MEETING OF THE AMERICAN SOCIETY OF MICROSCOPISTS AT DETROIT.

The third annual meeting of this society began at Detroit Tuesday, August 17th. The meeting was held in the Detroit Female Seminary, a building well adapted to the purpose, as, besides the large hall where the regular sessions were held, it was well provided with rooms of sufficient capacity for the accommodation of the leading manufacturers of microscopes and accessories, thus enabling them to make a fine exhibit of the latest and most approved forms of instruments and accessories. This, we may mension, is an interesting feature of the meetings of this society, which if not carried too far, may be productive of a great amount of value to microscopic students in enabling them to examine a large variety of instruments and apparatus, which otherwise could not be done without visiting the leading centres of manufacture at considerable expense.

The meeting was opened by the retiring president, Dr. R. H. Ward, of Troy, N.Y., introducing to the society the president-elect, Prof. H. L. Smith, of Geneva, N. Y. After the applause which greeted the new president had subsided, prayer was offered by the Rev. W. W. Hammond, of Detroit.

Prof. E. C. Wetmore, president of the Griffith Club of Microscopy, on behalf of that club, extended to the visiting society an address of welcome, and then introduced the Hon. J. J. Bagley, who stated that it was with pleasure he welcomed the visitors to the beautiful city of Detroit.

Regular business was then taken up. Secretary Prof. A. H. Tuttle announced that the Executive Committee had recommended to membership the following gentlemen, who were elected: Hiram A. Cutting, Linenburgh, Vt.; J. W. Crumbaugh, M.D., Lancaster, Pa.; Jno. Phinn, Esq., Editor *American Journal of Microscopy*, New York City; L. R. Sexton, Rochester, N. Y; S. O. Gleason, M.D., Elmira, N. Y.; T. S. Updegraff, M. D., Elmira, N. Y.; Lee H. Smith, M.D., Buffalo, N. Y.; F. O. Jacobs, Newark, Ohio; W. G. Lapham, Northville, Mich.; Nathan W. Lord, Columbus, Ohio; Sydney H. Short, Denver, Colorado; Gen. Wm. Humphrey and J. F. Main, M.D., Jackson, Mich.; O. W. Owen, M.D., Prof. E. C. Wetmore, Chas. R. Ferris and Fred Seymour, Detroit, Mich.

AFTERNOON SESSION.

The meeting was called to order by President Smith, and the proceedings commenced by Mr. George E. Fell, of Buffalo, N. Y., who gave a description of a series of plates he had prepared to illustrate on a large scale the structure of the human tooth. The speaker said these plates constituted a series of enlarged sectional drawings (cut transversely) exhibiting the structure, microscopical and general, of a human molar tooth. The average size of the drawings is six inches square.

Beginning with a top view of the crown surface of the tooth the student is successively introduced to the structure and conformation of the enamel, cementum, dentine and pulp cavity, up to the fangs of the tooth, as located in the alveolus of the superior maxillary bone. Mr. Fell stated that the drawings were prepared from a series of sections of a tooth prepared by himself for the microscopical study of its structure. His object in preparing them was to add another to the numerous aids offered to the medical and dental student in becoming acquainted with the structure of the human tooth. The plates were made up of a series of drawings overlapping each other, and finely colored, so that the various sections could be unfolded and each successive layer, of the interior structure of the tooth, consecutively exhibited. For the purpose of locating the positions of the different sections an enlarged side-elevation of a tooth (a modified copy of that prepared by Dr. F. G. Lemercier, of Paris), was used, upon which the position of the sections were defined.

Professor D. S. Kellicott, of Buffalo, N. Y., read a valuable paper upon the "*Lernescera Tortua*" a parasite harbored by the cat-fish or bull-head, and found in the river water near Buffalo. The reader stated that he had not found a locality where the parasite was at all abundant. He had only one specimen prepared for observation. It was found on a fish of ordinary size, and was deeply buried in a tumor, caused by its own presence, just back of the pectoral fin of the fish. After extraction it remained alive for several hours. The parasite could be distinguished by the naked eye, but to make out its minute structure, the best lens was required. The reader stated that with a Bausch and Lomb ½ inch objective of 98° angular aperture he had obtained the best results, making out structure which he was unable to see satisfactorily with lenses of a lower angular aperature. A very full description was given of this newly described Lemeoceran, and the whole address was attentively listened to by those present. A paper of this description by Prof. Kellicott, is specially valuable from the fact that he is one of the best authorities upon the subject of fish parasites in the country, having discovered many new species on fish inhabiting the inland lakes and rivers.

The next paper was on "The Relation of Medium-Power Objectives to Micro-Biology," by Mr. W. G. Lapham, of Northville, Michigan. The paper was of interest to students, giving the effects of the use of different objectives, and was full of hints and statements deduced from observation and the speaker's experience. The author thought that there ought to be a great National University, with a library and professors of Microscopy, and indeed of every branch of that particular science. The deduction from the essay was that with a "four-tenth objective any one could see all that they wanted to in micro-biological research."

It is quite unnecessary to state that this view was controverted by many present. While it may be admitted that with a *properly constructed* wide angled $\frac{4}{10}$ objective, very much that is ordinarily observed in micro-biological work may be seen, when eye pieces of different powers are used. To confine the work of the microscope of to-day to such powers as might be obtained with these combinations would obliterate, to a great extent, the widest field at present open to the microscopic student in original research President Smith commented upon the paper and raised objections to some of the views propounded. Secretary Tuttle also differed with the author on some points of his essay.

Mr. C. M. Vorce, of Cleveland, Ohio, read a paper on "Penetration of Objectives; Is it a Defect or an Advantage?" This paper was a very sensible *resumé* of a subject which has occupied the minds of microscopists for a long period of time, and upon which differences of opinion still exist. Mr. Vorce took the ground that there is yet work for the penetrating lens as well as the lens of wide angle with less penetration. Of the two series he would prefer the wide angled, defining, comparatively non-penetrating lenses, if the microscopist was unable to possess both series.

Following the election of new members the Society adjourned until 10 o'clock Wednesday morning.

The second day's session opened with a good attendance of members and visitors.

After the reading of minutes, etc., the executive committee reported the following as approved applicants for membership: The Rev. Wm. D'Orville Doty, Rochester, N. Y.; Rosa M. Redding, Newcastle, Ind.; Chas. Shepard, M. D., Grand Rapids, Mich.; W. B. Sprague, M. D., Detroit; Allen Y. Moore, Coldwater, Mich.; W. G. White, Buffalo, N. Y.; William A. Clapp, New Albany, Ind.; John Sloane, New Albany, Ind.; Richard J. Mohr, Fairfield, Iowa; Albert McCalla, Fairfield, Iowa. The gentlemen named were accordingly elected members of the society.

Prof. C. M. Vorce read the first paper of the day, which was entitled "The Microscopic Examination of Writings for the detection of forgery," etc.

The speaker treated the subject at length, saying that he had a great deal of interest in the matter, and directed his attention both to the verification and signatures and general writing. He had considered, first, the general characteristics of writing; second, special characteristics, modifications of, or departures from, general characteristics. There were five elements which determined the character of a person's handwriting: The paper, the pen, the ink, the personal qualifications of the writer, and the conditions under which the writing was done. Any one of these being changed from the ordinary conditions, the microscopic conditions of the writing were almost sure to be changed also. So far as the paper is concerned, its glazed

surface is the only characteristic which affects writing. The harder and smoother the surface the better defined is the writing upon it, and the better chance there is of determining any erasure, change, or interpolation. On paper of good quality, with a good pen and readily flowing ink, the lines of writing present a tolerably even contour, depending upon the rapidity, pressure, the amount of ink in the pen, etc. The speaker illustrated at length on the blackboard the various widenings or "webs" which are always found at points where two lines cross, explaining how a variation of speed, a change in the kind of ink and other causes affected this web. Upon rough paper the lines always have a ragged edge; the webbing is, if anything, less than upon hard, smooth paper. As to the pen, he stated that when a steel one was used the paper always showed a distinct groove or cutting on its surface, especially at the edges of the heavy lines, When a pen is old and corroded, the paper looks as though cut with a knife. The various qualities of ink were discussed, together with the effect on the appearance of the writing which copying in a letter press has. Some inks will not write well on paper that has been lithographed, running unevenly, as though the paper were greasy. By the fourth condition, the qualifications of the writer, the speaker meant his skill, method, physical ability, etc. A person much accustomed to writing usually writes at a good speed and without hesitation. The writing, in quality, is apt to look alike at all points on the page, Where writing is done slowly it is not so regular and the curves are not so smooth and geometrical. Where a habitually light writer attempts to make a heavy stroke, the shading is irregular. The same is true where a person accustomed to writing with a heavy stroke attempts to write light. These differences are such that they can be usually discovered with the aid of the microscope, and when a writer concentrates all his faculties on the appearance and character of the writing it never has the easy, flowing appearance which it otherwise would have. The tremor in the writing of aged persons, he stated, it was nearly impossible to imitate. The fifth condition, the circumstances under which the writing was done, had as much to do with its appearance as any other cause. One who habitually uses a flexible gold pen writes very differently with a steel pen. The reverse is equally true. Persons who are accustomed to write sitting usually cannot write as well standing. The practical application of these and other facts in the examination of writing requires patient investigation, much of it apart from the simple use of the microscope. In the great majority of cases the microscopic investigation is utterly useless without a corresponding outside investigation. The signatures to letters are apt to vary more than those written elsewhere. Letters produced as specimens of a person's handwriting are very apt to prove deceptive. Sometimes it is impossible from expert testimony to determine the character of the suspected writing. As an instance, the speaker related that he had in his possession a genuine promissory note in which a man had misspelled his own name in the signature. Had he died and there been a contest as to the signature it could hardly have been decided as anything else than a forgery. Unfortunately, however, the man lived to pay the note, thus spoiling a very good chance for a nice case of expert evidence.

Ex-President Ward discussed this paper at some length, his remarks particularly relating to the individual peculiarities of writers being noticed more or less in their handwriting. He considered it a very important factor in the detection of forgeries, etc.

The next paper was on "Mounting Materials," by Dr. Carl Seiler, of Philadelphia. He said the microscopists of both Europe and America were divided into two classes on this important question. Many believed that balsam should be the only material used in most cases and others as decidedly glycerine. He was of the opinion that all tissues which can be hardened and cut into sections are best mounted in balsam, and such specimens as membranes, hairs, cilia, etc., are best mounted in glycerine. If one wished to show delicate, fine lines he should use glycerine. The advantages of balsam are that it does not destroy colors, makes a specimen clear and does not deteriorate. The disadvantages are that the specimen is apt to shrink, and the process of drying is very slow. The advantages of glycerine are that delicate membranes may be preserved, while its disadvantages are that it always interferes with the coloring. The specimen also tends to deteriorate. Specimens mounted in glycerine are very apt to suffer from leakage. There are substances which in some cases combine the advantages of both, without the disadvantages of either. Among these the speaker mentioned Farrant's medium and Damar's cement.

This topic was discussed by Treasurer Fell; Dr. Younghusband, of Detroit; Dr. Seiler, of Philadelphia; Mr. J. H. Fisher, of Rochester, N. Y.; Mr. C. M. Vorce; W. H. Walmsley, of Philadelphia; Secretary Tuttle; President Smith and others.

The Society adjourned until the afternoon.

Afternoon Session.

At this session President Smith announced the Committee on the Griffith Award as follows, viz.: W. H. Walmsley, Prof. D. S. Kellicott and Mr. J. H. Fisher.

A work on "Angular Aperture of Microscope Objectives," by Dr. Geo. E. Blackham, F. R. M. S., was presented to the Society by the President on behalf of the author, to whom the thanks of the Society were extended.

The discussion of the paper read by Dr. Seiler at the morning session was continued, after which Mr. J. H. Fisher, of Rochester, N. Y., read a very interesting paper entitled "Notes on the Structure, Development, and Position, of a (supposed) Undescribed Flagellate Infusiorium." He referred at first to the but little explored domain of the lowest forms of animal life, which so nearly approach the vegetable. The Infusorium which he described he found in a small pond of stagnant water near Mount Hope. The body of the little animal was shaped like a cylindrical flask, green in color, the mouth resembling the neck of a bottle, and provided with a flagellum presumably for both prehensive and sustentatory purposes. The animalcule was minutely described, with its habits. It had no red eye-speck. Spines were equally distributed over it. It could not be identified, he thought, with any known species. Mr. Fisher provisionally named it *Laguncula piscatoris*.

This paper was discussed by Mr. Lapham, of Northville, Mich., who said he had seen an organism almost identical with it, except that its outer shell was composed of a series of successive plates.

The next paper was by Mr. William H. Walmsley, of Philadelphia, on "The Use of Wax Cells in connection with White Zinc Cement for Fluid Mounts." The methods employed by Mr. Walmsley, which he stated had given him great satisfaction, both as to the durability of the cell and the neatness of the mounts, was essentially the coating of the ordinary wax cell with white zinc cement. He gave his most approved formulae for the preparation of the cement which he discovered quite a number of years ago, and explained his manner of using it. He exhibited slides with cells from four to six years old, which had resisted the action of the fluid contained within them, without any apparent change. The paper was discussed by Mr. Fell, Mr. Fisher, and several other gentlemen. Mr. Walmsley, in reply to a question, said the cement would sometimes turn yellow.

Discussion was here discontinued, and the Society adjourned.

The address of President H. L. Smith was delivered in Whitney's Opera House in the evening. Prof. Smith said he thought they had very great reason to congratulate themselves upon the results attained at the two previous annual meetings. He might also speak of the wonderful improvements which had been made in the microscpe; but these would be less desirable than a discussion of some special question. He announced his subject to be "Deep sea soundings, and the relation of microscopic Algæ to deep sea animal life, with a few remarks upon evolution." He began with a glowing description of the wonders and beauties of the ocean. He then related the various stages by which it became known that it was possible for life to exist at great depths in the sea, and recounted the voyages of the United States vessel *Tuscarora*, and the English vessels *Challenger* and *Lightning* in their efforts to add to human knowledge concerning deep sea life.

Prof. Smith has in his possession material obtained from the soundings made by the *Tuscarora*.

He described the methods used to obtain specimens of the animal and vegetable life to be found three or four miles below the surface of the ocean. He then made a logical and lengthy argument to show that the low forms of deep sea life may furnish another link in the line of proof which is causing scientific men to tend so largely to the evolution theory.

The paper was lengthy and will appear in full in the proceedings of the Society.

Thursday's Session.

Following the reading of the minutes, the Executive Committee reported the name of P. L. Hatch, M. D., of Minneapolis as a member of the Society. He was duly elected.

The secretary also read a report of the Executive Committee in reference to amendments to the constitution. The amendments propose the election of honorary members; the election of secretary and treasurer for three years; making the vice-presidents the auditors of the treasurer's accounts and the treasurer the custodian of the society's property; making the terms of the officers begin at the conclusion of each annual meeting; and providing that if any member shall fail for two years to pay his dues he shall forfeit his membership. The report was accepted and the amendments will come up for action next year.

The Executive Committe also adopted a resolution which was approved by the Society, limiting the sale of the publications on hand, viz: The Proceedings of the Indianapolis and Buffalo meetings, to the members of the society to fill out sets. This action was deemed necessary in view of only a limited number of copies of these proceedings being on hand.

The nominating committee reported the following officers for the ensuing year:

President—J. D. Hyatt, president of the New York Microscopical Society.

Vice Presidents—Geo. E. Blackham, M. D., Dunkirk, N. Y., and W. B. Reoner, M. D., Cleveland, O.

Secretary—Prof. Albert H. Tuttle, Columbus, O.

Treasurer—Geo. E. Fell, Buffalo, N. Y.

Executive Committee—W. H. Brearly, Prof. J. H. Fisher, Prof. Albert H. Chester.

The report was adopted, and they were duly elected.

"Demonstration of Capillary Circulation in Man," was the title of a paper by Dr. D. C. Hawxhurst, of Battle Creek, Mich.

The process of examining the capillary circulation in the lip of a man was described. The lower lip was rolled over a support, and the microscope arranged to view the circulation.

Proper means were taken to steady the head. Clamps were applied to the lips so as to cause an engorgement of the capillary vessels. The method was that of a German scientist.

A power of about 100 diameters was used. The speaker related many interesting experiments, and also explained the effects produced by treating the lip with chloroform, ammonia, acids, glycerine, etc.

The paper was discussed by Dr. Seiler and Mr. Fell, these gentlemen deeming the power too low to be of much service. Dr. Seiler stated that other portions of the body were better adapted for viewing the circulation than the lip, and did not believe the method pursued would be fraught with results of scientific value.

The next paper was by Dr. Carl Seiler, of Philadelphia. "Describing an Improvement in a Microscope Stage." He said last year at a meeting of the society he set forth the necessity for certain improvements in the microscope of the future, one of which was an increased movement of the stage, giving at least four inches play in each direction. Mr. Walmsley, agent for R. & J. Beck, of London, had a binocular made by that English firm, embodying the improvements suggested. Dr. Seiler exhibited the instrument, which he said was particularly valuable in examining large specimens, such as sections of tumors, the vocal organs, or anything requiring a large stage movement to bring the whole of the specimen successively into play.

W. H. Bullock, of Chicago, described a microscope which he had specially arranged for examining rock sections. It was arranged with improved facilities for minute measurements, and had admirable arrangements for illumination of opaque objects, etc.

He also described a new section cutter devised by Prof. Burrill, of Illinois. It had some valuable features about it, notably the manner of holding the knife so that it could be inclined to any angle, with reference to the cutting surface. The well-hole was so arranged that it could be raised and lowered by the micrometer screw, carrying the material to be cut with it. This, it was claimed, offered some advantage over the ordinary "well hole." The arm which carried and supported the knife worked on a brass plate, a corresponding portion of the arm working in a groove cut in the plate, insuring with even an unsteady hand a true and perfect section. It was claimed that sections, the $\frac{1}{1000}$ of an inch in thickness, could be cut with this apparatus.

Mr. W. H. Griffith, of Fairport, N. Y., read the last paper of the Session, describing the new Griffith Club Portable Microscope. He took from his pocket a small narrow case which he opened. Inside was discovered the disjointed parts of a microscope. On placing them together, which was done in a very short time, a very complete instrument was the result. With this little instrument, which we cannot now describe very minutely, the lowest to the highest powers may be used. It is provided with the Society screw, coarse and fine adjustment, the latter on a principle believed to have never before been applied to the microscope, and which is capable of being used on larger stands. The body is composed of tubes which may be drawn out to the standard length of ten inches. In the field this little instrument may be used to advantage, being provided with a wood screw by which it may be secured to the side or branch of a tree or even to a fence-rail. It may then be used with the highest powers. The mirror is hung so that it may be used for transmitted or reflected light. If the owner is in need of a turn-table, by simply arranging a few screws and laying the instrument down on its side he may go to work "ringing" slides to his heart's content. The instrument was made for Mr. Griffith by Messrs. Bausch and Lomb, of Rochester, N. Y.

Prof. T. J. Burrill, Professor of Botany and Horticulture at the Illinois Industrial University, followed with a paper on "The So-called Fire-Blight of the Pear and Twig-Blight of the Apple Tree." His remarks, bearing as they do upon a subject of general interest, are given at some length.

He said the widespread and disastrous disease of the Pear tree, called Fire-blight, and that no less prevalent and alarming one known as Twig-Blight of the Apple tree, are due to the same immediate agency. They are identical in origin, and similar in their pathological characteristics, as *a priori* reasoning might have indicated. The Quince and probably other plants, among which may be named the Butternut, the Lombardy Poplar, and the American Aspen, also suffer from the same disease. From descriptions it was very probable that the "yellows" in the Peach will be found due to a similar cause. The immediate and exciting cause is a living organism producing butyric fermentation in the carbonaceous compounds, starch, etc., in the cells of the affected plants, especially in those of the bark outside of the liber. This organism, if really specifically distinct, is closely allied to the butyric *vibrion* of Pasteur and *Bacillus amylobacter* of Van Tieghem. The disease has been known in this country over 100 years. Various theories have been advanced, and one by one disproved, except the one of fungus growth. In 1878 the writer announced to the Illinois Horticultural Society the discovery of bacteria apparently connected with the disease. His investigations were carried on in an orchard where there were 94 Apple trees, 20 Pear trees and 1 Quince. "After finding myriads of bacteria in the fluids of the diseased tissues," he said, "I inoculated several Pear and Apple trees with what to me, at the time, were unsatisfactory but not uninstructive results. Beginning on the first day of July, 1880, I experimented in various ways at different times upon 66 trees of the Pear, Apple and Quince. Of the numerous applications of the virus upon the unbroken bark or leaves none were successful. Of the inoculations there were successful 63 per cent. of the Pear, 30 per cent. of the Apple, and 100 per cent. of the Quince. Upon the Pear and Quince trees used for the experiments, the disease appeared only in a single case except as the direct result

of the inoculation. This latter was sometimes performed with a knife, sometimes with a needle, always with careful precautions and close subsequent examination. Such experimental limbs as permitted it were cut and preserved like herbarium specimens, and are exhibited with the paper."

The organism found answers fairly to the description of Pasteur's butyric *vibrion*. They are usually oblong, rounded at the ends, mostly connected, two together. Their motions are not rapid, consisting of turning in every direction, and sliding irregularly forward. They are found within closed cells, in the open spaces, and in immense numbers in the viscid exudations from the diseased bark and leaves. The most conspicuous alteration observed in the tissues is the disappearance of the starch grains from the cells. The cell walls are left intact, and the protoplasmic portions remain until after the starch is mostly absorbed and appears to suffer little change until death ensues. The disease is, *par excellence*, one of the bark. The leaves die in consequence of this, or are themselves invaded, either primarily or secondarily, by the destroyer. The progress of the disease is always slow, but the leaves of an affected limb often turn black quite suddenly, perhaps according to meteorologic conditions. In diseased bark, before change has taken place visible from without, and while the leaves are still green and fresh, an active fermentation occurs. This continues until desiccation or the exhaustion of the fermentable substances puts an end to the process. The products of this fermentation are Carbon dioxide and Butyric acid, or a closely similar substance. From the fact that virus from the Pear affects the Apple tree, and vice versa, the speaker argued that the disease was similar in each. The experiments tended to show that the virus is harmless upon the epidermis of healthy plants, nor does it penetrate through the breathing pores. The speaker exhibited drawings of the cells of a healthy plant and a diseased one, showing that the starch in the latter was gradually absorbed. He obtained the virus from diseased trees, where it is exuded, and placed it in distilled water. Upon the dead leaves and branches the virus dried and looked like varnish. When redissolved it retains its vitality. The simple puncture of a bark of a tree with a needle which had been dipped in the virus would be sufficient to cause its death. Prof. Burrill exhibited a small vial containing about a teaspoonful of the virus in solution, which he said was sufficient to destroy a whole orchard.

The Griffith Award.

The committee appointed to examine the specimens of adulterations of commercial articles, and to award the prize, a fine objective, offered by Mr. E. H. Griffith, for the best mounted specimens, reported that C. M. Vorce was the only contestant and that his exhibits of coffee and butter were fine ones. He was therefore entitled to the prize.

President Smith presented it to him in a brief speech, and he accepted, regretting that there had been no other contestants.

A resolution offered by Prof. Burrill, that the president and vice-presidents elect of the society be appointed a committee to report upon some plan for uniformity in size and naming of eye-pieces and tubes, was adopted.

The report of the treasurer Mr. George E. Fell, showed $266.06 on hand, and $450.75 due the society, of which the treasurer regarded $114.69 as being very certain of being paid, making total assets $380.81. The report was adopted.

Prof. Griffith renewed his offer of a ½ inch objective or its equivalent for the best mounted slides showing adulterations in commercial articles, accompanied with the best Thesis upon the specimens submitted. His offer was accepted with thanks.

The Society then adjourned to meet at such time and place as the Executive Committee may determine upon.

The Soiree, which was given in the evening at Merrill Hall, by the members of the American Society and the local microscopists, was in every way successful, and gave great satisfaction.

PRESERVATION OF FOSSIL INSECTS AND PLANTS ON MAZON CREEK.

By J. W. Pike, Vineland, N. J.

Mazon Creek is a branch of the Illinois River, which it joins at Morris, Grundy Co., Ill. It has carved its channel down into the blue shale, which lies above the Morris coal seam, and exposed the ironstone nodules which contain the fossil plants and insects.

Scientific interpretation rests upon comparison. We compare this coalbed with other deposits of carbon, and with those now forming, and ascribe it to an ancient swamp or wet land surface. The shale above is compared with other clay-beds and with the mud of bays and lakes, and we conclude that it is the product of a subsidence and of deeper water. The fringing swamp had advanced upon higher ground, and from it floated the fern leaves and insects that were buried in the accumulating clay of the deeper basins. Leaves that sink upon the mud of a lake will rest flat upon the upper layer, and are buried under the layers that follow. So, too, the leaves in the Mazon shale are conformable to its lines of stratification. Over the shale are beds of sandrock. Compare them with beds of sand and clay now being formed over the peat and clay of the sinking Atlantic coast. It becomes clear that the beds of coal, shale, and sandstone on the Mazon are the product and record of a subsidence in the carboniferous period.

Metamorphism.—The shale immediately around the fossils was transformed into clay-ironstone nodules by the deposition of ferrous carbonate. The concreting force has emanated from the fossils, because the nodules take their general shape. The iron deposit has not merely filled the spaces between the particles of clay, but has crowded them apart and thickened the strata, making them concavo-convex above and below the fossils. Specimens exhibited show the continuity of the strata from the soft outlying shale through the nodules, their thickening and resulting convexity, the conformability of the leaves, etc.

These biological records, like primitive human inscrpitions, were written in nature's picture-language, only they are incomparably more perfect. Like the cuneiform of the Assyrian tablets it was done upon soft clay, but the clay was hardened automatically by the writing itself, and not by baking. Like the castings of the founder who surrounds his models with moist sand, these are casts; but they are casts of the delicate structure of ferns and insects, moulded in fine clay by the gentle touch of moving water. These inscriptions were not carved on the exposed and crumbling surface of monuments, but were sealed up in the concretions, and lay buried in the clay, beyond the reach of wear and decay, during the incalculable periods of the Permian, Triassic, Jurassic, Cretaceous and Teritiary. After the ages of ice and prairie lakes, the waters of the Mazon dug their channel through lake deposits, ice drift, carboniferous sandstone, and into the blue shale. The fossil bearing nodules were washed out of the softer shale, mingled with granitic gravel and strewn in the river bed. Exposure to the air changed the blue ferrous compound to ferric or red oxide. These nodules spontaneously divided into halves, disclosing these exquisite pictures of the ferns, insects and creeping things of the carboniferous lowlands. Per-oxidation continues till the iron separates from the clay. Thus the half of a nodule, with a fern pictured on its surface, may become a geode—a hard red brown shell of iron enclosing the clay in an ochery form in its interior; or it may, in the process, crack and crumble into flakes and fragments. The collector, therefore, must now anticipate the denuding forces, and dig the concretions out of the shale of the river's banks and bottom, and crack them for himself.

CAVES IN JAPAN.

By Prof. Edw. S. Morse.

Mr. Morse described a number of artificially-constructed caves which he had examined in various parts of Japan, giving sketches of them upon the black board.

These caves varied considerably in their design, but agreed in their general proportions, and were evidently intended as receptacles for the dead. They were excavated