at the *vegetal* ovum, with a view to solving this difficulty. If we may believe the observations of some high authorities (Tulasne) the mass which is fertilized in phænogamous plants at any rate, that which corresponds to the cell-egg in animals, is a simple mass of protoplasm with nothing corresponding to germinal vesicle and spot,—no nucleus and nucleolus. Immediately upon fertilisation, cells are produced in this mass by free-cell-formation, which dividing, give rise to the embryo. But if the observations of Henfrey are to be accepted, the embryo-sac does develop one or more germinal vesicles before ever the pollen-tube touches it, though there is no enclosure by cellulose until after that time. In this case, the embryo-sac with its protoplasm corresponds to the primitive protoplasm of the young ovary of animals, in which germinal vesicles arise, just the same in the plant as in the animal. In the plant, however, the protoplasm never segregates nor is it removed from the seat of its growth. There are some entomostraca (see the recent work of M. Müller on the Scandinavian Cladocera) in which four germinal vesicles are enclosed in one mass of protoplasm; only one of these vesicles develops and forms an embryo, the other being absorbed before fertilisation. So with the embryo-sac of Orchis for instance, three or four germinal vesicles arise in the mass of protoplasm, but only one develops, and the others are absorbed, forming an internal albumen in some cases; the absorption is here, however, *after* fertilisation. Dr. Van Beneden would no doubt speak of the abortive germinal vesicles in Cladocera as contributing to the deutoplasm; but we think a wide distinction ought to be drawn between such deutoplasm and that which is poured round the cell-egg from a distinct gland. From the above remarks, it appears there is much the same obscurity in plants as in animals with regard to the relation of the germinal vesicle to fertilisation, *i. e.*, whether the egg has a nucleus before fertilisation which persists and divides into the nuclei of the embryonal-cells—in all cases alike—and if so, how the apparent absence of such a nucleus at the moment of fertilisation in particular classes is to be explained. One thing may well be remembered in this matter: we have no right to lay any great stress on the mere formal structure of a cell, and the nucleus must be regarded as important only so far as we see it in direct connection with important phenomena. Morphologically it is but the central slightly differentiated part of a lump of viscid matter. Now we have in the non-nucleated red blood-corpuscles of mammalia and the nucleated red corpuscles of all other vertebrata a remarkable instance of the way in which structural units, undoubtedly of the same origin and signification in the two cases, may put on different appearances, and it seems to be just possible that with as little significance as the absence or the differentiation of a 'nucleus' is brought about in these two cases, may the absence or presence of a nucleus in the cell-egg at the moment of fertilisation be produced. This is one way of looking at the matter, but another is suggested to us by Dr. Van Beneden's exposition of the fusion of the deutoplasm with the original protoplasm of the cell-egg, which seems to be worth consideration. In the same way as the protoplasm of the cell-egg is found in some cases to be thoroughly fused with the deutoplasm, and in other cases distinct, may not the nucleus of the same ovum become at a certain epoch of its growth, under certain chemical and physical conditions, *diffused* or mixed up with the surrounding matter *temporarily*, again, contracting, segregating and assuming its nuclear form after a time, that is, after the first contraction of the yelk-cleavage has shown itself. Haeckel, in a recent very interesting 'Essay on the Plastid and Cell Theories,' suggests that we may see in the disappearance of the germinal vesicle of the cell-egg, a return to that elementary ancestral form which must be admitted as preceding the cell, namely, the cytod, the structureless mass of protoplasm with membranous pellicle or without, which he has shown to be the character of several well marked forms, his Monera. The other and more intelligible form of yelk-cleavage, in which the germinal vesicle is seen to persist and divide, has been recently observed by Haeckel in his studies on the development of the Siphonophora. A parallel to the variability of the ovum in the definition or non-definition of a nucleus is to be found in the red corpuscles of some pyrenæmatous Vertebrata. It is undeniable, as pointed out by Mr. Savory, that generally no nucleus can be seen in the circulating red corpuscles of the Frog. It is equally certain that often under the same circumstances they are well *defined*—a condition to be distinguished from that of granulation.

A table giving a summary of the different modes of formation of the blastoderm is given by Dr. Van Beneden, which we extract. The thorough way in which he has gone into his subject, and the importance of the views he advocates, will render this book classical in embryogeny, whilst its clear style, careful historical review, and interesting subject-matter should induce every student to master its contents.

Formation of the blastoderm.	With cleavage.	Total . .	Without separation of the protoplasm and deutoplasm		Mammals.
			With separation	Occurring at the termination of the cleavage .	*Gammarus locusta*, many Molluscs, Nematods, &c.
				At the commencement of the cleavage .	*Entoconcha mirabilis.* Heteropods, Pteropods, *Nephelis.* *Leptoplana tremellaris.*
		Partial . .	Without separation at the termination of cleavage of the protoplasm from the deutoplasm of the cicatricula		Osseous Fishes, Birds, Reptiles, Plagiostoms, certain Crustacea, *Nebalia*, *Mysis.*
			With separation . . .		Cephalopods.
	Without cleavage.	Separation of the protoplasm before fecundation			Trematods and Cestoids.
		Separation after fecundation .	Immediately after ,, .		*Ligia*, *Oniscus*, *Caligus.*
			Later .	Progressively .	Arachnida, *Astacus*, *Gammari* of fresh waters.
				Rapidly . .	Insects.

NOTES AND CORRESPONDENCE.

Limits of the Power of the Microscope.—On points of controversy I will not here enter, but I may say that De la Rive ascribes the haze of the Alps in fine weather to floating organic germs. Now the possible existence of germs in such profusion has been held up as an absurdity. It has been affirmed that they would darken the air, and on the assumed impossibility of their existence in the requisite numbers, without invasion of the solar light, a powerful argument has been based by believers in spontaneous generation. Similar arguments have been used by the opponents of the germ theory of epidemic disease, and both parties have triumphantly challenged an appeal to the microscope and the chemist's balance to decide the question. Without committing myself in the least to De la Rive's notion, without offering any objection here to the doctrine of spontaneous generation, without expressing any adherence to the germ theory of disease, I would simply draw attention to the fact that in the atmosphere we have particles which defy both the microscope and the balance, which do not darken the air, and which exist, nevertheless, in multitudes sufficient to reduce to insignificance the Israelitish hyperbole regarding the sands upon the seashore.

The varying judgments of men on these and other questions may perhaps be, to some extent, accounted for by that doctrine of Relativity which plays so important a part in philosophy. This doctrine affirms that the impressions made upon us by any circumstance, or combination of circumstances, depends upon our previous state. Two travellers upon the same peak, the one having ascended to it from the plain, the other having descended to it from a higher elevation, will be differently affected by the scene around them. To the one nature is expanding, to the other it is contracting, and feelings are sure to differ which have two such different antecedent states. In our scientific judgments the law of relativity may also play an important part. To two men, one educated in the school of the senses, who has mainly occupied himself with observation, and the other educated in the school of imagination as well, and exercised in the conceptions of atoms and molecules to which we have so frequently referred, a bit of matter, say $\frac{1}{50000}$th of an inch in diameter, will present itself differently. The one descends to it from his molar heights, the other climbs to it from his molecular lowlands. To the one it appears small, to the other large. So also as regards the appreciation of the most minute forms of life revealed by the microscope. To one of these men they naturally appear conterminous with the ultimate particles of matter, and he readily figures the molecules from which they directly spring; with him there is but a step from the atom to the organism. The other discerns numberless organic gradations between both. Compared with his atoms, the smallest vibrios and bacteria of the microscopic field are as behemoth and leviathan. The law of relativity may to some extent explain the different attitudes of these two men with regard to the question of spontaneous generation. An amount of evidence which satisfies the one entirely fails to satisfy the other; and while to the one the last bold defence and startling expansion of the doctrine will appear perfectly conclusive, to the other it will present itself as imposing a profitless labour of demolition on subsequent investigators. The proper and possible attitude of these two men is that each of them should work as if it were his aim and object to establish the view entertained by the other.

I trust, Mr. President, that you—whom untoward circumstances have made a biologist, but who still keep alive your sympathy with that class of inquiries which nature intended you to pursue and adorn—will excuse me to your brethren if I say that some of them seem to form an inadequate estimate of the distance which separates the microscopic from the molecular limit, and that, as a consequence, they sometimes employ a phraseology which is calculated to mislead. When, for example, the contents of a cell are described as perfectly homogeneous, as absolutely structureless, because the microscope fails to distinguish any structure, then I think the microscope begins to play a mischievous part. A little consideration will make it plain to all of you that the microscope can have no voice in the real question of germ structure. Distilled water is more perfectly homogeneous than the contents of any possible organic germ. What causes the liquid to cease contracting at 39° Fahr., and to grow bigger until it freezes? It is a structural process of which the microscope can take no note, nor is it likely to do so by any conceivable extension of its powers. Place this distilled water in the field of an electro-magnet, and bring a microscope to bear upon it. Will any change be observed when the magnet is excited? Absolutely none; and still profound and complex changes have occurred. First of all, the particles of water are rendered diamagnetically polar; and secondly, in virtue of the structure impressed upon it by the magnetic strain of its molecules, the liquid twists a ray of light in a fashion perfectly determinate both as to quantity and direction. It would be immensely interesting to both you and me if one here present, who has brought his brilliant imagination to bear upon this subject, could make us see as he sees the entangled molecular processes involved in the rotation of the plane of polarisation by magnetic force. While dealing with this question, he lived in a world of matter and of motion to which the microscope has no passport, and in which it can offer no aid. The cases in which similar conditions hold are simply numberless. Have the diamond, the amethyst, and the countless other crystals formed in the laboratories of nature and of man no structure? Assuredly they have; but what can the microscope make of it? Nothing. It cannot be too distinctly borne in mind that between the microscope limit and the true molecular limit there is room for infinite permutations and combinations. It is in this region that the poles of the atoms are arranged, that tendency is given to their powers, so that when these poles and powers have free action and proper stimulus in a suitable environment, they determine first the germ and afterwards the complete organism. This first marshalling of the atoms on which all subsequent action depends baffles a keener power than that of the microscope. Through pure excess of complexity, and long before observation can have any voice in the matter, the most highly trained intellect, the most refined and disciplined imagination, retires in bewilderment from the contemplation of the problem. We are struck dumb by an astonishment which no microscope can relieve, doubting not only the power of our instrument, but even whether we ourselves possess the intellectual elements which will ever enable us to grapple with the ultimate structural energies of nature.

But the speculative faculty, of which imagination forms so large a part, will nevertheless wander into regions where the hope of certainty would seem to be entirely shut out. We think that though the detailed analysis may be, and may ever remain, beyond us, general notions may be attainable. At all events, it is plain that beyond the present outposts of microscopic inquiry lies an immense field for the exercise of the imagination. It is only, however, the privileged spirits who know how to use their liberty without abusing it, who are able to surround imagination by the firm frontiers of reason, that are likely to work with any profit here. But

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freedom to them is of such paramount importance that, for the sake of securing it, a good deal of wildness on the part of weaker brethren may be overlooked. In more senses than one Mr. Darwin has drawn heavily upon the scientific tolerance of his age. He has drawn heavily upon *time* in his development of species, and he has drawn adventurously upon *matter* in his theory of pangenesis. According to this theory, a germ already microscopic is a world of minor germs. Not only is the organism as a whole wrapped up in the germ, but every organ of the organism has there its special seed. This, I say, is an adventurous draft on the power of matter to divide itself and distribute its forces. But, unless we are perfectly sure that he is overstepping the bounds of reason, that he is unwittingly sinning against observed fact or demonstrated law—for a mind like that of Darwin can never sin wittingly against either fact or law—we ought, I think, to be cautious in limiting his intellectual horizon. If there be the least doubt in the matter, it ought to be given in favour of the freedom of such a mind. To it a vast possibility is in itself a dynamic power, though the possibility may never be drawn upon. It gives me pleasure to think that the facts and reasonings of this discourse tend rather towards the justification of Mr. Darwin than towards his condemnation, that they tend rather to augment than to diminish the cubic space demanded by this soaring speculator; for they seem to show the perfect competence of matter and force, as regards divisibility and distribution, to bear the heaviest strain that he has hitherto imposed upon them.—*Professor Tyndall, 'Address to the British Association,* 1870, *on the Scientific Use of the Imagination.'*

Migration Theory.—A paper was read on this subject by Dr. Caton at the Biological Section of the British Association. The result of a number of experiments on the mesentery of the frog were described, in which the phenomena described by Cohnheim were observed. Inflammation in the fish and tadpole had also been studied; in the former, congestion was found to be absent during inflammation; this peculiarity was referred to the venous heart. Though the formation of pus-cells was observed, migration was never seen. In the tadpole, migration was observed to occur very frequently, produced by the slightest congestion, and even when all local irritation had been carefully avoided. The general conclusions arrived at, were that cell-migration depends on congestion, and that its connection with the suppurative process is very doubtful. Cell-migration in the tadpole was exhibited under the microscope on one of the days of the meeting.

The Application of the Microscope to the Investigation of Meteorites.—The difficulties in the way of the complete investigation of a meteorite resemble those we meet with in terrestrial rocks. In both the ingredient minerals are minute, and are often, especially in the case of the aërolitic rock, very imperfectly crystallized. Moreover the methods for separating them, whether mechanically or chemically, are very incomplete. With a view to obtain some more satisfactory means of dealing with these aggregates of mixed and minute minerals, I sought the aid of the microscope, by having in the first place sections of small fragments cut from the meteorites so as to be transparent.

One may learn, by a study and comparison of such sections, something concerning the changes that a meteorite has passed through; for one soon discovers that it has had a history, of which some of the facts are written in legible characters on the metorite itself; and one finds that it is not difficult roughly to classify meteorities according to the varieties of their structure. In this way one recognises constantly recurring minerals; but the method affords no means of determining what they are. Even the employment of polarized light, so invaluable where a crystal is examined by it of which the crystallographic orientation is at all known, fails, except in rare cases, to be a certain guide to even the system to which such minute crystals belong. It was found that the only satisfactory way of dealing with the problem was by employing the microscope chiefly as a means of selecting and assorting out of the bruised débris of a part of the meteorite the various minerals that compose it, and then investigating each separately by means of the goniometer and by analysis, and finally recurring to the microscopic sections to identify and recognise the minerals so investigated. The present memoir deals with the former part of this inquiry. Obviously the amount of each mineral thus determined, after great care and search, can only be extremely small, as only very small amounts of a meteorite can be spared for the purpose, notwithstanding that as large a surface as possible of its material requires to be searched over for instances of any one of the minerals occurring in a less than usually incomplete form. On this account one has to operate with the greatest caution in performing the analysis of such minerals; and the desirability of determining the silica with more precision than is usually the case in operations on such minute quantities of a silicate suggested to me the process, which was adopted.—*Professor Maskelyne in the 'Proceedings of the Royal Society*, 1870.'

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Proceedings of the Royal

Academy of Natural Sciences—Exhibition of the Biological and Microscopical Section.—The Biological and Microscopical Section of the Academy of Natural Sciences gave an exhibition of microscopes and microscopic specimens, at the Hall of the College of Physicians, on Friday evening, the 10th of June. As this reception was especially intended for professional men, the class of objects displayed included many illustrations in pathological anatomy and histology, of course chiefly interesting to physicians; and about forty-five microscopes in all, each in efficient working condition, were collected from the members and arranged upon the tables. Among the specimens displayed, the Director of the Section, Dr. S. Weir Mitchell, had on exhibition some preparations of teeth, bone, &c., mounted by Professor Christopher Johnson, of Baltimore, and also a collection of blood-corpuscles from different animals. Dr. William Pepper, Vice-Director, further illustrated the subject by a series of blood-crystals. The amœboid movement, lately so famous in connection with both Cohnheim's theory of the origin of pus and Huxley's lecture on "Protoplasm," was well shown by Dr. J. G. Richardson, the Secretary, with a power of 1300 diameters; while the Corresponding Secretary, Professor McQuillen, illustrated various departments of dental anatomy and physiology by sections of teeth of man and animals (showing, among other points, the interglobular spaces), and of bone exhibiting the lacunæ and canaliculi. He likewise displayed specimens of human muscle infested with trichina spiralis from fatal cases of trichiniasis; also the infecting swine's flesh. Professor James Tyson had on exhibition a series of urinary deposits. Dr. Wm. F. Norris contributed some specimens of nerves in the cornea, and capillaries showing their parietal nuclei—respectively gold and silver stainings—by the methods of Cohnheim and Recklinghausen. Some large sections of brain, kidney, &c., were displayed by Dr. W. W. Keen, who also showed sundry illustrations of nerve-structure. Dr. W. B. Corbitt exhibited a valuable series of specimens of various malignant and other tumours, collected in Germany, and many of them classified under the supervision of Professor Rokitansky.

Mr. Walmsley and Mr. T. W. Starr each contributed a number of mounted preparations. Mr. Zentmyer displayed, among other instruments, one of his binocular microscopes. Professor J. A. Meigs exhibited, with others, an injected specimen of the gall-bladder, made by Dr. P. B. Goddard many years ago.

Professor B. H. Rand arranged upon a side table his spectroscopic apparatus, and demonstrated the spectra of different metals, and explained this delicate method of analysis.