true explosion may be imagined, when the amount of heat-energy stored up in such a boiler is calculated. The quantity of heat transformed into mechanical energy by a mass of water and of steam of such magnitude, set free, and expanding down to the pressure and temperature of the atmosphere, from the pressure and temperature at which it existed in the boiler of the Riverdale, would amount to above 1,500,000,000 foot-pounds (over 200,000,000 kilogrammetres). This would be sufficient to throw the boiler and its contents, were the heat all utilized, as in a perfect steam-engine, five miles high. This may give some faint idea of the enormous forces at work, and the tremendous energy stored in a steam-boiler, even where the pressure of the steam is very low, as it was in this case.

It will be concluded, from what has been above stated, that a steam-boiler of the most ordinary and least dangerous type has stored within it an inconceivable amount of available energy in the form of heat, which may be at any moment transformed, in part, into mechanical energy with terribly destructive results, both to life and property; that this powerful agent for good or for evil can only be safely utilized when the utmost care, intelligence, and skill, are employed in its application, and in the preservation of the vessel in which it is enclosed; that the present code of law relating to the care, management, and inspection of steam-boilers, is entirely inadequate to insure safety; that the inspection of steam-boilers, as at present practised by the employees of the government, is not only liable to be inefficient, but is likely to prove worse than none, as it gives to the owner, and perhaps often to the man in charge, of the boiler, a feeling of security which is entirely without basis in fact, and which may therefore cause the neglect of that watchfulness which might otherwise prevent accident; that simple pressure produced by the test-pump, as now provided for by the law, is not a sufficiently effective method of detecting weakness in the boiler, or to be relied upon to the exclusion of other better and well-known methods of test.

The fact that the hydrostatic test is not conclusive as to the safety of a boiler has long been well known and admitted among intelligent engineers. The steam ferryboat Westfield met with precisely such an accident a dozen years ago; and it was shown at the coroner's inquest, at which the writer assisted that official in the examination of his expert witnesses, that the boiler had been inspected, and had been tested, but a few weeks before, by the U.S. inspector, who applied a pressure considerably in excess of that at which the explosion took place. The cause of the accident, by which a large number of people lost their lives, was precisely that which caused the explosion of the Riverdale's boiler, and the method of rupture was the same. In either case, proper methods of inspection would have saved the lives of the sufferers.

It is undoubtedly true, that many of the inspectors are conscientious, experienced, skilful, and painstaking men, and do their duty in spite of the defects of the existing law; but it is also true that now and then a careless or incompetent inspector will neglect the simplest details of his work, and that we must expect occasional repetition of this sad experience, until the law is intelligently framed, and so administered that the passing of a defective boiler by the inspector shall become as nearly as possible an impossibility.

ROBERT H. THURSTON.

Hoboken, Sept. 23, 1883.

THE AMERICAN SOCIETY OF MICROSCOPISTS.

THE sixth annual meeting was held this year in Chicago, Aug. 7-11. The usual number of members was present, and the meeting was full of interest from the beginning to the end. The forenoon session of Tuesday was given to organization, and the report of the president on the official action of the executive officers for the year. At the afternoon session, papers were read as follows. Microscopical examination of seminal stains on cloth, by F. M. Hamlin. After pointing out the defects of Koblanck's method, that usually given in the manuals, he explained his own, which he had found eminently successful. It is in brief as follows. "1. If the stain to be examined is upon any thin cotton, linen, silk, or woollen fabric, cut out a piece about one-eighth inch square, lay it upon a slide previously moistened with a drop of water, and let it soak for half an hour or so; . . . then with a pair of needles unravel or fray out the threads at the corners, put on the glass cover, press it down firmly, and submit to the microscope. 2. If the fabric is of such a thickness or nature that it cannot be examined as above, fold it through the centre of the stain, and with a sharp knife shave off the projecting edge thus made, catching upon a slide moistened with water the particles removed. After soaking a few minutes, say five to ten, the powdery mass will sink down through the water, and rest upon the slide. The cover-glass may now be put on, and the preparation examined."

College microscopical societies, by Sarah F. Whiting. The author discussed, first, the question 'What use can a microscopical society subserve?' second, 'How can it be made a success?' Such a society, in its range of topics, can take in almost all the physical and social sciences; and an enthusiasm created in it will help many of the departments of college-work. The society welcomes the incoming classes, and affords an opportunity for a change to those accustomed to years of dry drill in the mathematics and languages of the preparatory schools. It opens their eyes to the perfections of nature, awakens in them a curiosity, and stimulates interest in all the scientific studies of the college course. There are interesting subjects of microscopical investigation, carried on in society, which do not come under any department of college instruction. The live college microscopical society will not only awaken interest in students and teachers, but will attract the attention of the authorities who control the funds, and the community generally. The conditions of success in such a society are just what they are in every other scientific society the object of which is not alone investigation, but instruction of its members and others. There must be desirable members, those who are willing to work: all must have something to do. "The freshmen, by their exclaiming, fan the flame of enthusiasm, and, before they can do any thing alone with the microscope, can serve the society on the lamp committee." There should be a class in microscopical technology, apparatus, a library, and especially the current scientific journals.

Cataloguing, labelling, and storing microscopical preparations, by Simon H. Gage. This paper pointed out the advantages of properly cataloguing, etc., one's microscopical preparations, and then gave in detail the course found to be successful by the author. "The catalogue should indicate all that is known of a specimen at the time of its preparation, and all the processes by which it is treated. It is only by the possession of such a complete knowledge of the entire history of a preparation that one is able to judge with certainty of the comparative excellence of methods." The card method is advocated. "The cards are postal-card size, and each preparation has its own card. . . . These may be arranged alphabetically; and, as new preparations are made, new cards may be added in their proper order, while those of destroyed or discarded preparations may be removed without in any way marring the catalogue. Finally, the cards may be kept in a neat box which occupies but little more space than a manuscript book." The cabinet should allow the slides to be flat, exclude dust and light. Each slide should have a separate compartment, numbered to agree with the slide. The floor of the compartment should be beveled at the end, so as to facilitate removal; and the drawers of the cabinet should be independent, but so close together that slides will not fall out when tipped; and each should be numbered with Roman letters.

The president, Albert McCalla, delivered his annual address, Tuesday evening, in Weber music-hall. His theme was 'Verification of microscopical observation.' Referring to the scientific spirit and a common bond of the society's organization, he said, "In this intensely practical age of ours, we are in danger of forgetting that the true aim of science is simply the pursuit of truth, and that the mighty benefits, the invaluable and almost countless gifts, of wealth and ease and safety, which result from scientific discovery, and which so greatly bless the world to-day, will result most surely when science has an eye single to the search for simple truth, — truth that to the practical world seems often abstract and unimportant. . . . We are not all botanists, not all zoölogists, nor all students of lithology; yet we have a well-defined common ground. We are all deeply interested in the physics of the microscope and in the methods of its use; and, in order to be skilled in that department of investigation we have severally chosen, we must be more or less fully practical in microscopical work in many fields." To prove that "only as theories are submitted to repeated and varied forms of verification is error eliminated and final truth obtained," numerous facts were cited from the history of scientific progress; after which, the means of verification of microscopical observation were discussed. These are repetition of observation, use of the camera lucida, photomicrography, media and reagents, improved lenses and apparatus, and a better knowledge of optics.

Wednesday forenoon was devoted to papers on bacteria. T. J. Burrill read a paper on preparing and mounting bacteria. He stated that the elements of successful staining are as follows: "1. The organisms should be decidedly and conspicuously stained; 2. The general mass of embedding-material should be left unstained, or so different in color that the organism can be distinctly seen; 3. There should be no granular or other precipitations from the staining-material; 4. The color should be suitable for the purposes required, and permanent if the object is to be mounted; 5. The process should be as simple as possible, and free from manipulative difficulties. . . . Except for a few special results, aniline dyes are by far the most serviceable in staining bacteria. However, no one staining-material, nor any single method of procedure, can be made to answer well the requirements for all kinds of bacteria."

Dr. H. J. Detmers presented some conclusions reached by himself while studying the diseases of cattle in Texas. Bacteria he regarded as unquestionably the cause of certain fevers. Under certain conditions, all bacteria become pathogenetic; but these conditions are not yet fully understood.

Dr. George E. Fell read a paper on the clinical advantages of ozone, and its effects on the micro-organisms of infusions. After giving the favorable results of the use of ozone by Dr. F. W. Bartlett in scarlet-fever, diphtheria, whooping-cough, typhoid-fever, etc., he gave in tabular form the results of a series of experiments by himself, — experiments in which bacteria, and other forms indigenous in infusions, were subjected to the influence of air charged with ozone.

Following the discussion on the three preceding papers, Dr. G. E. Blackham presented the report of committee on oculars. The report recommends naming oculars, like objectives, by their equivalent focal lengths in English inches. For the tubes of oculars the standard medium size, 1.25 inch is recommended, with the alternatives of 1 inch and 1.35 inch for those who wish smaller or larger tubes; also for the upper tube of the ocular .75 inch, and, for sub-stage tube, 1.50 inch. The purpose of the society is to secure uniformity in these sizes, so that apparatus of different makers shall be interchangeable, as objectives have been since the adoption of the 'society screw.'

The first paper in the afternoon was a critical study of the action of a diamond in ruling lines on glass, by Prof. William A. Rogers. The author stated his theory relating to the method which Nobert may possibly have employed in the production of his plates briefly thus: "The lines composing Nobert's finest bands are produced by a single crystal of the ruling-diamond, whose ruling qualities improve with use. . . . When a diamond is ground to a knife-edge, this edge is still made up of separate crystals, though we may not be able to see them; and a perfect line is obtained only when the ruling is done by a single crystal. When a good knife-edge has been obtained, the preparation for ruling consists in finding a good crystal. Occasionally excellent ruling-crystals are obtained by splitting a diamond in the direction of one or more of the twenty-four cleavage planes which are found in a perfectly formed crystal. A ruling-point formed in this way is, however, very easily broken, and soon wears out. Experience has shown that the best results are obtained by choosing a crystal having one glazed surface, and splitting off the opposite face. By grinding this split face, a knife-edge is formed against the natural face of the diamond, which will remain in good condition for a long time. When a ruling-crystal has been found which will produce moderately heavy lines of the finest quality, it is at first generally too sharp for ruling lines finer than 20,000 or 30,000 to the inch, even with the lightest possible pressure of the surface of the glass. But gradually the edges of this cutting-crystal wear away by use, until at last this particular crystal takes the form of a true knife-edge which is parallel with the line of motion of the ruling-slide: in other words, when a diamond has been so adjusted as to yield lines of the best character, its ruling-qualities improve with use. If Nobert had any so-called 'secret,' I believe this to have been its substance.

"The problem of fine ruling consists of two parts, — first, in tracing lines of varying degrees of fineness; and, second, in making the interlinear spaces equal. The latter part of the problem is purely mechanical, and presents no difficulties which cannot be overcome by mechanical skill. It will be the aim of the present paper to describe the more marked characteristics of lines of good quality ruled upon glass. . . . A perfect line is densely black, with at least one edge sharply defined. Both edges are perfectly smooth. Add to these characteristics a rich black gloss, and you have a picture of the coarser lines of a perfect Nobert plate. In the study of the action of a diamond in producing a breaking fracture in glass, the microscope seems to be of little service; but we can call it to our aid in the study of its action in ruling smooth lines. One would naturally suppose that a line of the best quality would be produced by the stoppage of the light under which it is viewed by the opaque groove which is cut by the ruling-diamond. Without doubt, this is the way in which lines are generally formed; but it is not the only way in which they can be produced. An examination under the microscope will reveal the fact, that in some instances, at least, a portion of the glass is actually removed from the groove cut by the diamond; and that the minute particles of glass thus removed are sometimes laid up in windrows beside the real line, as a plough turns up a furrow of soil. . . . The particles of glass removed take four characteristic forms: (*a*) They appear as chips scattered over the surface of the glass; (*b*) They appear as particles so minute, that when laid upon a windrow, and forming an apparent line, they cannot be separated under the microscope; (*c*) They take the form of filaments when the glass is sufficiently tough for them to be maintained unbroken; (*d*) They take a circular form. . . . It must not, however, be supposed that lines of the best quality always present the appearance described above." These characteristic results were illustrated by plates, with the fragments and fibres in place. The author also referred to Mr. Fasoldt's claim, that he has succeeded in ruling lines one million to the inch. He thinks the limit just a trifle too high; but, if reduced one-half, he is by no means sure but that it may be reached.

Following this was a paper by A. H. Chester, describing a new method of dry mounting, in which the cover-glass is easily removable. The object is fastened to the slide in the usual way, and a tin cell built up about it sufficiently high for the cover to clear the object; then a ring of larger bore is cemented on, making a flange to receive cover. The latter ring, having been punched out of tin foil by a gun-wad punch, and put in place with the smaller hole uppermost, makes a groove above the cover, into which a spring-brass ring is put, holding the cover in place. The advantages of this method are many, — the objects may be easily viewed uncovered; dust or moisture accumulating in the cell may be removed; the mounting is quickly done, etc.

In the evening session, Mr. W. H. Walmsley read a paper giving the latest and best results and methods, by himself and others, in the art of photomicrography. The photographs in illustration were exhibited by L. D. McIntosh by means of his solar microscope with ether oxygen light.

Following this was a short paper by D. S. Kellicott, giving an account of certain stalked infusoria found in the crayfish. Two species, believed to be peculiar to the gill-chambers, were described. One of these is new to science, and was named Cothurnia variabilis. The well-marked varieties seem to be due to situation; i.e., those on the hairs of the lining-membrane are relatively longer, with a spine at the upper edge of the aperture of the lorica, but without a spine on the ventricose front of the same, while a stouter variety, situated on the membrane itself, has a spine in front, but none on the edge of the aperture. A third variety occurs on the gills: it also has a spine on the ventricose part of the shell, but the aperture is horizontal instead of vertical. They are so abundant as to encumber the gills of the host, rendering them brown to the eye. An Epistylis from the same host was named E. Niagarae: it is close to E. balanorum, a marine form. The same writer, at another session, described Cothurnia lata n. s., found on Diaptomus, and also gave a general account of two internal parasites of the crayfish.

The first paper Thursday morning was on the effects of division of the vagi on the muscles of the heart, by A. M. Bleile. The object of the paper was the demonstration of nutritive or trophic nerves for the heart, and was a continuation of work reported in the Proceedings of the society last year.

Following this, T. S. Up de Graff described certain fresh-water worms. One, a rotifer, is new: it was named Brachionus Gleasonii. Independent of the spines, its length is 0.145 inch, the front of the carapace without spines. The posterior edge bears five curved spines: there is one, also, on the dorsal part of the shell, — a peculiar feature.

The remainder of the session was occupied by short papers, by Francis Wolle, on fresh-water algae, and one by John Kruttschnitt on ferns and their development.

In the afternoon the session was opened by a report upon a standard centimetre, prepared by the U. S. bureau of weights and measures, by W. A. Rogers. The lines of the centimetre are ruled on a plate of platinum-iridium soldered to brass with silver. The report describes the plate, and compares its divisions with a standard. The original basis of this unit is a metre upon copper, prepared for Professor Rogers by Professor Tresca of the Conservatoire des arts et métiers at Paris. The report concludes thus: —

1. That the centimetre A, measured by the middle defining line, is exactly a hundredth part of the metre des archives reduced to sixty degrees Fahrenheit. It can therefore be safely adopted as the unit in all measures with low-power objectives.

2. That the second millimetre of the scale is exactly a thousandth part of the metre des archives when at the same temperature.

The centimetre is now the property of the society; it having been tendered to it by the national committee on micrometry, and accepted and adopted as a standard or basis for future studies and discussions in micrometry. The scale is in the hands of Dr. George E. Fell. A committee was appointed for securing copies on glass. The rules for its control and use will soon be published.

After this report, Dr. George E. Blackham read a communication on the relation of aperture to amplification in the selection of a series of microscopic objectives. The author showed that amplification is not the only element which enters into the problem of rendering visible minute details, but the aperture of the objective forms another element. Working, then, on the general lines laid down, he had selected as a set of powers, sufficient for all the work of any microscopist, the following: —

One 4-inch objective of 0.10 n.a. = 12° an angle, nearly.
" 1 " " " 0.26 n.a. = 30° " " "
" $\frac{1}{6}$ " " " .94 n.a. = 140° " " "
" $\frac{1}{8}$ " " " 1.42 n.a.

"The first two to be dry-working objectives, without cover-correction; the third to be dry-working, with cover-correction; and the fourth to be a homogeneous immersion objective, with cover-correction; and all to be of the highest possible grade of workmanship. The stand should have a tube of such length that standard distance of ten inches from the front surface of objective to diaphragm of eye-piece can be obtained on it, and to be furnished with six eye-pieces; viz., 2-inch, 1-inch, and $\frac{3}{4}$-inch Huyghenian, and $\frac{1}{2}$-inch, $\frac{1}{3}$-inch, and $\frac{1}{4}$-inch solid."

In the evening the annual *soirée* took place, in connection with the State microscopical society of Illinois, at the Calumet club-house. There were two hundred and fifty microscopes on the tables. A great variety of objects were shown to a party of five hundred guests of the club.

There were a number of reports and papers to be disposed of on Friday, the society adjourning at five P.M.

The first paper was by Dr. W. T. Belfield, on the detection of adulteration in lard. Photographs representing crystals of pure and adulterated lard were exhibited. Those of the former are long, thin plates, with beveled ends, while the crystals of tallow are plume-shaped, resembling somewhat an ostrich feather.

Dr. V. S. Clevinger presented a paper on the pathology of the brain.

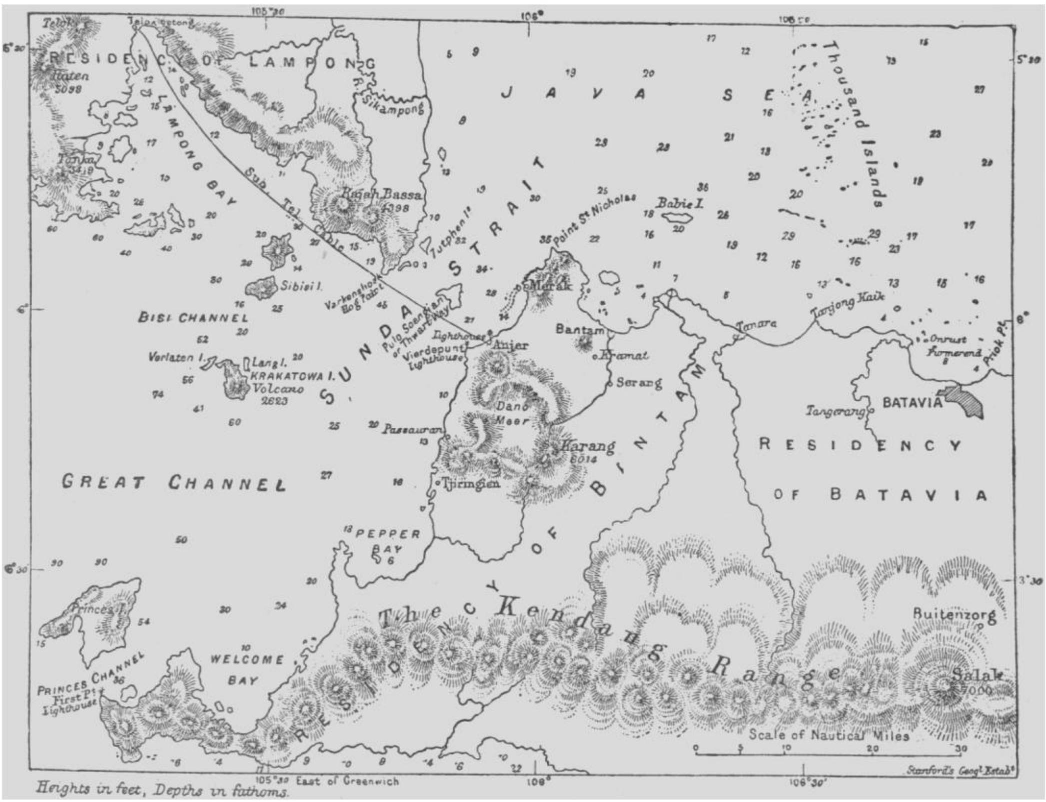
Dr. Thomas Taylor's paper, on internal parasites in the domestic fowl, was read. The parasites referred to were a mite from the lungs, another mite in the cellular tissue, and an encysted nematoid from the crop.

A paper on the termination of the nerves in the kidneys was presented by M. L. Holbrook. The author's method may be stated thus: "The fresh kidneys, as well as those preserved in chromic-acid solutions, were frozen in the freezing-microtome of Dr. Taylor, and the sections allowed to remain in the gold solution for varying periods of time, from forty minutes to several days. When removed, they were carefully washed in distilled water, and placed in a strong formic acid of a specific gravity of a hundred and twenty degrees for from five to eight minutes, or in a twenty-five-per-cent solution of the same for hours and even days. Sometimes I obtained very good specimens by placing the sections first in a dilute twenty-five-per-cent solution of formic acid for twenty-four hours, and afterward staining them with chloride of gold until they reached the color desired. . . . The nerves supplying the kidneys are mainly of the non-medullated variety. They accompany the larger arteries of this organ, either in bundles, or in flat, expanded layers; and the latter features I found more common than the former. Sometimes an artery would be found encircled by a network of non-medullated nerves in a bewildering number. Hundreds of such nucleated bundles of fibres could be traced around, above, and below an artery, freely branching, bifurcating, and supplying all the neighboring formations with a large number of delicate fibrillae. . . . The bundles of nerve-fibres give off delicate ramules to the afferent vessels by which they enter the tuft; and here they produce a delicate plexus spun around its capillaries. It was impossible to decide where the ultimate fibrillae branch in the capillaries of the tuft. . . . Sometimes I obtained specimens in which it seemed as if the ultimate fibrillae branched beneath the covering, flat epithelia in the delicate connective tissue between the convolutions of the capillaries. . . . In perfect specimens there is no difficulty in satisfying one's self of the fact that every tubule is encircled by a plexus of non-medullated nerve-fibres, coursing either in the immediate vicinity of the tubule, in the interstitial connective tissue, or within the dense layer subjacent to the epithelia, known as the *membrana propria*, or even with the layer along the feet of the epithelia themselves."

Short papers were read by Dr. Salmon Hudson, on the yeast-plant; by J. M. Mansfield, on division of labor among microscopists; by Dr. L. M. Eastman, on egg-like bodies in the liver of the rabbit; by Dr. George E. Fell, on a peculiarity in the structure of the human spermatozoon. Dr. Lester Curtis made some observations on vessels of the spinal cord of the cat; and Dr. F. M. Hamlin, on mounting foraminifera. New apparatus was described as follows: new microscope-stand with concentric movements, by J. D. Cox; new modification of the Spitzka microtome, by V. S. Clevinger; and a new binocular arrangement, by Edward Bausch.

The next annual meeting will be held at Rochester, N.Y., in August, 1884.

The officers for the present year are: president, Hon. Jacob D. Cox; vice-presidents, William A. Rogers, T. J. Burrill; secretary, D. S. Kellicott; treasurer, George E. Fell; executive committee, Albert H. Chester, William Humphreys, and H. A. Johnson.



THE JAVA UPHEAVAL.[1]

THE details which have reached us during the past week, of the terrible seismical manifestation at Java, prove it to be one of the most disastrous on record. Probably, moreover, it is the greatest phenomenon in physical geography which has occurred during at least the historical period, in the same space of time. The accompanying sketch-map will afford some idea of the extent and nature of the change which has taken place, and the character of the sea-bed and the land in the region affected.

The volcanic island of Krakatoa lies about the

[1] Taken from *Nature*, Sept. 6.