head. I went to bed with them and got up with them. In the gray of the morning, when I looked across Gloucester Square, it seemed an immense distance across to the houses on the opposite side. It was nearly the same length as the span of my tubular bridge!"

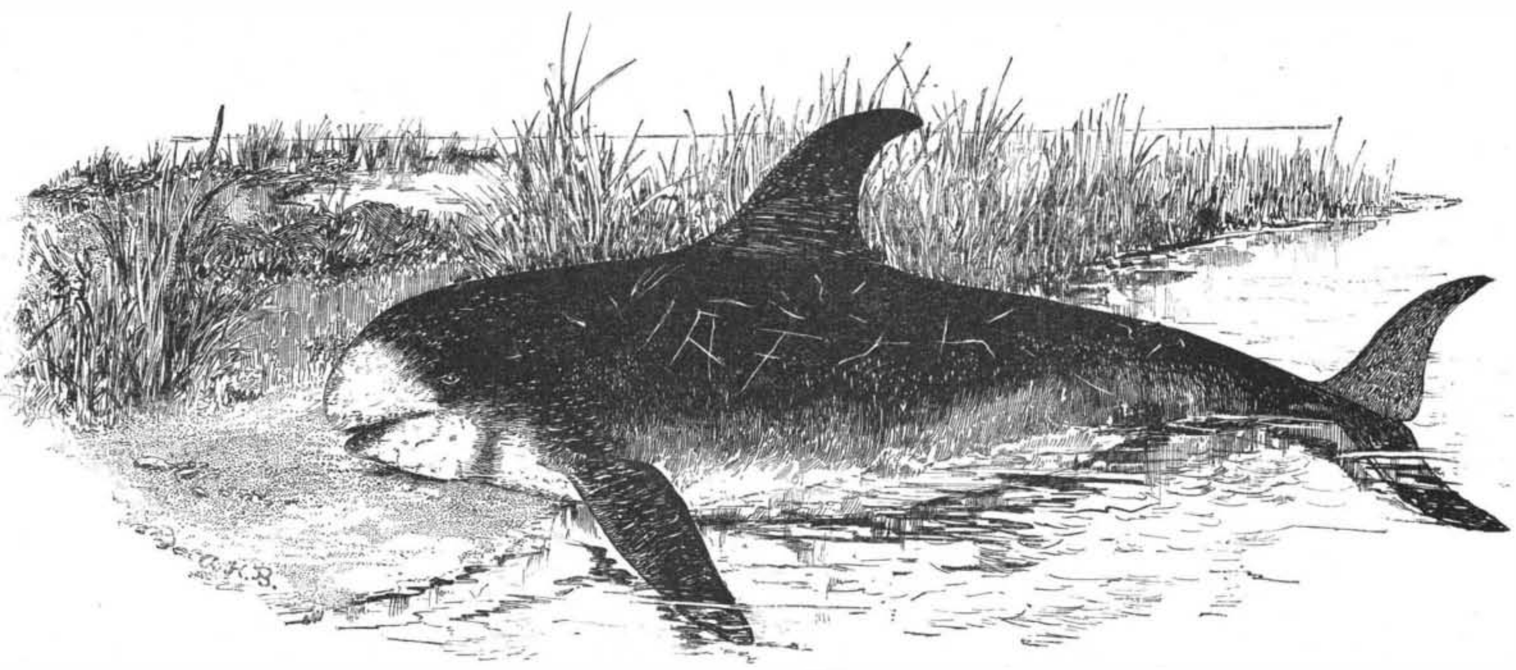
Our spans, as I have said, are each nearly four times as great as Stephenson's. To get an idea of their magnitude, stand in Piccadilly and look toward Buckingham Palace, and then consider that we have to span the entire distance across the Green Park, with a complicated steel structure weighing 15,000 tons, and to erect the same without the possibility of any intermediate pier or support. Consider also that our rail level will be as high above the sea as the top of the dome of the Albert Hall is above street level, and that the structure of our bridge will soar 200 feet yet above that level, or as high as the top of St. Paul's. The bridge would be a startling object indeed in a London landscape.

It is not on account of size only that the Forth Bridge has excited so much general interest, but also because it is of a previously little known type. I will not say novel, for there is nothing new under the sun. It is a cantilever bridge. One of the first questions asked by the generality of visitors at the Forth is, Why do you call it a cantilever bridge? I admit that it is not a satisfactory name, and that it only expresses half the truth, but it is not easy to find a short and satisfactory name for the type. A cantilever is simply another name for a bracket, but a reference to the diagram will show that the 1,700 feet openings of the Forth are spanned by a compound structure consisting of two brackets or cantilevers and one central girder. Owing to the arched form of the under side of the bridge, many persons hold the mistaken notion that the principle of construction is analogous to that of an arch.

In preparing for this lecture the other day, I had to consider how best to make a general audience appreciate the true nature and direction of the stresses on the Forth Bridge; and after consultation with some of our engineers on the spot, a living model of the structure was arranged as follows (see illustration): Two men sitting on chairs extended their arms and supported the same by grasping sticks butting against the chairs. This represented the two double cantilevers. The central girder was represented by a short stick slung from one arm of each man and the anchorages by ropes extending from the other arms to a couple of piles of brick. When stresses are brought on this system by a load on the central girder, the men's arms and the anchorage ropes come into tension and the sticks and chair legs into compression. In the Forth Bridge you have to imagine the chairs placed a third of a mile apart, and the men's heads to be 360 feet above the ground. Their arms are represented by huge steel lattice members, and the sticks or props by steel tubes 12 feet in diameter and 1¼ inches thick.

I have remarked that the principle of the Forth Bridge is not novel. When Lord Napier of Magdala accompanied me over the works one day, he said: "I suppose you touch your hat to the Chinese?" and I replied, "Certainly," as I knew that a number of bridges on the same principle had existed in China for ages past. Indeed, I have evidence that even savages when bridging in primitive style a stream of more than ordinary width have been driven to the adoption of the cantilever and central girder system, as we were driven to it at the Forth. They would find the two cantilevers in the projecting branches of a couple of trees on opposite sides of the river, and they would lash by grass ropes a central piece to the ends of their cantilevers and so form a bridge. This is no imagination, as I have actual sketches of such bridges taken by exploring parties of engineers on the Canadian Pacific and other railways, and in an old book in the British Museum I found an engraving of a most interesting bridge in Thibet upward of 100 feet in span, built between two and three centuries ago and in every respect identical in principle with the Forth Bridge. When I published my first article on the proposed Forth Bridge, some four years ago, I protested against its being stigmatized as a new and untried type of construction, and claimed that it probably had a longer and more respectable ancestry even than the arch.

The best evidence of approval is imitation, and I am pleased to be able to tell you that since the first publication of the design for the Forth Bridge, practically every big bridge in the world has been built on the principle of that design, and many others are in progress.



A TATTOOED WHALE.

BRUIJN'S ECHIDNA (PROECHIDNA BRUIJNI), NEW GUINEA ANT EATER.

Our engraving shows the rare and extraordinary echidna that has quite recently been discovered in Northern New Guinea (*Proechidna bruijni*). This curious animal in outward appearance resembles the hedgehogs in its spine-covered body and the ant eaters in its long and tapering snout. The latter is incapable of being opened, and the mouth consists of a small hole at the apex, through which the long and vermiform tongue is protruded. The spines are short and stout, but of needle-like sharpness, and spring from a thick coat of dark brown fur. The forefoot is furnished with three broad and nail-shaped claws, while those of the hinder limb are long, sickle-like, and very sharp. Worked by the powerful muscles with which the creature is provided, these are admirably adapted for digging. The tail is rudimentary. Bruijn's echidna, which is over two feet in length, and is thus considerably larger than its Australian representative, is said by the natives to live in burrows in rocky ground.—*Dr. F. H. H. Guillemard, Cruise of the Marchesa.*

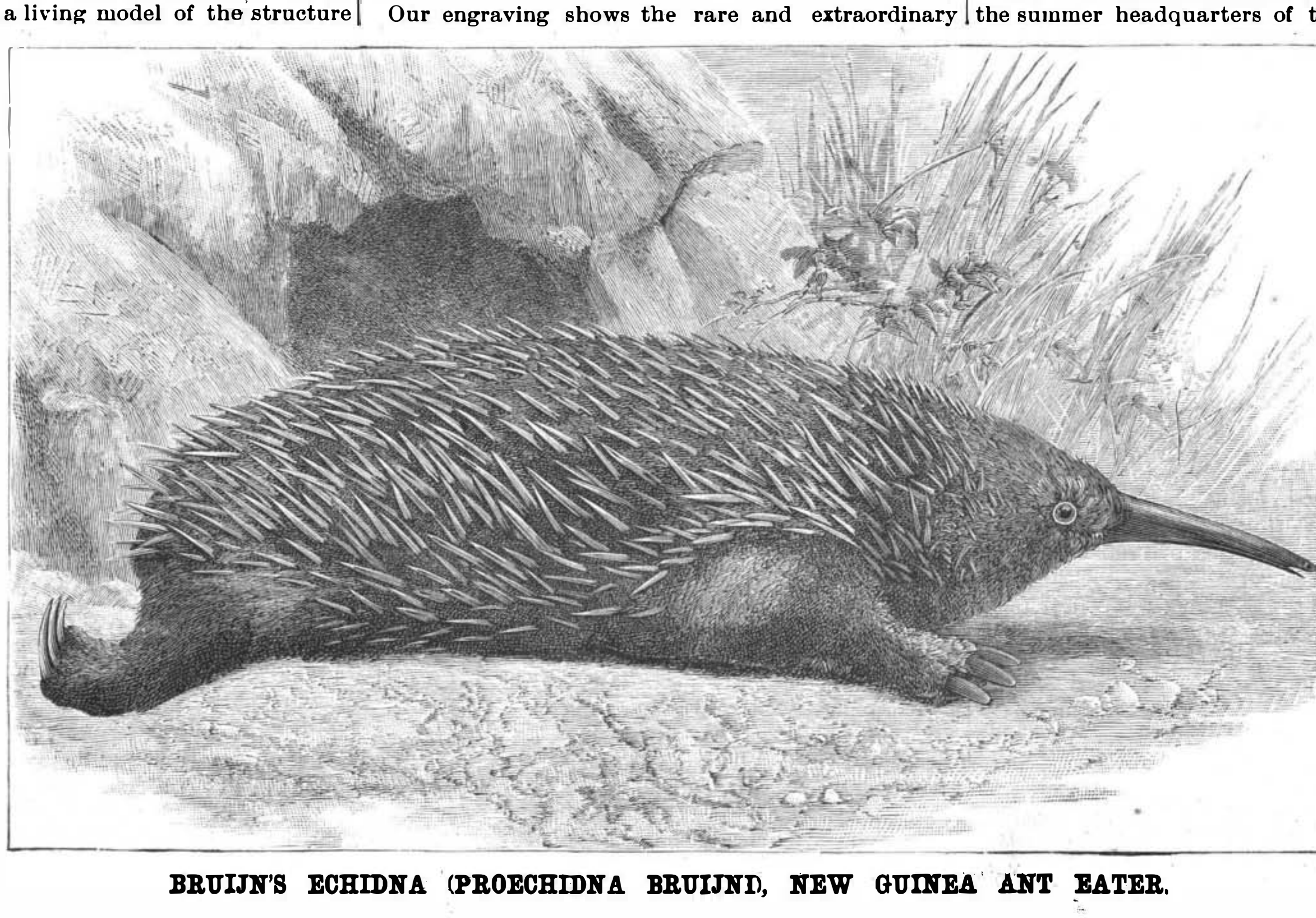
A TATTOOED WHALE.

The accompanying sketch is taken from a cetacean, about twelve feet long, caught in a bluefish gill net by fishermen at Nantucket Island, off Cape Cod, on the fourth of July. Owing to arrangements made with the lighthouse board and life-saving service, in 1883, members of these departments of the government are instructed to inform the commissioner of fisheries, at once, by telegraph, of the occurrence of stranded or captured marine animals such as whales, porpoises, blackfish, and other forms of cetaceans.

Among the papers forming the report of the fish commissioner for 1883 is a circular of instructions to fishermen and others on the coast, giving descriptions and drawings of most of the known forms of cetaceans, and directions for the proper preservation of specimens, so affording sufficient knowledge to secure the safety of valuable and rare forms until they can be taken charge of by the necessary experts.

In consequence of the peculiarity of the animal captured at Nantucket, news of the fact was sent to the summer headquarters of the United States Fish Commission, at Wood's Holl, Mass., and the "whale," as the fishermen described it, was taken there, whence it will be sent, as a skeleton, to the National Museum at Washington, to form a part of the osteological collection there. The animal is a *grampus* (*Grampus griseus*), a species which is somewhat common throughout the North Atlantic.

Several specimens have been taken, their capture being chiefly due to the habit of the species of skirting very near the shore, in pursuit of its food of small fishes and minute surface



BRUIJN'S ECHIDNA (PROECHIDNA BRUIJNI), NEW GUINEA ANT EATER.

crustaceans. The *grampus* forms one member of the large class of cetaceans occurring in the seas, and is related more or less closely to the porpoise and whale. Having a wide range over the Atlantic, it is not uncommonly seen by vessels. Its habits are similar to those of the rest of the family of cetaceans. Its flesh is sometimes eaten by the fishermen of Cape Cod, and is esteemed very palatable by them.

A peculiarity of the species is the presence of irregular markings or scratches of white on the black sides of the body. These marks appear as though made with some blunt instrument plowed across the skin, but examination shows them to be natural, and they occur on all the specimens, being more numerous as age increases.

In the specimen drawn, the markings assume several irregular forms, and one can easily distinguish the letters A and F. It is said that letters and other signs and outlines are not uncommon, and this animal may be said to carry its own initials on its body, as a sailor bears his name and the symbols of his occupation on his arm or breast.

Alcohol in High Latitudes.

In an interesting article in the *Forum* for August on this subject, General Greely says: "The members of the Lady Franklin Bay expedition, 25 in number, passed two years in an unprecedentedly high latitude, within eight degrees of the geographical pole. During that time many arduous sledge journeys, under conditions of extreme exposure, were made by the men. These journeys varied from 2 to 60 days in length; and owing to the character of the ice and the necessity of transporting with them all supplies used during their absence, such physical exertions were required on the part of the sledgemen that the end of each day's work almost invariably found them in a state of physical exhaustion. The greater part of these journeys were made in temperatures below zero (Fahr.), and for many days at a time the mercury in the thermometer never thawed; while on special occasions temperatures ranging from 50 to 60 degrees below zero, or eighty or ninety below the freezing point, were experienced for a number of consecutive days. And they endured all this labor and exposure without artificial heat, and upon a limited sledge ration, calculated to a nicety, of the least amount of food compatible with health, so that the physical waste was barely repaired. Despite all this exposure and the demands upon the physical strength and vital energy, no case of serious frost bite nor any disabling illness occurred, save in one instance, when Sergeant Rice, the photographer, attacked by inflammatory rheumatism, was brought to camp by a relief party. In this single case Dr. Pavy and Rice, who composed the original party, had abundantly provided themselves with rum from an English cache in Lincoln Bay.

In all these sledge journeys no ration of spirits was ever granted. The officer or non-commissioned officer in charge of the party was provided with a small quantity of brandy for medicinal purposes, which was required, as it proved, only a few times, there being always left a small margin as a gratuitous issue on festal occasions when the sledge party was returning. While at the home station, no spirits of any kind were ever issued regularly. Usually, though not always, on Sunday evenings, about half a gill of rum was issued to each man who desired it; and the same quantity was also given whenever the birthday of one of the party or any other festal occasion occurred.

I cannot recall a single instance where spirits were ever medicinally prescribed at Fort Conger, though there might have been such a case. Generally a small quantity of rum or brandy was given to each member of a sledge party returning from the field, though this was not infrequently declined. In a few cases in the field where spirits were taken during work, or surreptitiously obtained and drunk before the day's work was over, the effect of alcohol seemed to show itself in diminished power for work, in impaired resistance to cold, and in one case it interfered with a man's appetite for the solid food of the sledge ration.

The use of rum in our home quarters at irregular intervals served an excellent purpose in stimulating the mental faculties, which in the cases of some of the men seemed to be deadened and sluggish, owing to the monotonous character of our surroundings and the unvarying routine of duty. During our two years' service at Conger I did not drink in all a pint of spirits, though occasionally I took a glass of light wine; and my own experience was that I was as well without alcohol as with it, though the social effect of wine among the officers was undoubtedly good. Some of the men rarely drank the rum issued, and by common consent these did as well without it as with it; though it seemed certain that some of the party would not have passed the two winters at Conger as cheerfully or as well without alcohol as they did with a small quantity.

During the boat retreat southward from Conger to Cape Sabine, in August and September, 1884, a considerable quantity of rum and whisky was taken with the party, but although there was much exposure from great physical labor, more than half of the journey was completed before the issue of the spirits was begun. It was commenced at a time when the party was somewhat disheartened by the surroundings, and the particular result then sought was to benefit the men mentally rather than physically. The use of rum during the boat retreat appeared to be most beneficial when given to the men just after the day's work was over, and after they had entered their sleeping bags. Before reaction came the men received hot food. Every one who could, avoided drinking the rum until he had entered his bag. The men always expressed most strongly their appreciation of rum and its effects after a day spent in exhausting labors, under discouraging circumstances and with unfortunate results, so that I judged the effect to be a mental stimulant and benefit rather than a physical one. In addition to its effect upon the mind, it produced, in the chilled, damp, and half-frozen men, a marked feeling of warmth, which in my own case appeared to result from an increased surface circulation; and in addition the alcohol evidently had narcotic properties, for it speedily induced drowsiness and greatly promoted sleep. These special issues of rum, either in the field or during the retreat, rarely exceeded half a gill at a time, and when the men received, for urgent reasons or on particular occasions, double the amount, they stated to me that its beneficial result seemed to be little, if any, greater than that of a half gill.

The subject of alcohol was frequently and generally discussed during the winter at Cape Sabine, and all, without exception, concurred in the opinion that spirits should be taken after a day's labor was over, and not before or during exhausting work, nor while suffering from exposure which was to be continued. The opinion of nearly every one was that it should be a constituent of the Arctic sledging ration. My own opinion is the same now as it was in 1881, that in small quantities the issue of alcohol is very beneficial, but that its regular and daily issue would be deleterious rather than beneficial. It should, without doubt, be carried by all expeditions and sledge parties, as a medicine and for emergencies. Dr. Enval, of the Swedish Arctic expedition of 1872–73, says: "I believe spirits and liquors to be of great use in small and moderate quantities, but exceedingly mischievous and pernicious in case of the least excess." The last part of his statement could be verified by me from cases within my own knowledge; as to the first part, it is fully in accord with my own ideas. At Camp Clay, a half gill of rum was issued every Sunday, until the supply was nearly exhausted; and the issue of these spirits to the half-starved, half-frozen, and dispirited men was of the highest possible value. The party looked forward from one Sunday to another as being the feast day, owing in a great measure to this issue of rum. Later, when the party had been slowly starving for many months, and when the supply of food was so diminished as to necessitate a greater reduction of rations, the pure alcohol on hand was issued as food, being diluted with about three times its weight of water. Each man received daily perhaps a quarter of an ounce of alcohol, the effect of which was most beneficial. The general impression, with which I most heartily agreed, was that the alcohol supplemented the food, and had a decided alimentary value. There could be no question of its beneficial effect as a mental stimulus to every member of the party under our unfortunate conditions at Sabine.

It seems to me to follow from these Arctic experiences that the regular use of spirits, even in moderation, under conditions of great physical hardship, continued and exhausting labor, or exposure to severe cold, cannot be too strongly deprecated, and that when used as a mental stimulus or as a physical luxury they should be taken in moderation. When habit or inclination induces the use of alcohol in the field, under conditions noted above, it should be taken only after the day's work is done, as a momentary stimulus while waiting for the preferable hot tea and food; or, better, after the food, when going to bed, for then it may quickly induce sleep and its reaction pass unfelt.

The experiences of the Lady Franklin Bay expedition instance alike the benefit and injury of alcohol on special occasions. The first man to perish, of scurvy and starvation together, was one who was known as a regular drinker. At Sabine, the issue of alcohol in the morning to hunters, on urgent medical recommendations, was followed by the Esquimau Jens, an unerring hunter, missing, at his own chosen distance, a large seal which might have saved the party; afterward, Long, his nerves unaffected by spirits, killed, at the water's edge, a bear over two hundred yards distant. As an instance of the benefit of alcohol may be noticed Sergeant Frederick's remarkable experience, when his shrewd judgment and his proper use of spirits saved his own life under most desperate circumstances of exhaustion and exposure. His gallant comrade, Sergeant Rice, worn out in a fruitless effort to obtain meat for his starving comrades, perished by exhaustion in Frederick's arms. Frederick, having stripped himself to comfort his companion's last hours, found himself chilled and exhausted as well as weakened by months of starvation; but his extraordinary energy and great physical power of endurance were supplemented and stimulated by a mixture of ammonia and brandy.

This article will not have been written in vain if it has the effect of correcting among any class of laboring men the mistaken idea that their capacity for work is increased or their powers of endurance to exposure and cold enhanced by the use of alcohol. The English navvy never drinks while working, and the Esquimaux and Chukches, without alcohol, endure unharmed the severest temperatures known to man.

A. W. GREELY.

The Spirit Level.

There unfortunately exists a great deal of conflicting evidence regarding the true inventors of the different parts of the spirit level. Indeed, there are hardly two authorities who agree upon the subject. The original form seems to have been that of a plummet, and is described as "instrumentum quo, plumbo a filo et gnomone pendente, rectio sive obliquitas operis perpenditur." The great Huygens appears to have been the first to apply the telescope to a level of his which was constructed on the principle of a plummet. The honor of having first applied the air bubble to the determination of horizontality seems to be due to that universal genius Dr. Hooke. From all that I can gather, it appears that his invention must have been made subsequent to March 25, 1674, and prior to the year 1675, as in his "Attempt to prove the motion of the earth by observations," by date March 25, 1674, he describes a new method of stilling the plummet by immersion in water. In his "Animadversions," published also in 1674, after fully describing his invention of the air bubble confined in a tube, he speaks of its peculiar advantage and great delicacy of movement, and remarks: "This can hardly be performed by the ordinary way of plummets, without hanging from a vast height, which is not practically to be performed without almost infinite trouble, expense, and difficulty," etc. Hutton, in his "Mathematical Dictionary," remarks that the application of the air bubble to the level "is said to be due to M. Thevenot," but with what justice I cannot say, having been unable to meet with any reference to this instrument in the writings of that author. Thevenot was born in 1621, and he died in 1692. I have been unable to discover who was the inventor of the circular level, which I imagined had been of recent date; but Switzer, at page 91 of his "Treatise on Water Works," which was published in 1734, remarks that the circular level was then employed in the construction of the surveying instrument called a plane table. According to Sir John Herschel, the cross hair, which gives so much accuracy to all astronomical as well as leveling instruments, was the invention of Gascoigne, a young Englishman, who used it in 1640. He was killed at the age of twenty-three, at the battle of Marston Moor. M. Le Bion appears to have been the first to conjoin the telescope of Huygens with the air bubble of Dr. Hooke; and this must have been subsequent to the year 1684, as such an instrument is not shown in De la Hire's edition of "Picard's Treatise on Leveling." But it was not till Sisson's improvements that the level could be considered as in any way an accurate or philosophic instrument. All that were made previously to his time were coarse instruments, adjusted by a ball and socket, and in other respects resembling the common perambulatory survey level, which, from the nature of the construction, can be leveled in only one direction, and cannot be reversed, or moved even in the slightest degree, without requiring readjustment. Sisson may therefore be considered as the inventor of the instrument in common use. The main feature in his improvements was the introduction of the four screws called the parallel plate screws. I have been unable to find out the date of Sisson's improvement, and, indeed, the only notice I can find of him is the following in Switzer's "System of Water Works:" "The invention" (alluding to the instrument with parallel plate screws), "as I take it (for I am not as yet well acquainted with that gentleman), of William Sisson, at the corner of Beaufort Buildings, in the Strand." Since the time of Sisson, the celebrated Ramsden introduced a tangent screw and clamp, for moving the instrument with accuracy through small distances in an azimuthal direction. Messrs. Troughton & Simms also made several improvements in the arrangement of the various parts of the instrument; and Mr. Gravatt added a cross bubble for facilitating the rough setting of the instrument—or that adjustment which is made with the legs of the tripod; and an enlargement of the diameter of the object glass, so as, by the admission of a greater number of rays of light, to allow of the telescope being shortened, without impairing its optical powers.—*T. Stevenson.*

OUT of twenty young men who competed for a West Point cadetship at Westfield, Mass., ten were rejected by the physician because they had "the tobacco heart," brought on by cigarette smoking. They were unfit for West Point service.—*Boston Traveler.*

Bids for New Cruisers and Gunboats.

In compliance with the advertisement of April 6 last, with subsequent modification, bids were opened at the Navy Department on August 8 for the construction of the cruiser No. 1, of about 4,000 tons, known as the Newark (cost not to exceed $1,300,000); of cruisers Nos. 4 and 5, of 4,000 tons, known as the 19 knot ships (cost not to exceed $1,500,000 each); and gunboats Nos. 3 and 4, of 1,700 tons, of the type of gunboat No. 1, now building. The description of the twin cruisers is in most respects similar in every detail with that of the Newark. The exceptions are that they are to have machinery of 7,500 indicated horse power under forced draught. The speed is to be 19 knots. The rig is that of a three-masted schooner, spreading 5,400 square feet of sail. Their armament is also to consist of main batteries of twelve 6 inch breech-loading rifles.

Cramp & Sons were the only bidders for cruiser No. 1. Their bid for this vessel, upon department's plan for hull and bidder's plan for machinery, was $1,248,000. But two bids were received for the 19 knot vessels—Messrs. Cramp & Sons at $1,410,000 each and the Union Iron Works at $1,428,000. These bids were based upon the department's plans for both hull and machinery. The Union Iron Works' bid was for one vessel only. Several other bids designated as "special" were submitted by the Messrs. Cramp & Sons for these two vessels—one of $1,325,000 each upon bidder's plans complete, and another of $1,350,000 upon modified plans of the cruiser Baltimore, now building by them. In the bids for gunboats Nos. 3 and 4, Cramp & Sons are cut out narrowly by N. F. Palmer, Jr., & Co., the firm with which Mr. Quintard, John Roach's assignee, is connected. According to the department's designs entirely, Cramp proposes to build the gunboats at $495,000 each. N. F. Palmer & Co.'s bid is just $5,000 less—$490,000 each. As the bids go, it would seem that the three cruisers will probably be built at Cramp's yard in Philadelphia, and the gunboats at Roach's yard at Chester. Mr. Quintard says that if the contract is awarded to Palmer, the hulls will be built at Chester and the machinery at the Quintard Iron Works. The Secretary of the Navy is not bound to accept the lowest or any bid, but he is not likely to reject any of them.

The hull, machinery, and fittings of cruisers Nos. 1, 4, and 5 to be finished within two years from signing the contract, and those of the gunboats Nos. 3 and 6 within eighteen months, with penalties for delay. The weight of the engines and machinery, including water in the surface condensers and boilers, is not to exceed 850 tons for the cruisers and 340 tons for the gunboats, under a penalty of $25,000 and $10,000 respectively for an excess of five per cent in weight, and $1,000 for each ton weight beyond that. The indicated horse power is to be 8,520 for the cruisers and 3,400 for the gunboats, with a premium or penalty of $100 for each horse power in excess or deficient.

Although only three firms competed for the construction of these ships, the Secretary seems well satisfied with the results. He says: "The requirements which the contractors assume are more exacting than in the case of any previous bidding. The law for cruisers Nos. 4 and 5 provides that the contracts for the construction of them shall contain provisions to the effect that the contractor guarantees that when completed and tested for speed, under conditions to be prescribed by the Navy Department, the vessel shall exhibit a maximum speed of at least 19 knots per hour, and for every quarter knot of speed so exhibited over and above said guarantee the contractor shall receive a premium over and above his contract price of $50,000, and for every quarter knot that said vessel fails of reaching said guaranteed speed there shall be deducted from the contract price the sum of $50,000. The department has prescribed a four hours' run for the trial—the vessel to be loaded to the mean load draught—so that there is to be no shamming in the conditions of the trial. This contract is bid for by both the Union Iron Works and Cramp & Sons, and it is a requirement which calls for a boat up to the highest point of speed which these cruisers have reached anywhere. Of course the exactions of the bidding drive off people who are not sure of their ground; but I consider that we are very fortunate in being able to place all of the boats with responsible parties with these very exacting requirements."

Velocity of Electrical Transmission.

Prof. Gould has ascertained that aerial telegraph wires on poles transmit electricity at the rate of from 14,000 to 16,600 miles per second, and that the velocity of transmission increases with the distance between the wires and the earth, or, in other words, with the height of suspension.

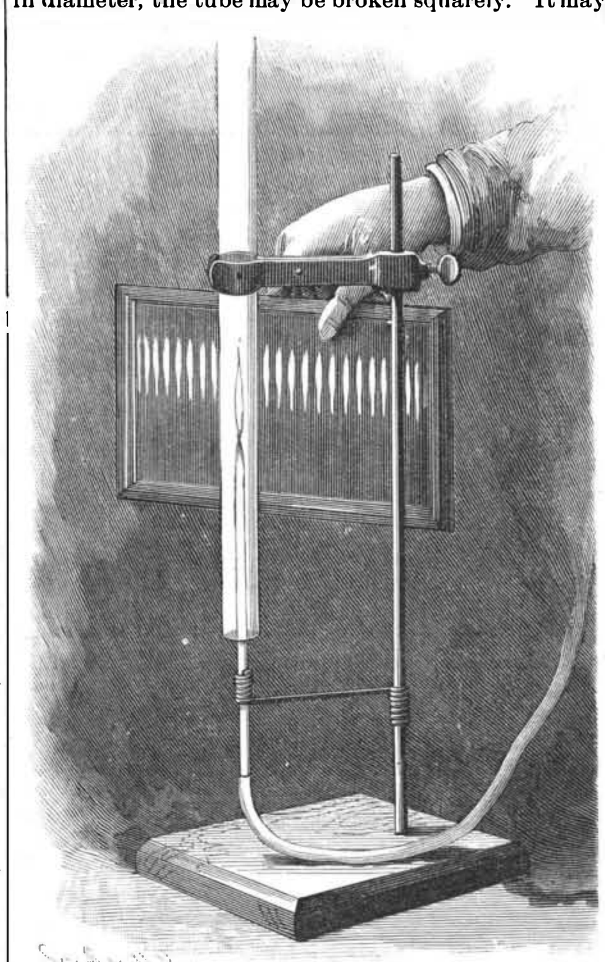
Subterranean wires, like submarine cables, transmit slowly. While wires suspended at a feeble height transmit signals at a velocity of 12,000 miles per second, those that are suspended higher give a velocity of from 16,000 to 24,000 miles. Wheatstone's experiments in 1833 seemed to show a velocity of 288,000 miles per second, but this result has never been confirmed.—*La Lumiere Electrique.*

MUSICAL FLAMES.

BY GEO. M. HOPKINS.

The experiments of Tyndall and others on sounding flames are so interesting and so easily repeated with very simple appliances, that the student of physics, particularly in the department of acoustics, should not fail to repeat them. The production of musical sounds by means of flames inclosed in resonant tubes is especially easy. One form of this experiment is illustrated by the engraving.

For the mere production of sounds, a metal tube will answer, but for the analysis of the flame by which the sound is produced a glass tube will be required. This tube, whether of metal or glass, may be 40 inches long and one inch internal diameter. It should be supported in a fixed vertical position in a suitable support, a filter support, for example. In a lower arm of the support is placed a glass tube three-eighths inch in diameter, having its upper end drawn to a small circular aperture, which will allow sufficient gas to escape to form a pointed flame about 2½ inches in height. The tube is drawn down by heating it near one end until it softens, by continually turning it in a gas flame, then quickly removing it from the flame, and drawing it out as far as possible. By making a nick with a fine file in one side of the tube, at a point where it is about 1-16 inch in diameter, the tube may be broken squarely. It may



PRODUCTION OF SOUNDING FLAMES.

then be tried as a burner. If the flame yielded by gas at full pressure is less than two inches in length, the tube should be again broken off at a point where it is a little larger in diameter, and if the opening happens to be too large, it may be reduced by holding the extreme end of the tube in a gas flame until it partly fuses, when it will contract.

The small glass tube is connected with the gas supply, and the jet is lighted and inserted centrally in the larger tube, and moved slowly upward in the tube until a clear musical note is heard. If the flame is full size, the note will be the fundamental note of the tube. By turning off the gas so as to make the flame three-fourths to one inch high, and again inserting the burner in the tube, a point will be found between its former position and the lower end of the tube at which a tone of higher pitch will be heard. This is one of the harmonics. If the burner with the small flame be carried further upward into the tube, a point will be reached where both the fundamental and harmonic will be produced simultaneously. These tones are produced by rapidly recurring explosions of the gas, the explosions being rendered uniform by the vibratory period of the column of air contained in the tubes.

There are two methods of analyzing these flames. One consists in simply shaking the head, or quickly rolling the eyes from side to side, thereby enabling the eye to receive the impressions of the successive flames in different positions on the retina. The other consists in viewing the image of the flame in a revolving or oscillating mirror. By holding an ordinary looking glass in the hand, opposite the flame, as shown in the engraving, and oscillating the glass, what appears to be a single flame in the tube will be shown as a succession of flames of like form in the mirror.

Another way of showing the intermittent character of the flame consists in revolving a disk having alternating radial bands of black and white, in proximity to the tube, so that the disk is illuminated only by the light of the intermittent flame. When the disk attains a proper speed, the intermittent illumination will cause it to appear stationary. This beautiful experiment is due to Toepler.

By employing a concave mirror instead of a plane one as described above, the image of the flame may be projected upon a screen.

The Berlin Screw Industry.

In reviewing the present situation of the screw industry, the *Berliner Tageblatt* lately remarked that Berlin makes screws in such quantites and of such qualities that its products are esteemed not only in Germany, but in other countries. The principal manufacture is that of fine screws worked bright, from the larger sizes for machinery down to the smaller kinds for watch work, etc.; the materials employed being iron, steel, brass, German silver, etc. Efforts are now being made to increase the production of rough black screws for ordinary wood and iron work; this class of screws having been hitherto principally made in Westphalia, but the development of machinery instead of hand labor in Berlin will, it is considered, alter this situation. There are in the Westphalian district—near Hagen—fifteen screw factories, employing in all about 3,000 workpeople. The Berlin industry comprises twenty-eight factories with about 1,500 workpeople. As these are, however, almost exclusively engaged in the manufacture of screws—while at the various establishments near Hagen only about one-third of the workpeople are employed in this particular industry—it is claimed that Berlin is at least as important a seat of screw manufacture as the Hagen district. Berlin used at one time to draw its supplies of raw material almost entirely from Westphalia, but of late years the constantly increasing employment of ingot iron and ingot steel instead of welded iron has developed the use of Brunswick raw materials—from Peine—which are cheaper than the Westphalian articles, this being partly due to the shorter railway journey they have to make. Steam machinery is exclusively employed for making bright screws, one factory having lately erected a new steam engine of 45 horse power. The screw-making machines in use are upon a system invented by Kernaul some thirty-five years ago, but which has since then been much improved. The manufacture of these screw-making machines constitutes a special branch of Berlin industry. The introduction of the new patent automatic machinery will, it is expected, lead to a further development of the manufacture of screws, more particularly in connection with the making of nuts to go with the larger sizes of normal machine bolts. The history of the Berlin screw manufacture is considered to disprove the assertion that an important metal article can only be made in the immediate vicinity of the works where the raw material is produced. This result is attributed to the intelligence and manual skill of the Berlin workmen. One factory at Kopenik produces annually 2,000,000 steel horseshoe calkins, the steel for which comes from Hagen

Death by Electricity.

A number of interesting experiments have just been made with such electrical machines as are employed in industries, with the view of determining under what conditions they may become dangerous. These have been conducted by M. D'Arsonval, who has already established the fact that what is truly dangerous where these machines are used is the extra current that occurs at the moment the current is broken, and in order to annul this extra current he proposed to interpose a series of voltameters containing acidulated water along the conducting wire. The new arrangement now employed is at once more simple and efficient. It consists of a V-shaped tube made of an insulating substance, which, after being filled with mercury, is interposed in the main current. In order to close the latter it is only necessary to turn a tap, which is arranged similarly to the tap on a gas pipe. In this way the machine is unprimed without its being able to give an extra current spark.

Another arrangement is also made use of, a glass tube being filled with mercury and dipped into a reservoir containing the same substance. This tube is provided with a ground stopper, this not only permitting the suppression of the extra current, but also interposing any sort of resistance in the current. Although these details appear rather technical, they relate to a most important matter. The use of electrical machines is increasing, and it is of practical use to know that currents are not dangerous until a power of 500 volts is reached. It is also of interest to know that the mechanism of death varies with the nature of the electricity used. Thus, with the extra current or with alternating currents, there is no anatomical lesion, and the patient can usually be brought back to life through the practice of artificial respiration, as employed in cases of drowning. The discharge of static electricity from batteries, on the contrary, causes a disorganization of the tissues that renders fruitless all attempts to restore life