during the progress of operations. Finally it was filled with concrete made with Portland cement morter, 1 cement to 2 sand. A full description of this portion of the work has already appeared in these columns.* The other foundations presented comparatively little difficulty in execution.

The masonry superstructure is of granite, and includes an east and west approach terminating in abutments from which the two great arches spring. The arches meet again at a central pier which acts as abutment for both and which rises between them to the top of the bridge. The total length of the bridge and approaches is 2,380 feet; each approach is 660 feet long, leaving 1,060 feet for the main bridge. The western approach is level; the first portion, 260 feet in length, is in earthwork supported by masonry side walls. The rest is in masonry, including three semicircular arches, each of 60 feet span. The eastern approach starts on a lower grade, and for part of its length rises toward the bridge; 300 feet are in earthwork, as described for the other end. The remaining 360 feet includes three semicircular arches of 60 feet span and one seven-centered arch of 56 feet span. A clear width of 80 feet is afforded over this portion, as well as over the remainder of the structure, 50 feet of which are roadway, while 30 feet are devoted to the two sidewalks. The roadway is paved with asphalt.

The supporting members of the bridge proper consist of two steel arches of 510 feet span each and 90 feet versed sine. Each arch includes six parallel ribs 13 feet deep, divided by radial divisions so as to represent voussoirs. They are braced together horizontally to secure the whole against wind strains, and are connected by trusses at the junction of each voussoir lying in the plane of the radial divisions, so as to act as sway bracing. As each voussoir referred to a horizontal chord gives a projected length of 15 feet, the interval between the sway bracing trusses is a little in excess of this. Each pair of ribs are spaced 14½ feet laterally from center to center. The top and bottom chords are calculated to sustain the bending strains; the web is calculated to resist the shearing strain.

From the extrados of the arches thus formed, lattice columns rise vertically to the floor line. These are also braced laterally by trussing. At intervals of about 15 feet cross beams are placed to support the roadway. Upon these longitudinal beams are placed, the intervals between which are filled by arched buckle plates receiving the roadway.

The pivot system of skewbacks was used, and has already been illustrated in this paper.† As the arched trusses rise and fall under the effects of change of temperature or of load, the hinge joint works to and fro with theoretical exactness. The latter point has been determined by micrometric measurements.

As regards the load which the arches are constructed to carry, it includes 8,000 pounds live load per lineal foot of bridge. This is in addition to the dead weight of the structure, which is about 33,000 pounds per lineal foot. A wind pressure of 1,200 pounds for the same unitary distance is allowed for. A 20 ton road roller can be taken over it without going outside of the very liberal factor of safety provided for in the table of unit strains.

The roadway is 151 feet above the river level. On the approaches it is bordered by a handsome stone parapet, with bronze ornaments. The bridge proper has an iron and bronze rail, designed by Messrs. Delinas & Cordes. Gas lamp posts and combined gas and electric light posts are placed on either side. Over the piers stone refuges with seats are placed.

The bridge, as now situated, can be reached by the cable cars on Tenth Avenue, but the general condition of the roads leading to it on either side leaves much to be desired. It is to be hoped that the beautiful structure will soon be made more accessible, and that its absolute usefulness will not be postponed much longer.

Mr. William Hutton, of this city, was the chief engineer, assisted by Mr. Theodore Cooper.

An Irresistible Bait for Rats.

According to a Washington correspondent to the Cincinnati *Commercial Gazette*, an interesting not to say valuable discovery has been made by Capt. Weedin, in charge of the animals at the Zoo. The building is infested by rats, and how to get rid of them has long been a perplexing question. Traps were used, but nothing would tempt the rodents to enter. In a storeroom drawer was placed a quantity of sunflower seeds, used as food for some of the birds. Into this drawer the rats gnawed their way, a fact which led the Captain to experiment with them for bait in the traps. The result was that the rats can't be kept out. A trap which appears crowded with six or eight rats is found some mornings to hold fifteen. They are turned into the cages containing weasels and minks. The latter will kill a rat absolutely almost before one can see it, so rapid are its movements. The weasels are a trifle slower, but none of the rats escape them.

*See SCIENTIFIC AMERICAN, April 16, 1887.

†See SCIENTIFIC AMERICAN, February 18, 1888, page 101.

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 698.

For the Week Ending May 18, 1889.

Price 10 cents. For sale by all newsdealers.

A REMARKABLE OCEAN VOYAGE.

Five days twenty-three hours seven minutes is now the top record across the Atlantic, the City of Paris making it on her last trip this way—a remarkable trip, not only because it beats by two hours forty-eight minutes the best previous record, to wit, that made by the Etruria last June, but because she is a new ship, and, at least for a small portion of the voyage—crossing the Banks—was slowed down. Thus it is not unreasonable to expect still more of this ship, when her engines shall have become more smooth by attrition and her commander more familiar with her characteristics.

To many the mere fact of record beating will not compare in importance with the fact of using double engines and twin screws on so big a ship. With these and the re-arrangement of bulkheads which they permit, the safety of a ship is believed to be increased. Heretofore a steamer parting her shaft lay helpless on the broad ocean, her sole reliance the coming of another ship to her rescue.

There is another and perhaps it might be called a still more important factor of safety in the twin engine arrangement—it permits the subdivision of that longitudinal section of compartment which heretofore has made the most modern ship vulnerable abaft the mainmast. This contained the engines and the boilers, and the gross weight of sea water it would contain was sufficient to more than counterbalance the ship's buoyancy. With the sister ships City of New York and City of Paris, this compartment is divided into two parts, a separate engine and boilers being placed in each. Should one of these be torn open by collision and flooded, it would not swamp the ship or even destroy her power of locomotion. She would heel over a few degrees in the direction of her hurt, a condition that, to a certain extent, could be rectified by a slight shifting of the upper cargo, if the sea was fairly smooth. In any event, the second engine would go on driving its propeller as though nothing had happened, save for the diminution of speed.

It ought to be added that though the safety of passengers is still further assured by the new type of steamer, vessels that may be in or crossing the steam lanes have additional dangers to fear, not for the greater speed now obtaining, for they have not anything to fear from that during clear weather, but for the desire for quick passages which it induces and the resultant haphazard running in thick weather to insure them.

THE MARINE CONFERENCE.

The marine conference, about to sit at Washington, will devote most if not all its attention to the problem of collisions at sea and how they may be avoided—a problem, be it said, which the ablest navigators have thus far been unable to solve. Many practical suggestions looking to the improvement of the sea rules have come from this side of the water, and the unanimity shown by the maritime powers in joining in an American conference is a not undeserved tribute to Yankee cunning and resource. The masters of the Atlantic liners are most concerned in the result of this conference, and it is interesting, therefore, to note their opinions on the subject. Here are the most noteworthy ones as recently published:

Capt. Kennedy, late master White Star steamer Germanic, favors Barker's American system of signals. [In this, a steamer running in thick weather is expected to indicate by long and short sounds blown on her whistle the course she is holding.] He would restrict the signals to 8; one for each 4 points, N. to N. E.; N.E. to E.; E.S.E.; S.E. to S., and so on. He would, however, advise a separate signal for vessels bound east or west; the first signifying which way the ship is bound, the second the direction her head is pointing.

Capt. Brooks, of the Guion Line's steamer Arizona: "All the codes I have yet seen are too complicated for practical use. Two steamers approaching each other at the rate of 40 knots an hour—combined speed—would not allow their commanders to act if they had to make any such compass signals [referring to the Barker and similar systems]. Nine times out of ten they would be misunderstood. I would strongly recommend the signals in use by the New York ferry boats: one short blast, my helm is to port; two short blasts, my helm is to starboard. Thus, if I hear a steamer's whistle ahead on my port bow, I immediately put my helm a-port and blow one blast. If I hear the whistle on my starboard bow, I put my helm hard a-starboard and blow two blasts."

Capt. Burton, of the White Star steamer Coptic: "I think steamers should be fitted with two separate steam signals. This could be accomplished by having two valves on the same steam pipe." He would blow one whistle for from N. to E., another for from E. to S., etc.—four signals in all.

Capt. Boyer, of the French line's steamer La Champagne: "The rules laid down by the International Convention [the last one] are absolutely insufficient to enable even the most vigilant navigator to escape disaster. Article 12 of the rules says steamers

must have steam whistles with the sound unbroken by any obstacle. As it is the waves of sound are broken by the masts [in front of them]. The proper place for a steam whistle is in the bow. Two fast vessels approach one another at 40 knots an hour or $\frac{66}{100}$ knot per minute. To avoid collision here, the warning sound should be heard six minutes before the ships meet. Hence it is necessary that the whistle should carry the sound $\frac{66}{100} \times 6$ or $\frac{396}{100}$ of a knot, equal to about four nautical miles. Article 12 also says that steamers [running in thick weather] 'shall give a prolonged blast of the whistle at intervals not exceeding two minutes.' This is not often enough. There ought to be one minute intervals. Again: 'Every steamer shall go at reduced speed in thick weather.' The phrase is vague. It is to be hoped that science may discover some means of more precisely locating a sound at sea, as now it often appears to come from a direction opposite to that whence it actually proceeds." Until a practical system can be hit upon, he thinks steamers should be made to take routes according to the season.

What Captain Boyer says about the uncertainty of sound, especially if the wind is abeam, or quartering, has often been remarked. Every sailor has witnessed the phenomenon of a fog signal coming from two or more quarters, as if a stranger was advancing from several points at the same time. Perhaps the adoption of Captain Boyer's suggestion of a whistle on the bow would obviate this uncertainty or some of it; the sound having then no masts ahead to deflect it. Even then there is reason to believe that such signaling of courses would be of little avail, for of what advantage is it for a master to know a stranger is approaching, say from the E.S.E., if he is ignorant, and of course he must be, of the known point from which that course is laid off? A ship can be coming straight for his bow, a second for his broadside, a third for his quarter, and all be heading E.S.E. and sailing on parallel lines, the one to the other. Captain Brooks' commendation of the rule followed by the New York ferry boats would seem to be fully deserved. Indeed, this system will scarcely fail to find more or less favor with practical navigators, though with such speed as that prevailing among the ocean greyhounds, still more certainty than this will assure is desirable and, indeed, necessary. In the ferry boat service, such as that obtaining hereabout, the conditions which on the broad seas are fraught with such imminent dangers are often present. A fog signal ahead means as little to the pilot of a ferryboat as to the master of an ocean steamer. He knows something is coming his way, but not just where it may be expected to appear. But if the pilot of that something has a means of assuring him that he has ported his helm, he has something definite to steer by, and porting his own helm, he veers off in a contrary direction till the lessening sound of the stranger's whistle assures him that danger is past and that he may safely bear up again on his course. Most of the steamship collisions have been caused by ships turning the same way at the vital moment. The officer of the deck hears a steamer dead ahead, and, with nothing to guide him, orders the wheel put hard down. The strange sail, thinking to weather him, puts his helm up, and they meet.

There is much hard practical sense in this rule of the New York ferry boat pilots, and doubtless there is a hint in it that the coming marine conference may study with profit.

Transmission of Power through a Bore Hole.

Mr. Wm. Hall, manager of the Spring Hill (N. S.) mines, gives the following account of the successful completion of a winding plant, situated on the surface, and hoisting from an underground slope. A bore hole 4 inches in diameter has been put down from the surface to the bottom of 1,300 foot level (north slope), a depth of 600 feet perpendicular. An engine and boiler have been placed in position on the surface close to the bore hole. Power is then transmitted by means of a wire rope and an arrangement of pulleys at the top and bottom of the bore hole. Beside the wire rope in the bore hole is placed a signal cord. By means of this cord communication is kept up between the engine men and the man at the bottom. The first cost of the bore hole is not nearly so great as that of 1,800 feet of steam pipes, while the cost of repairs, where pipes are suspended from the roof by means of hooks, will be entirely saved. Other repairs necessary to prevent leakages in the pipe will also be obviated, thus effecting a very material annual saving.

The Electrical Omnibus in London.

The electrical omnibus lately left the depot of the Ward Electrical Car Company, and ran to Euston Station. Some of the directors and the manager of the Liverpool Tramways Company were awaiting it, with Sir George Baden-Powell, M.P., and Mr. Houlding, the chairman of the sanitary committee of the Liverpool corporation. The omnibus returned by way of Euston Road, Great Portland Street, and Regent Street, to the company's depot at James Street, Haymarket. It came through the crowded traffic without exciting any alarm on the part of even private carriage horses.

Department of Microscopy, Brooklyn Institute.

The annual reception of the Department of Microscopy of the Brooklyn Institute occurred on Thursday, May 9. There were in position more than 50 microscopes, each arranged to exhibit an object of interest. These microscopes were placed on six long tables, each table provided with three incandescent lamps supplied with a current from Mr. E. R. Knowles' patent storage batteries, furnished for the occasion by the Mutual Electric Manufacturing Co., of Brooklyn. The lamps were maintained during the entire evening at a high state of incandescence, giving a very white light, well adapted for the display of microscopic objects, particularly those requiring the polariscope. The yellow hue so familiar to those in the habit of using kerosene lamps was entirely wanting. Besides this advantage, there was an absence of heat; the lady visitors could view the objects without fear of burning their hats, a common occurrence when lamps are used. A rare opportunity was afforded to several hundred interested spectators to see in an hour more of the minute wonders of nature and art than they would be liable to see in a lifetime but for such an occasion as this.

The following is a list of the objects exhibited, together with notes briefly describing the objects:

Rev. J. L. Zabriskie, the president of the section, exhibited two very interesting objects, the peridium of the fungus (*Rœstelia aurantiaca*) from the immature fruit of the English hawthorn, and the ovipositor of the pigeon borer, the latter being shown by polarized light. This is a hymenopterous insect, whose larva burrows in the languishing wood of various trees, such as maple, elm, and hickory.

Mr. George M. Mather, vice-president of the section, exhibited the elytron of diamond beetle, showing the gem-like scales, which present all of the colors of the spectrum in great brilliancy. The same exhibitor showed natural crystals of malachite and azurite. These are ores of copper which are found associated in Arizona copper mines.

Fossil seeds of chara, of the Eocene period, found in the Isle of Wight, were exhibited by Mr. George E. Ashby, the secretary of the department. The seeds of this water plant are found ranging through the strata of the whole tertiary period.

Mr. E. C. Chapman, the treasurer of the department, exhibited a beautiful mount of platino-cyanide of yttrium by polarized light. Mr. Chapman says that Professors Young and Lockyer think that yttrium exists in the sun.

Mr. A. A. Hopkins, the curator of the department, exhibited a beetle's eye, through which the spectator was able to see hundreds of images of a moving object placed in the field of view.

Mr. William Potts, treasurer of the Institute, exhibited specimens of volvox. This beautiful aquatic plant is of spherical form and maintains a continuous rotation by means of cilia.

Mr. Geo. B. Scott had an interesting exhibit of moth eggs, some of which were just hatched, and the young caterpillars were seen standing on the eggs. Crystals of metallic chromium were exhibited by Mr. F. L. Lathrop. These crystals were obtained by Prof. A. K. Eaton. It is believed that this is the first time that this object has been exhibited under the microscope. Mr. Frederick Braun exhibited *Eozoon Canadense*, a fossil found in the rocks of the Laurentian age.

Salicine was exhibited by Mr. H. Fincke under the polariscope. This is an alkaloid obtained from the bark of the willow tree. It is noted for its brilliant display of color when exhibited by polarized light. The same exhibitor showed brilliant octahedral crystals of arsenious acid; also portulacca seed; the proboscis of a horse fly, showing the lancets; and a slide of diatoms containing 57 specimens beautifully arranged within the space of five one-hundredths of a square inch.

Mr. Joseph Ketchum projected a thin section of the intestine of a cat, stained and injected. He also exhibited a beautifully arranged slide of foraminifera. These minute fossil skeleton remains are found in many geological periods, and vast deposits of rocks are made up entirely of these minute shells.

Mr. Frank Healy exhibited a leaf of *Pomaderris apetala*, showing beautiful stellate hairs. Human blood disks, stained so as to show the red and white corpuscles, were shown by Frederick J. Wuling, Ph.G. Dr. S. E. Stiles exhibited the eggs of the stone mite.

Mr. G. M. Hopkins showed crystals of salicine under polarized light. Half of the field was backed by mica, so that the radial color bands in the crystals on opposite sides of the median line of the mount revolved in opposite directions, showing the curious effect of thin films on polarized light. Dr. Alexander Hutchins showed a section of the human stomach. Dr. J. H. Hunt showed beautiful specimens of ruin agate by the aid of polarized light.

A specimen of mica from Sing Sing, N. Y., containing aciculate crystals of rutile deposited between the lines of growth of the crystals, was shown by Mr. Geo. F. Kunz. These crystals, when viewed by transmitted light, produce the appearance of stars.

Mr. T. B. Briggs exhibited a specimen of anthophyllite of his own preparation. This beautiful specimen was chipped from a Brooklyn bowlder.

Mr. Edgar J. Wright exhibited living hydra having six to ten tentacles. The contortions of this animal in search of its food are at least suggestive of the devil-fish.

Dr. A. J. Watts showed moss-like and fern-like gold crystals of his own preparation. These beautiful forms were crystallized under the influence of electricity.

A section of rock from summit of Mount Sinai was shown by Mr. James Walker, and *Spirogyra nitida*, in conjugation, were exhibited by Mr. J. W. Martens, Jr.

Mr. J. W. Freckelton exhibited (by reflected light) a fragment of fire opal from Honduras. A longitudinal section of human skin, showing hair follicles, was shown by Dr. Z. T. Emery. Dr. E. W. Owens exhibited the head of a spider, showing eight eyes, also a mount of arranged diatoms containing 289 forms.

The smallest exhibit of mechanical work was exhibited by Dr. F. D. Bailey. It consisted of the Lord's prayer engraved on glass within the space of 1-1200 of a square inch. Mr. J. D. Mallonee exhibited the eyes of a butterfly. Prof. W. Le Conte Stevens, of the Packer Institute, Brooklyn, exhibited a fine specimen of native copper crystals.

Mr. H. S. Woodman exhibited diatoms from the Pacific coast, which were cleaned and mounted to show by reflected light. The most noticeable forms are *Arachnoidiscus Ehrenbergii* and *Triceratium Arcticum*.

Crystals of ammonium oxalatewere shown by reflected light by Mr. H. B. Baldwin; and Mr. C. W. Boyer exhibited a cross section of the stem of a dandelion. Fossil insects in amber were shown by Mr. W. G. Bowdoin. Over 1,000 species have been identified in this gum, nearly all of which are now extinct. Mr. Stephen Helm had an interesting exhibit of pond life. H. Hensoldt, Ph.D., showed a section of oolitic limestone containing fluid cavities.

The circulation of blood in a frog's foot was shown by Dr. C. N. Hoagland. The blood corpuscles moving in rapid streams through the minute channels was a very curious sight.

Trichinæ in a cat's tongue was shown by Dr. D. Rollins Brown. Crystals of butter were exhibited by polarized light by Mr. John Loeber. Mr. William Finney showed a cross section of whalebone, exhibiting a curious cellular structure.

House-top Summer Resorts.

A plan to make our house-tops useful is sketched by Dr. Gouverneur M. Smith, in a paper on "Wasted Sunbeams—Unused House-tops." The Oriental has no difficulty in the matter. He lives on the top of his house a considerable part of the year, and builds his roof with an especial eye to that sort of occupation. Why may not we? By pitching our tents upon them, or by taking them as they are, except that the roof coverings would have to be made more solid, we might make our roofs comfortable sojourning places and inexpensive summer health resorts.

"Roofing," says the author, "can be contrived suited to this climate, and enduring as pavement. A pleasure resort might ornament each residence, its limits bounded by the area of the dwelling; neighborly consent could widen the range, turf and flowers brightening the plan. Iron-framed and glass-inclosed rooms or cupolas could be added, which would prove useful during all seasons, artificial heat tempering brumal inclemency. If such adaptation of house-tops would be an advantage to the affluent, who can escape city life during the summer, how much greater advantage would be secured to the tenement house districts! . . . For the higher graded tenement houses, such fresh air facilities would be hailed with delight by the inmates. The proximity of open breathing places to their rooms would endear their humble homes. Summer moonlight evenings could have a new aspect; and again, round a family lantern, groups might gather to read, sew, or engage in games, and thus a home-felt pleasure could quiet restless spirits, craving questionable or illicit amusements. More true enjoyment might be observed in such groups than on the piazzas of fashionable resorts. Landlords could arrange for the periodical sweeping of roofs, as well as of the halls and stairways, and, among a very large class of the respectable poor, pride would stimulate to a tidy and decorative care of their home parks."

By a little alteration in structure the upper stories of houses, now stuffy places enough, could be made light and airy, and attractive as resorts or play rooms in inclement weather.—*The Popular Science Monthly.*

Arsenic in Bone Meal.

"Feeding bone meal," so-called "precipitated phosphate," has been successfully added to the food of cattle in doses ranging from 2 to 15 grms. daily for young animals and 20 to 50 grms. for adult individuals. If the acid used in the manufacture is arseniferous, calcium arseniate or arsenite will accompany the phosphate. The proportion of arsenic in the samples examined ranged from 0·028 to 0 17 per cent (calculated as metallic arsenic).—*H. Fresenius.*