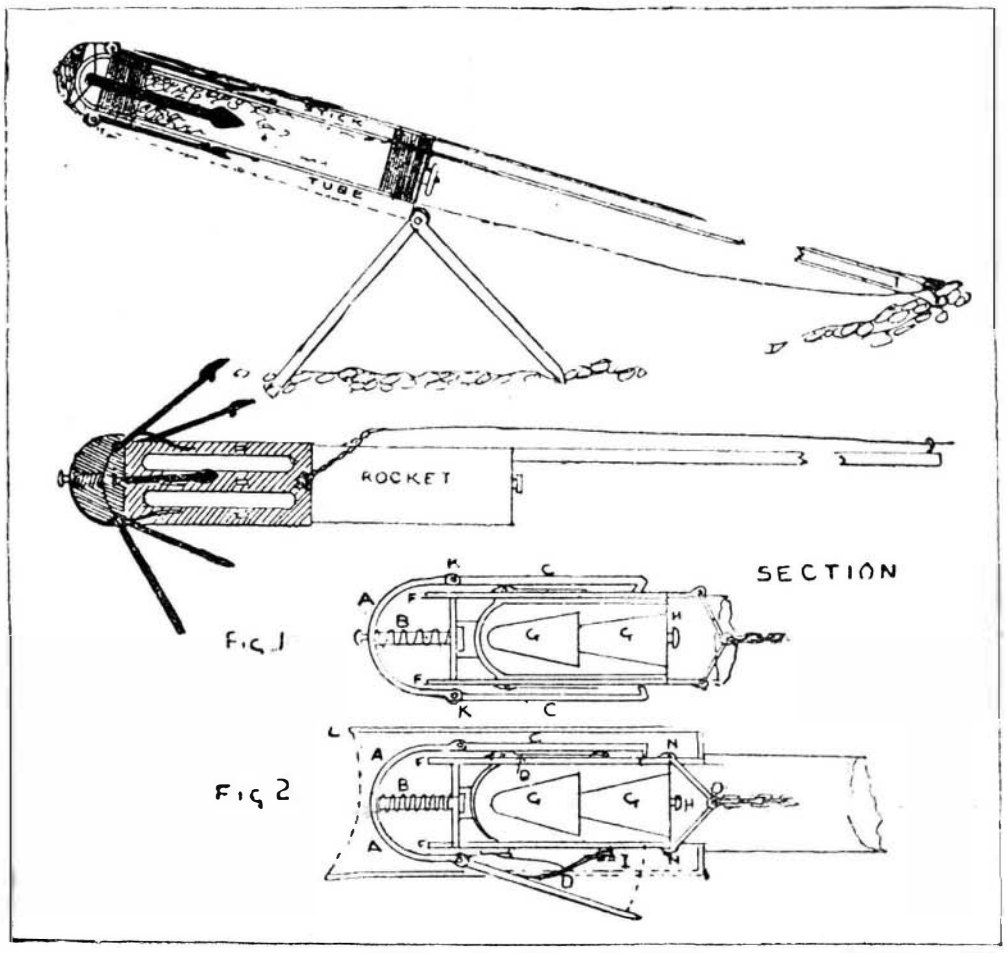
Manufacture of Alum in India.

In a recent issue of the *Indian Engineer* attention is drawn to the manufacture of alum at Kalabagh, on the Indus, at the western end of the Salt Range in the Punjab. The works are owned and superintended by a native khan, and as the expenses are small the profits are very considerable. The process of manufacture is divided into five stages—(*a*) burning the shale; (*b*) extracting the soluble matter from the burnt shale; (*c*) boiling it with salts of soda and potassium; (*d*) crystallizing the impure alum; (*e*) heating in earthen pots and recrystallizing. In the first stage the black alum shales, composed of clay and iron pyrites, are brought by coolies to the works, where they are broken up into lumps about 5 in. square. These lumps and brushwood are placed in alternate layers of about 1 ft. thick, and when the heap is about 15 ft. high it is ignited from below. As the pile burns and sinks down, more layers of brushwood and shale are added. After burning for about six months, the mass is allowed to become cold. The shale has become a bright red color, due to the oxidation of the iron, and is very friable. In the next stage the burnt clay is thrown into square earthen vats about 10 ft. long and 2 ft. deep. Water is then slowly added until its level is nearly up to that of the shale. The soaked portion of the shale is raked down a little at a time into that part of the vat containing the water, with which it is thoroughly mixed; it is afterward taken out with a perforated shovel.

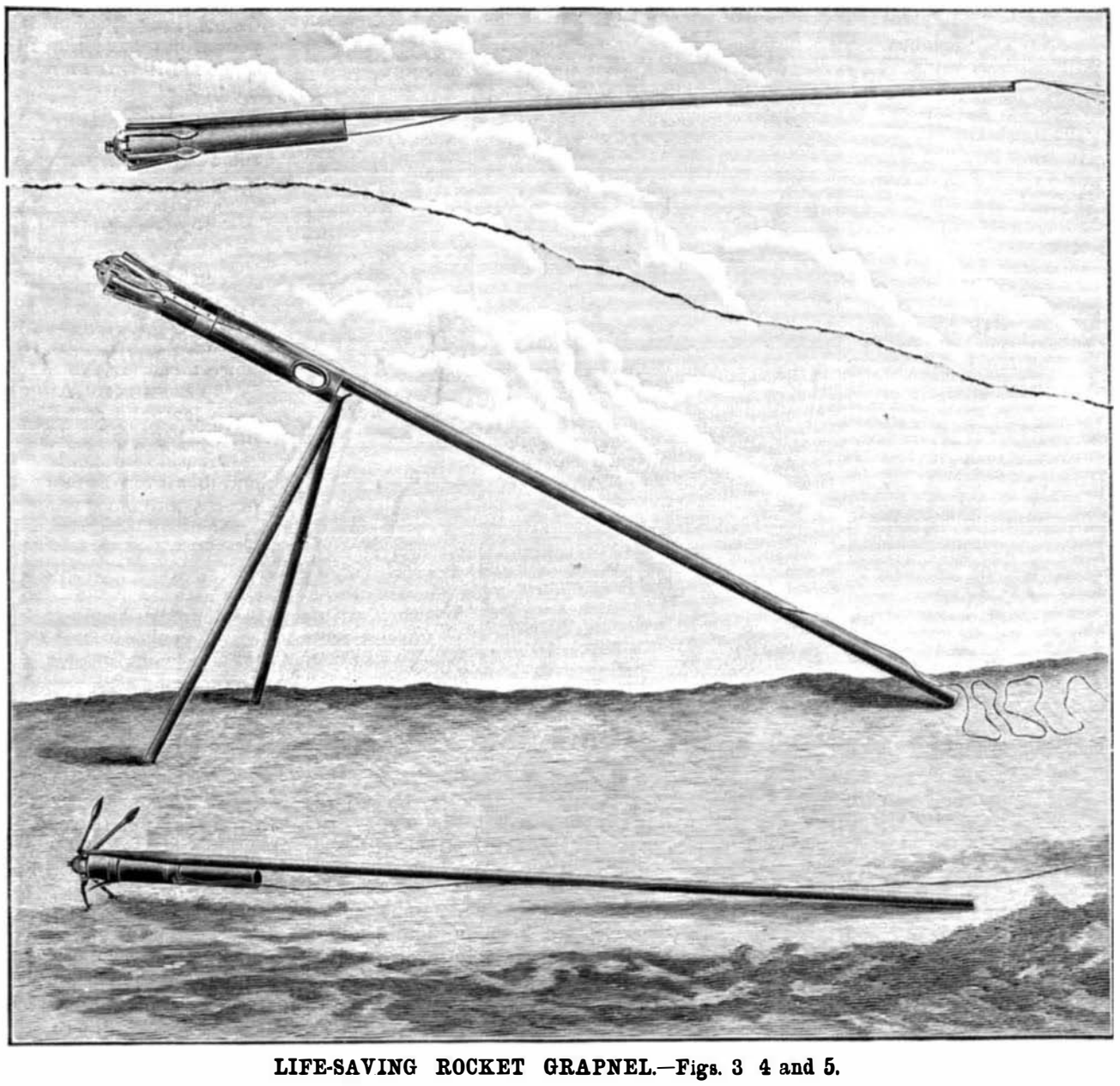
The water containing the soluble part of the burnt shale is, after a time, drawn off into a similar vat, and any red solid suspended matter is allowed to settle. It is afterward drawn off into a shallow circular vat about 10 ft. diameter made of plates of sheet iron riveted together. The solution is then boiled with an impure sodium and potassium salt called *jamsan*, obtained from *reh*—the sodium sulphate and carbonate efflorescence so commonly found in the Punjab. The liquid, after further boiling, is decanted and allowed to crystallize in vats of sun-dried clay. The crystals are about ½ in. diameter, and of a light grayish-green color. These are stacked and allowed to drain for ten days. After this they are put into earthen pots holding about 1½ maunds (112 lb.) with a little water, and are heated in a kiln or oven. The earthen pots are broken open when cool, and large crystals of alum, some 6 in. long, are found inside. This is the form in which it is sold in the bazars. These works produce some 3,000 maunds per annum. From three to four seers of alum (7 to 9 lb.) is about the quantity obtained from each maund (75 lb.) of black shale.

The Height of Rooms.

According to the *Practitioner* for March, the English Local Government Board has addressed a memorandum to the sanitary authorities of England concerning the height of rooms used for habitation, a recent law having conferred upon them authority to regulate this matter. It is held that it is unnecessary to appoint a maximum height, but, as low-pitched rooms are more difficult to ventilate than rooms of greater height, especially sleeping rooms, in which the occupants are not able during sleep to vary the conditions of air movement through the rooms, a minimum height should be established. While a room may have sufficient floor space for a given number of people, whether this number will have enough breathing space to keep them in health will depend upon the height of the room. For example, if there is just enough breathing space when the height is eight feet, it is obvious that there will not be enough when the height is only seven feet. A minimum of nine feet is recommended, and the board will not approve of a smaller height than eight feet over the total area of the room. In a room of irregular height there must be a mean height of eight feet.



LIFE-SAVING ROCKET GRAPNEL.



LIFE-SAVING ROCKET GRAPNEL.—Figs. 3 4 and 5.

THE LIFE-SAVING ROCKET GRAPNEL.

Several months ago, when the steamship Eider, of the North German Lloyd's, was stranded, the efforts to save her were more or less nullified by the lack of proper appliances for establishing communication between ship and shore. This apparent lack of invention induced the proprietors of the London *Daily Graphic* to offer a prize of $500 to the inventor of the best means of communication between a stranded ship and the shore or a boat.

The responses to this offer were surprising. Within the short period from February 6, 1892, to March 31, 1892, when the competition closed, no less 1,899 projects were sent in, and soon afterward 300 more were presented, making 2,200 in all. Of this large number, all but one hundred came from Great Britain, and of the hundred Germany and Austria furnished the larger share; some came from France, but only a very few from the United States. Many of the plans resembled each other. Those that presented any special features of novelty were published in the *Daily Graphic* and have been reproduced in the SCIENTIFIC AMERICAN SUPPLEMENT. Very many of the plans lacked novelty.

The work of deciding to whom the prize should be awarded was intrusted to a board of judges, consisting of Rear Admiral Seymour, C.B., Captain Vyvyan, R.N.R., Elder Brother of the Trinity House, and Captain Wyatt. The devices submitted formed a wonderful collection of contrivances, embracing buoys, various forms of propelled boats, kites, balloons, guns, rockets, mortars, rafts, trained birds and dogs to carry lines, cranes, bridges. life boats, parachutes, harpoons, anchors, oil spreaders, aerial machines, electrical appliances, etc. Those who wish to know more particularly about these various devices will do well to consult the engravings of them given in the SCIENTIFIC AMERICAN SUPPLEMENT.

The judges, after long and careful consideration, finally decided to award the prize to Messrs. Thompson and Noble, of Southampton, for their rocket grapnel and line, of which we herewith present engravings. The diagrams, Figs. 1 and 2, show how the device is used. The upper sketch represents the grapnel and rocket in position ready for firing. The second represents the rocket after being fired, the grapnel having opened out as soon as the ground was touched. The two lower figures show sections Fig. 1 of the grapnel and Fig. 2 of the grapnel fixed on the rocket tube. A is the head of the cap or grapnel; B, the spring to relieve the arms when required; C, arms of grapnel; F, bolts from head to tube for spring; D, side springs to push out arms when required to grip. L is the tube which passes over the rocket and forms the shell of the entire grapnel; G, charge in the rocket; H, fuse; I, the slot for keeping the arms in position before firing; K, hinges and stops for arms of grapnel. N is the connection wire to swivel, ●, which is attached to the grapnel tube, and conducted by the wire line to the rocket line at the end of the

stick, which always holds good when the rocket line gets burned next to the rocket.

Fig. 3 is another view showing the apparatus set up ready for firing, Fig. 4 shows the traverse of the rocket through the air, Fig. 5 shows the device after it has struck the ground, Fig. 6 is an enlarged view of the grapnel and attached line.

The judges in their report speak as follows:

"This invention is a grapnel that can be readily and quickly fitted on to the Boxer's Board of Trade life-saving apparatus rocket. The grapnel has arms fitted to it which keep shut closely to its sides during the flight of the rocket, but which, on its touching the ground, open out, and, when the line attached to the rocket is hauled on, grip the earth, and so secure the line to the shore. This invention provides for the use of either a single line or of a block and double line rove through it, according to distance and circumstances. We have seen the above rocket grapnel tried more than once. We think it a very great advantage that these grapnels can be fitted to the present Board of Trade rocket, for five reasons. First, these rockets are well tried, known, and approved. Second, there is already a large stock of them. Third, the plant for making them is in existence. Fourth, the same may be said of the troughs for firing them. Fifth, the line used with them has been well tested in all ways.

"We do not think finality is yet nearly reached, and we believe that a rocket and grapnel, both lighter and more satisfactory, would be evolved in the course of properly conducted experiments. We think that the Board of Trade rocket line is capable of reduction both in size and weight; thereby adding to the length of range, without too much reducing the required strength. Before concluding our report, we desire, in the interests of seamen generally, to record our opinion that circumstances often arise when a light shoulder line-throwing gun, such as those devised by Messrs. Dawson, of Dundee, and Commander J. D'Arcy Irvine, R.N., would be invaluable, and often be the means of saving life by rapidly taking a line to a man overboard, or to a boat adrift or in distress, also for communication between two ships at sea in bad weather. By such means one vessel might take another in tow without lowering a boat, or might be enabled to save lives from a sinking ship, when a boat could hardly live."

The report closes with a strong appeal to the government to institute measures looking to the encouragement of new inventions calculated to save life. "We venture to think that this is not too much to ask at the hands of one of the richest nations of the world, and essentially the nation that lives by its sea-borne commerce, by its ships and its sailors, whose mercantile fleet numbers about 15,000 vessels, manned by 204,000 valuable lives, to say nothing of the passengers annually carried under the national flag—a nation the value of whose literally 'floating' capital, or property at sea, on any given day in ships and their cargoes is said to be worth not less than 200 millions sterling—a nation of people who consider themselves as one of the most humane and enlightened in the world."

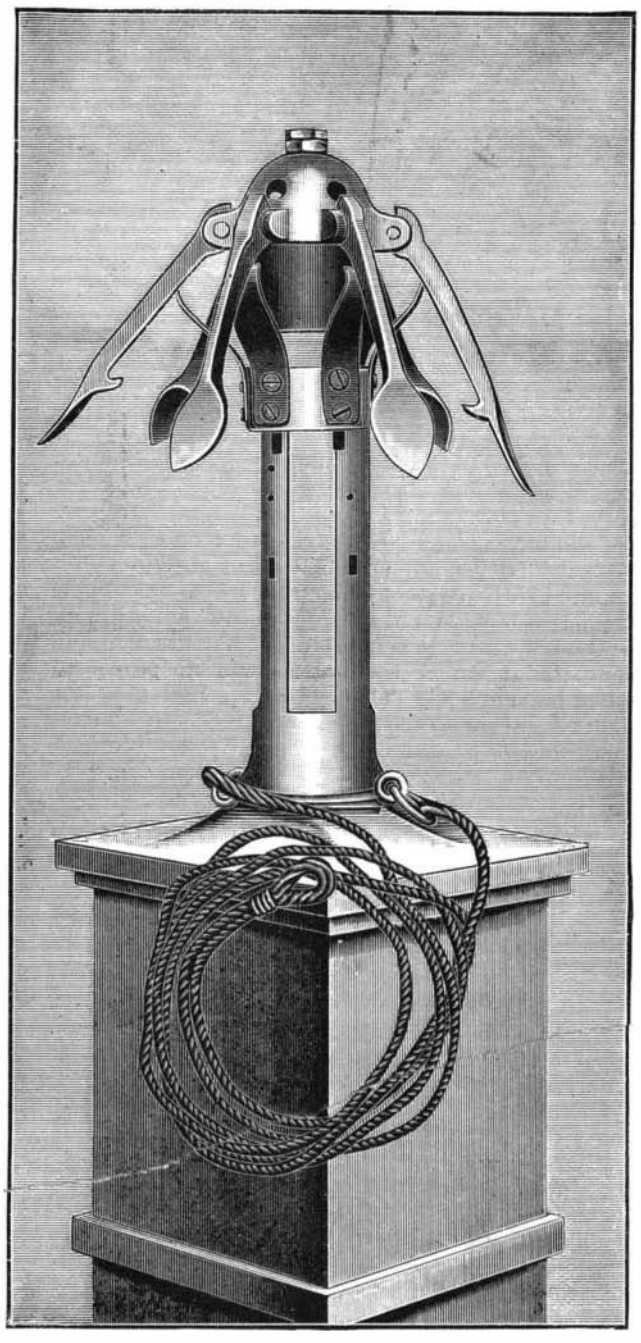


Fig. 6.—LIFE-SAVING ROCKET GRAPNEL.

The Humming Bird's Food.

BY MORRIS GIBBS, M.D.

This article refers to the ruby throat, the only representative of this interesting family in our State. Much has been written regarding the food of this species, and yet I am satisfied that but few accurate notes have been offered to the readers. The writer offers observations taken with a view to learning of the feeding habits, and does not pretend to assert that others' notes, however conflicting, are not correct. Locality has everything to do with the habits of birds, and the requirements of the same species may differ vastly in a slight variation either in latitude or longitude. Again, the resources of a region may radically alter the food habits of any and all animals. Certain it is that my observations convince me, contrary to all writings that I have seen, that the food of the ruby-throated humming bird is mainly honey, and that these little fellows do not rely to any extent on an insect diet.

Years ago I captured several in our flower garden with my insect net, and, in accordance with the views of all books read, they were offered insects as food, but invariably completely ignored everything of this nature set before them. No matter whether I gave them the liberty of a large room or confined the frightened creatures in my hand or a small box, the result was invariably the same; all insect food was refused, whether small beetles or even those minute flies or gnats often common about honey-producing flowers. However, on releasing the captive, it would immediately visit the flowers, and appear to revel in the exploration of the deep recesses of the fuchsias and trumpet creepers. One immature specimen that I caught would sip sugar water from my hand, and even protrude its delicate tongue for the sweets to be so easily had. This young one was so very unsophisticated that it had to be taught regarding the honey water, by dipping its tiny, slender beak into the sticky mass, after which it quickly learned. The old ones only fluttered in my hand, and would not eat, but would apparently enjoy that which was forced into their bills. But, left to themselves and watched secretly, they could be seen indulging in the sweets provided for them. If held carefully and an insect forced between their mandibles, they invariably ejected it with a snap of the bill and a side jerk of the head.

Of the wild flowers of Michigan, there are many species which the hummers visit regularly, but as nearly all of these flowers are so far from my residence, it follows that my observations are mainly made from our house plants and garden flowers. Of all of the uncultivated species that I know, the flowers of the wild crab apple are most sought after by the ruby throat, and during the season, about the middle of May, a hundred birds may be seen in a few hours about a group of these trees. There are very few insects on the crabs, and in wet days none, and yet the hummers swarm about. They must come alone for sweets. One point in relation to my theory of the hummer's love for honey would seem to receive a challenge, and it is that the ruby throat rarely hovers over the common red and white clover. Now, as we know, red clover is one of the sweetest of flowers, and a head is agreeable to any one's palate, while the white clover is a great favorite with the honey bee. My reply to this is that the individual flower is too small for the ruby throat's attention.

On our piazza in the city are a number of house plants, some growing in a hanging box, others in pots on a stand, while several species of outdoor perennials and annuals flourish in a bed just below, and a large creeper clambers near. It is safe to say that from early morning till evening twilight there will be an average of one visit every half hour by the hummers to this collection. So unsuspicious have they become that one can study them at a yard's distance. One advantage in observing them is that they always make their presence known by their pleasant humming and a faint, sharp chirp; thus warning one when to lay aside the book and watch their movements.

On first appearing, they immediately dash toward the fuchsias, which are their greatest attraction, and the next best is the trumpet creeper, and then the selection appears to them indifferent, as the pelargoniums, nasturtiums, morning glories, and others are visited indiscriminately. However, the fuchsias are first choice, and, wondering at their preference, I examined the blossoms thoroughly for insects and sweets. In very few cases, and at rare intervals, I found small insects, as no others can reach the heart of the flower; but in every case I met with a most refreshing nectar—to be sure, in very small quantity to us, but to a hummer a most plentiful supply. Let my readers pluck a full blown fuchsia blossom, and cutting into the calyx near the stem end, apply the part to the tip of the tongue, and they will be fully convinced why the hummer is partial to this beautiful pendent flower.

Thinking to test their fondness for sugar, some was dissolved and then dropped deeply into the blossoms of the creeper. In the course of the hour, in their rounds, the busy birds found the bait, and fully thrice the amount of time was spent on the extra sweetened flowers as was occupied over those of nature's honeying. The sweetening attracted many insects in the course of the day, principally ants and small flies and gnats, but not one instance of their capture could I detect, although careful record of the number of insects in each flower was kept, and the flower examined after each bird departed.

The movements of the hummers when visiting a bed of flowers are interesting. With a dash it is among us with the characteristic impetuosity of its kind, but it is not then detected by the ear, as the noise of a flying bird is, but slight and not always heard. It is when the bright, red-throated fellow stops in mid-air that we hear his rapidly vibrating wings, always loudest when he makes a sudden side movement from flower to flower. Selecting a flower, after a second's inspection of his surroundings, a rush is made toward it at a very rapid rate, but just as we think he will fly past or against the blossom, he stops—stops instantly. In the fraction of a second he introduces his tiny, but long, slim bill into the heart of the flower, and then is away to the next. The swiftness with which this delicate bird travels about, exploring hundreds of flowers each hour of the day, and from early morning till twilight, is truly a marvel.

At each insertion of the tiny beak, his mobile tongue is thrust out and from side to side, and the sweets, and, I think, some pollen, are drawn into its mouth. The tip of the tongue is peculiarly and beautifully constructed for this purpose, and with the perfect adaptability of its slender, delicate bill, the bird is endowed with the means of securing sweets, possessed by no other groups of bird.

In conclusion, I will say that I have carefully dissected many humming birds, both old and young, but have never found anything to convince me that the birds lived on insects. It may be that at times when flowers are scarce some species of insects are captured, but I am satisfied that in season, when flowers are abundant, the ruby throat of Michigan lives on honey.—*Science.*

The Petrified Forest of Arizona.

BY H. C. HOVEY.

For the sake of others, as well as on my own account, it seems desirable to correct certain errors that might be amusing were they not annoying. The only description given by me to the public concerning the petrified forest of Arizona appeared in the SCIENTIFIC AMERICAN for July 23, 1892. Yet a long and sensational report of my visit to the locality has been published in the dailies of New York, Chicago, Kansas City, and elsewhere, and has even been copied in several scientific papers, with blood-curdling details of hairbreadth escapes, and alluring accounts of my finding opals, rubies, and sapphires, in addition to the more common gems, that abound in what is fitly styled the "Chalcedony Park." All this is given in quotation marks, and is emphasized by the solemn statement that the author is a clergyman. Hence the occasion for this formal disclaimer.

I may add that a letter just received from Hanna's ranch refers to this matter and closes as follows: "Since the appearance of your very comprehensive and truthful article in the SCIENTIFIC AMERICAN, we have had many letters from all parts of the United States inquiring as to our wonderful petrified forest. The Atlantic and Pacific Railroad have become so much interested as to put a special station at Whistling Post 233, where you got off from the fast California express to foot it across the plain to our ranch, and we shall hereafter make it a point to meet tourists on arrival and convey them by carriages to the Chalcedony Park. We wish that you would also let it be known that during the summer and fall the streams are entirely dry, so that there need be no fear of such perils as you had to encounter."

IN France hard water has been successfully made soft by means of electricity.

Measuring the Rise and Fall in Waterways.

Mr. F. J. Smith describes in *Nature* a unique method of observing the rate at which a river was rising after a fall of rain, as follows: The river was a considerable distance from the spot where its height was to be known. By means of the combination of two organ pipes and a telephonic circuit described in the following lines, I have been able to make the required measurements within rather closer limits. At the river station an organ pipe was fixed vertically in an inverted position, so that the water in the river acted as a stopper to the pipe, and the rise or fall of the water determined the note it gave when blown by a small bellows driven by a very small water wheel. A microphone was attached to the upper end of the organ pipe; this was in circuit with a wire leading to a town station at some distance; at the town station there was an exactly similar organ pipe, which could be lowered into a vessel full of water while it was sounding. By means of a telephone the note given by the pipe at the river was clearly heard at the town station; then the organ pipe at this station was lowered or raised by hand until it gave the same note. The lengths of organ pipe under water at the two stations were then equal, so that the height of the water in the distant river was shown. The determination can be made in less than a minute by any one who can recognize the agreement of two similar notes. The arrangement when first tested was so placed that the height of water at two places near together might be easily compared. I found that a lad with an average ear for musical sounds was able to get the two heights to agree within one-eighth of an inch of each other, while a person with an educated ear adjusted the instrument immediately to almost exact agreement. The total height to be measured was 17 in. A difference of temperature at the two stations would make a small difference in the observed heights. For instance, taking a note caused by 250 vibrations per second, a difference of 10° C. between the temperature of the two stations (one not likely to occur) would make a difference of about 0·02 ft. in height, a quantity of no moment in such a class of measurements. The organ pipes were of square section and made of metal to resist the action of the water.

Hook Swinging in India.

In the SCIENTIFIC AMERICAN of March 5, 1892, we gave engravings of the hook swinging festival as practiced by the heathen at Madura, in India, with a description of the proceedings by the American missionary Rev. J. S. Chandler. We have lately received some additional photographs of the same performances, from Mr. H. C. Van Ingen, artist and photographer, at Coonoor, Nilgiris, S. India. The further practice of this barbarous rite has been prohibited by the government. Mr. Van Ingen, who took the photographs from which our engravings were made, has also sent us some fine photographs of the Indian bison, the domestication of which is now being attempted.

AN AERIAL AND SUB-AQUATIC TORPEDO.

A torpedo designed to be guided in its flight on leaving the gun after the manner of an arrow from the bow, and to continue its course on or near the surface, should it strike the water, is shown in the accompanying pictures. The piece of ordnance for starting the torpedo, shown in Fig. 1, is preferably a breech-loading gun, the torpedo, shown in Fig. 2, being loaded in from the muzzle. Fig. 3 is a cross section through the front part of the projectile, showing the wings on top of the main tube, and below a weighted piece similar to the keel of a boat, while Fig. 4 is a cross section of the rear wings, the latter sliding forward on the body when the projectile is placed in the gun, as represented in the principal view, but slipping back to the rear as the projectile commences its flight. The shape and inclination of the wings are such as is designed to uphold and direct the projectile in a straight course through the air, retaining it also near the surface after it strikes the water, until its propelling power is completely exhausted. In addition to the propelling force supplied by the gun at the time of discharge, in the usual manner, this torpedo is provided with further means of propulsion, concealed within the rear portion of its body, the combination being designed to give the projectile a great range and high speed through either the air or water. A 12 inch torpedo of this construction is adapted to carry 350 pounds of a high explosive. The improvement is the invention of Mr. L. Gathmann, a mechanical engineer of Chicago, who has made a number of tests on Lake Michigan with projectiles up to ten feet in length, and is said to have demonstrated that they will carry several miles with great accuracy of aim.

THE GATHMANN TORPEDO—Fig. 2.

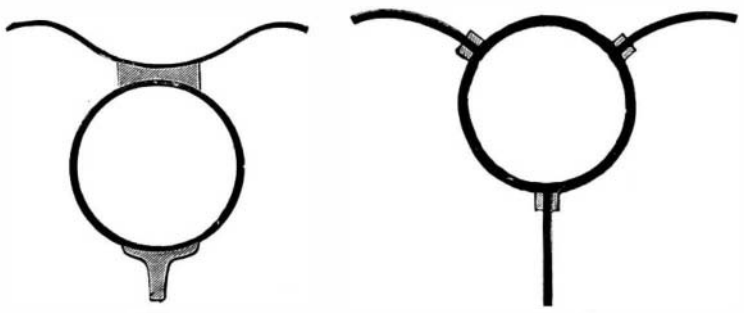


Fig. 3. Fig. 4.

THE GATHMANN TORPEDO—SECTIONAL VIEWS.

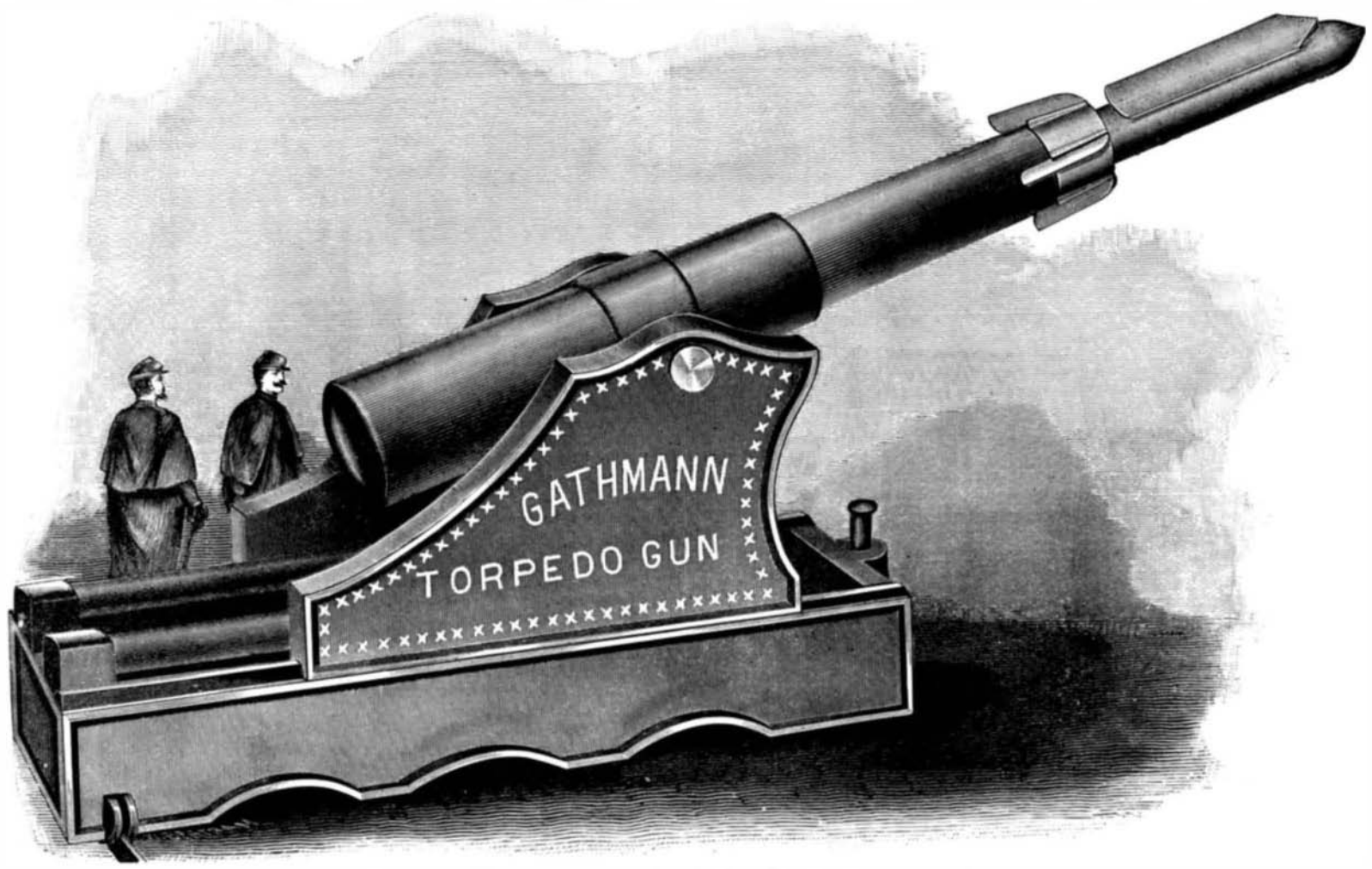
The New Packing House, Kansas City.

The new Armour packing house at Kansas City was started up "for business" on October 1, with between 600 and 700 men at work, which force will be enlarged to between 2,000 and 3,000 when in full operation, and as the old house (Armour Packing Company) employs nearly as many men, the total force in the employ of the Armours in the city will be between 5,000 and 6,000 men.

One of the most interesting features of this plant is the cooling machinery for the two cold storage houses, one 178 × 135 feet and the other 178 × 118 feet, each four stories high, with capacity for 10,000 beeves daily. The refrigerating machinery cost $250,000, and was furnished by the Frick Company, of Waynesboro, Pa. The machines are their single-acting vertical compressors with horizontal engines. The power is furnished by two 150 horse power tandem compound condensing Corliss engines, and each of the two refrigerator machines has a capacity of 200 tons per day. This is sufficient to reduce to the freezing point a space of 4,000,000 cubic feet. Each cooler is supplied individually with large steel ammonia pipes, and the system by which they are connected with the ice machine is such that the full pressure can be turned upon any one cooler if necessary. In case one of the ammonia tanks becomes disabled, by a system of pipes and shut-off valves the pressure can be transferred to the other tank without any loss of cooling power whatever. There are over 200,000 feet of ammonia pipes in the several coolers. The machines were set up under the direction of Thomas Shipley, who had 250 men under his direction for thirty days, the machines and materials used having required 150 cars in their transportation from the works in Pennsylvania to the packing house.—*Ice and Refrigeration.*

How to Get Rid of Mosquitoes.

In a late number of *Insect Life*, Mr. L. O. Howard publishes a note upon the use of kerosene against them, the substance of which is as follows: On the surface of a pool of water, containing about 60 square feet, he poured four ounces of kerosene. This formed a very thin oily film on the surface of the water. On the 5th of July the pool was teeming with animal life, but for the next ten days that the pool was under observation no living insects were observed. At the end of this time, a count of the insects on a small portion of the surface, from which was estimated the total number, showed 7,400—370 of which were mosquitoes. The kerosene remedy was tried this last summer on the swamp meadow pools of Stratford, Conn., with much success.



THE GATHMANN TORPEDO AND TORPEDO GUN—Fig. 1.