NOTES AND MEMORANDA.

To the Editors of the Quarterly Journal of Microscopical Science.

SIR,—In the account of the discovery of the segmental organs in Elasmobranchs by Professor Semper, and myself, which appeared in the January number of your journal, one or two expressions are used, which might lead to an erroneous impression as to the priority of this discovery. This rests with Professor Semper, who published his first note on the subject in July, my own account, though entirely independent of his, not being published till October.

F. M. BALFOUR.

[What we said was that Mr Balfour was the first to *publish figures* establishing the fact of the existence of a series of openings into the body-cavity from the primitive kidney-duct of the Elasmobranchs. This, we believe, is true.]—EDS.

Amplifiers for the Microscope.—In the Biological and Microscopical Section of the Academy of Natural Sciences, of Philadelphia, January 4, 1875, Dr. J. Gibbons Hunt made a communication upon the subject of *amplifiers for the microscope,* in the course of which he remarked that from the time of the first observation by the aid of more than two convex lenses, an almost constant effort had been made by opticians to fit in the best intermediate glasses, and yet further improvement in this respect was confidently to be looked for. The amplifier which he had upon the table consisted of a concavo-convex lens, with its concave side turned towards the eye, and so placed within the body of the microscope as to stand at a considerable distance from the objective. This adjustment of position was best accomplished by having the amplifier screwed to the end of a tube arranged with rack-work in such a manner as to traverse six or eight inches, because we could thus compensate for a want of complete correction in the objectives employed.

The advantages obtained by using an amplifier were, in the first place, gain in magnifying power, as could be seen in his microscope upon the table, when with an amplification of 800 diameters, afforded by a four-tenth of an inch objective,

he had on exhibition the navicula angulatum resolved into dots all over the field, which was apparently more than sixteen inches across. By the aid of an amplifier we also gain a greater focal distance, and an increase of flatness of field.

Amplifiers have been employed in telescopes for the past fifty years, but ten or twelve years ago they were only adapted to microscopes, in this city at least, by one or two amateurs. Subsequently, Mr. Tolles, of Boston, saw them in use here, and on his return home made one, apparently with gratifying success, as he has since kept them in stock.

Dr. J. G. Richardson inquired of Dr. Hunt whether, in his opinion, the four-tenth objective associated with his amplifier, as he had it upon the table, and eye-pieced so as to give a power of 800 diameters, was equal to his Powell and Leland's one sixteenth immersion lens, combined with the "A" eye-piece. Dr. Hunt replied that on histological work the results were not quite so good, but on pleurosigma angulatum he considered them fully equal. The combination of amplifier and objective which he used was, however, a merely accidental one, so that a skilful optician would probably be able to arrange the lenses more efficiently, and at a lower cost. Pigott's aplanatic searcher appeared to be a modification of the amplifier, but had proved so unsatisfactory in his hands that he had entirely laid it aside.

Professor Stricker on Pathology of Suppuration.—For some time past Professor Stricker, of Vienna, has been conducting a series of investigations on the pathology of suppuration of the cornea. An account of his results has been published in the December number of 'Stricker's Medizinische Jahrbücher' for 1874. Mr. D. J. Hamilton, who has been working on the subject of inflammation, during the present winter in his Laboratory, sends us the following account of the methods of procedure and the appearances met with. The cornea of the kitten is the most convenient for experimenting upon; for it is worthy of remark that the cornea of a young animal is more easily inflamed than that of an older one. The animal having been narcotized with a mixture of ether and chloroform, a small eschar is made in the centre of the cornea, with solid nitrate of silver. The animal is then left for twenty-four hours, by which time abundant inflammation has been excited around the cauterized spot. The entire cornea must now be stained with nitrate of silver whilst the animal is alive, for the appearances presented if the protoplasm is stained in the living state are very different from what are seen when the staining is performed after the animal is dead. To stain it properly the animal must be again

narcotized, and then the solid nitrate of silver is rubbed over the entire surface of the cornea. When this is done in the living state all the layers become stained in a few minutes. The cornea is now cut out and placed in a weak solution of acetic acid and water for twenty-four hours. By this time it has swollen up and can be easily split into layers. When one of these layers is placed in glycerine and examined with a low power (No. 2 Verick), a cloudy zone is noticed surrounding the cauterized spot, while outside this the cornea appears to be normal. The inflammatory process does not affect the whole cornea, but is most marked at a short distance from the point of greatest irritation. And, now, if we examine this cloudy area with a higher magnifying power (No. 7 Verick, or No. 10 Immersion Hartnack), we can distinguish certain well-marked changes in the corneal tissue, and are thereby enabled to interpret their history The first noticeable phenomenon, and probably the earliest change that occurs, is a remarkable contraction of the processes of the corneal cells, so that instead of fine processes uniting the cornea-cells together we see a dense network with very little intercellular substance. In certain parts the contraction has gone so far that the cornea-cells are individually isolated. What next occurs, and is so clearly demonstrated as not to leave the slightest doubt on the subject, is fissiparous division of this dense network of cornea-cells and their contracted processes. The divided parts are at first irregular in shape, but when separated from the parent stem, as afterwards happens, become rounded, a nucleus is developed in their interior, and they become individual pus-corpuscles. In some places the divisions are extremely small, and, in these instances, it is probable that pus-corpuscles are not immediately formed; but that they remain as the granular material of fully formed purulent fluid. The intercellular substance next becomes disintegrated, and we have a microscopic abscess as the result. He has never found any evidence to show that the large numbers of pus-corpuscles seen in this point of suppuration emigrate from the vessels surrounding the border of the cornea, and is of opinion that the changes met with in the layers of the inflamed cornea are a prototype of what occurs in other tissues.

Professor Max Schultze.—A recent number of the 'Archiv für Mikroskopische Anatomie' contains a memoir of this lamented anatomist, from which we take most of the following account. Max J. S. Schultze was born in 1825, at Freiburg, in Breisgau, and was the son of C. A. S. Schultze, at that time Professor of Anatomy and Physiology there, though

shortly afterwards transferred to a similar post in Greifswald. In his youth, zoology was his favorite study, and music his favorite amusement; he attained also considerable proficiency in drawing, which was afterwards of great use to him. His medical studies were chiefly carried on in Greifswald, but for one winter he was a pupil of Johann Müller and Brücke, in Berlin. As a student, and in the early part of his career as an investigator, he devoted special attention to animal chemistry, and several of his earlier memoirs relate to this subject. In 1849 he obtained his medical degree, taking as the subject of his thesis (which received a prize) *De arteriarum notione, structurâ, constitutione chemicâ, et vitâ;* and was shortly afterwards appointed Demonstrator of Anatomy and *Privat-docent.* Even while thus engaged, zoology occupied the first place in his interest, and especially the marine fauna of the northern seas. His first important memoir on these subjects was that on the 'Turbellariæ,' published in 1851, with seven plates, and this, with his other published papers, secured for him a grant from the University of Berlin of the Blumenbach Travelling Exhibition, something corresponding, as we must suppose, to our Travelling Fellowships. To this period also belongs his important discovery of chlorophyll in animal organisms. The valuable opportunity afforded by his travelling pension was employed by Schultze in studying marine zoology on the coast of Italy, where both the Adriatic and Mediterranean seas supplied him with abundant material. It was here that he made the researches which were published in 1854 in the classical monograph "On the organisation of Polythalamia, with remarks on Rhizopoda in general;" a memoir which was not only important in its zoological aspect, but as afterwards forming the basis of Schultze's reform of the cell-theory.

In the same year he was made Extraordinary Professor at Halle, and married his first wife, who was his cousin. During the five years of his stay in Halle, he produced a remarkable number of important papers, among which must be mentioned his first great memoir on the electrical organs of fishes, and two papers on the termination of nerve-fibres in the organs of sense; both subjects which he afterwards made especially his own. We may also enumerate, as better known in this country, two zoological papers "On the development of arenicola piscatorum," and "On the natural history of the terrestrial planariæ," both of which were translated in the annals of natural history, and finally one on "Internal

movements in certain diatoms from the North Sea," which was translated in this journal.

The reputation which, in spite of the, in many respects, unfavorable circumstances of the professorship at Halle, Schultze soon acquired, obtained for him in 1859 an invitation to the important chair of anatomy at Bonn, then vacant by the translation of Helmholtz to Heidelberg. It was here that he became especially celebrated as a teacher, both for the unstudied elegance of his style and the masterly skill of his practical demonstrations. His inaugural dissertation, *Observationes de retinæ structurâ penitiori*, was the first of his classical contributions to the study of the retina.

In the next year appeared an important memoir on Hyalonema, and another on Cornuspira, with remarks on the organization of Polythalamia (translated in the 'Annals of Natural History'), but in 1861 he published his first observations on the subject by which he will probably be best known to posterity, viz., the nature of the cell. This memoir, 'On muscle-corpuscles, and what one ought to call a cell,' appeared in the same year as Lionel Beale's lectures, and about the same time as researches of Brücke, having the same tendency. It is to those three investigators that we owe the modern doctrine of the cell; viz., the substitution for the conception of a cavity enclosed by a membrane, of that of a mass of sarcode or protoplasma, which, with some inconsistency, we call by the same name; and there can be no doubt that the share of Max Schultze in effecting this reform was very large indeed. The same line of investigation was carried on in his important work on the Protoplasma of Rhizopoda, and of vegetable cells published in 1863, and later on by observations on the movements of white blood-corpuscles, in which he was aided by his admirable invention of the hot stage. The new views were not accepted without an active controversy, in which Reichert was the chief defender of the doctrine of a cell-membrane.

The later researches of Schultze were chiefly in the same lines as those already mentioned, on the organs of sense, especially the retina, and the terminations of nerves, with some further memoirs on simple forms of life, and two or three papers on technical methods, in which he introduced the reagents now so well-known, iodized serum, osmic acid, and acetate of potassium. The 'Archiv für Microscopische Anatomie,' which has been since its foundation the chief organ of histological research in Germany was commenced in 1865, partly in consequence of the estrangement which controversy had produced between Schultze and Reichert, one of the editors of

the 'Archiv für Anatomie und Physiologie.' It has certainly justified its foundation by its brilliant success. Besides his journal, the organization of the anatomical teaching at Bonn, and especially the building of a new Anatomical School, which is now one of the most splendid and complete in Europe, occupied the later years of his life. So engrossed was he in this task that he refused two brilliant offers of chairs at Strasburg, and at Leipzig. In 1872 the new building was finished, and in 1874 the professor occupied the dwelling-house attached to it, but a few days only after taking up his residence there he died suddenly of a perforating ulcer of the duodenum in his forty-ninth year. The loss to science in his untimely death can hardly be estimated. Certainly Germany never produced a more accomplished histologist. The list of his published memoirs extends to eighty-two, produced between 1846 and 1872. The 'Archiv' is to go on under the editorship of Professors V. la Valette St. George of Bonn, and Waldeyer of Strasburg.

The late Professor von Mohl.—Hugo von Mohl, born April 8th, 1805, was the fourth of five brothers, all of whom were men of note, either for public services or intellectual ability. His father was some time Minister at Wurtemberg for Home Affairs and Worship, while his mother, a person of exceptional gifts, was the daughter of Autenrieth, Finance Minister in the same State.

Von Mohl's early education was obtained at the Gymnasium of his native town, Stuttgart. In his nineteenth year (1823) he entered the University of Tübingen, where (in 1828) he graduated in medicine. In his inaugural dissertation (alluded to below) he clearly foreshadowed the course in science in which he was to pre-eminently excel. It was his father's wish that he should devote himself to surgery. This, however, was distasteful to him; and the intercourse into which he was thrown during the next few years with Von Martius, Zuccarini, Steinheil, and other botanists, soon determined the direction of his pursuits. In 1831 he contributed to the great work of Martius on Palms a memoir on the structure of the stems of those plants. In this year he was nominated first "adjunct" to the Botanic Garden of St. Petersburg, a post which, however, he did not accept, owing to his being appointed Professor of Physiology at Bern, whither he went in 1832. After the death of Schübler he returned, in 1835, to Tübingen as Professor of Botany in the University; and here he remained, notwithstanding many brilliant proposals tempting him elsewhere, till the time of his death. The interests of the University of Tübingen were matters about which he

felt a keen solicitude, and the foundation of a Faculty of Natural Science in that University was essentially his work. In 1843 the Order of the Crown of Wurtemberg was conferred on him and he was ennobled. About this time he was obliged to make a prolonged stay in South Tyrol on account of delicate health. He recovered; but although a man of great stature and robust build, he appears, after he had accomplished his sixtieth year, to have fallen into chronic ill health. He suffered from pleurisy and attacks of diarrhœa. Eventually he became very reserved in manner and subject to giddiness. On the morning of Easter Monday, April 1, 1872, having been cheerful and well the night before, he was found dead in bed.

These particulars are derived from the memoir which appeared in the 'Botanische Zeitung' for 1872. Von Mohl was elected a Foreign Member of the Royal Society, March 26th, 1868.

In describing fully Von Mohl's scientific career and position, it would be necessary to write the history of vegetable histology. His work is practically coincident with the application of the higher powers of the microscope to the investigation of vegetable tissue. Confining himself almost exclusively to the higher classes of plants, from the group of Muscineæ upwards (and neglecting the Algæ, Fungi, and Lichens), there is hardly a point of any consequence in which some research or investigation of Von Mohl's is not the solid foundation of our present knowledge. The catalogue of Scientific Papers of the Royal Society enumerates 78 of his papers—not including various dissertations, some of which, along with a selection of the more important of his papers, were in 1845 collected and published in a quarto volume, under the title of "Vermischte Schriften." The list of his publications which accompanies the memoir in the 'Botanische Zeitung' gives the titles of no less than 90. Nor were his own labours the only way in which he contributed to the advancement of our knowledge of the minute anatomy of plants. In 1843 he commenced, in conjunction with Schlechtendal, the 'Botanische Zeitung,' a small quarto weekly periodical of eight pages, occasionally illustrated with plates, which he continued to edit till the time of his death. The volumes of this journal chronicle, year by year, the gradual development of the microscopic study of plants, a field in which (doubtless in no small degree owing to the example of Von Mohl) German science has reaped a more abundant harvest than that of other nations. No one can fail to be struck with the thorough character of Von Mohl's scientific

work. His energies were always ready to turn themselves to any part of his subject where facts seemed to need investigation, or the results of others to challenge re-examination or criticism. His papers are, in their way, models of "contributions to knowledge."

Von Mohl's first publication in 1827 was a prize thesis on the structure of climbing plants, in which he endeavoured to show that the stems have a dull kind of irritability, so that they bend towards any object which they touch. This explanation has given place to a better knowledge of the phenomena; but Mr. Darwin, to whom that service to science is largely due, bears witness to the *prima facie* probability of Von Mohl's view ('Journ. Linn. Soc.,' Bot. vol. ix, p. 10). His inaugural dissertation in 1828 (already alluded to) gave the first account of the true structure of the dots or "pores" frequently met with in the walls of cells ('Ueber die Poren des Pflanzenzellgewebes'). He showed that they were thinner portions of the cell-membrane.

In 1831 Von Mohl, as already mentioned, contributed to the 'Historia Naturalis Palmarum' of Von Martius an elaborate account in Latin of the structure of the stems and roots of palms, under the title "De Structura Palmarum." This was republished in German in his 'Vermischte Schriften' in 1845, and was translated for the Ray Society in 1849 by Prof. Henfrey. Von Mohl gave the final blow to the theory of the internal growth of monocotyledonous stems first propounded by Desfontaines, and upon which De Candolle had founded the division of vascular plants into Exogens and Endogens. In this memoir he appears to have first described the origin of ducts from rows of closed cells, a point which he further developed in the following year in a paper, "Ueber den Bau der porösen Gefässe.

The publication by Von Mohl in 1835 of his discovery of the multiplication of cells by division ('Ueber die Vermehrung der Pflanzenzellen durch Theilung') in *Cladophora glomerata* has been the starting-point of all subsequent investigations into the development of the tissues and organs of plants. It revealed, in fact, the precise mode by which vegetative *growth* is accomplished: Mirbel, in his memoir on the development of *Marchantia*, communicated to the Académie des Sciences in 1831 and 1832, but not published till 1836, had described the formation of pollen-grains by the quadripartite division of a mother-cell. This, however, though an extremely important observation, is not a case of growth, properly speaking, and does not affect Mohl's historical position in the matter. In 1838 Schleiden announced

the multiplication of cells by the formation of new cells *in their interior* as a general law in the vegetable kingdom. He was supported by Nägeli. The views of Von Mohl, developed as they were by Meyen and Unger, eventually established themselves. In a paper on the structure of cork and bark, Von Mohl described the nature of the tissues which enter into their composition, and accounted for the diversity of their character in different plants, especially the exfoliation of layers of bark in such trees as the Plane.

In 1844 Von Mohl maintained, against the theory of Dupetit-Thouars, the dependence of the growth of Dicotyledons on the physiological activity of leaves. The same year he published his remarks on the structure of the vegetable cell, which for a long time immensely influenced the course of vegetable histology. He regarded the cell-well as generally composed of a primary external imperforate membrane, and a secondary one usually perforated with apertures. This he supposed to be lined by a third membrane, "Primordialschlauch," the primordial utricle of English writers. "This membrane forms a perfectly closed, cell-like, thin-walled vasicle, which in the fresh plant is closely applied to the inner wall of the cell, and therefore escapes observation; while in specimens which have been preserved in spirit it is contracted, and more or less detached from the wall."

Von Mohl's paper, "Ueber die Saftbewegungen im Inneren der Zellen," published in 1846 ('Bot. Zeit.,' p. 73), has been the starting-point of all modern views about the vegetable cell. He first described accurately the "opaque viscid fluid of a white colour, having granules intermingled with it, which fluid I call *protoplasm*." He observed the vacuolization of the protoplasm until it forms a mere network. He described the motion which takes place in the filament of the network, "or perhaps now first becomes visible," and he measured its rate. Schleiden gave the theory its finishing touch in the third edition of his 'Principles' (1849), by identifying Mohl's primordial utricle and circulating fluid.

In 1850 Von Mohl published a small work with the title 'Die Vegetabilische Zelle,' which weaves the results of a great deal of what he had written in scattered memoirs into a continuous whole. It was translated into English by Prof. Henfrey in 1852.

Von Mohl felt the greatest interest in improving the means of histological and anatomical research, and wrote several papers on the construction and use of optical instruments, and in 1846 published a book on micrography.