of nerves start from the above lobe and communicate with the electric batteries. If these nerves be cut or tied all electric phenomena cease; but in order to completely prevent any discharge they must all be tied or cut, for if they are only cut or tied on one side of the body the discharge will continue on the other side.

"The *gymnotus* is similar to an eel in appearance, and is commonly known by the name of 'electric eel.' These eels average about seven feet in length, and their skin is covered with a glue-like substance. They abound in the rivers and lakes in certain parts of South America. Their electric power is so great as to knock down men and even horses. Whenever a fisherman chances to catch a *gymnotus* and a young crocodile in the same net, when it is hauled in the latter reptile is generally found dead or paralyzed, while the electric eel shows no mark—the crocodile having been electrified before it could reach the fish.

"In certain sections of South America when it is necessary to enter a pond or stream of electric eels, wild horses are driven into the water infested by these formidable fish. Humboldt describes the method pursued. As soon as the eels hear the unusual noise caused by the plunging of the horses, they rise to the surface and attack the animals with their powerful electric batteries. The natives surround the pond or occupy the branches of trees overhanging the water, armed with harpoons and long reeds, and by their wild cries and reeds prevent the horses from landing. After a desperate combat, in which many horses are often killed and others paralyzed by the repeated and terrific shocks of electricity, the *gymnoti* being weakened by fatigue and loss of galvanic power, seek to escape in order to rest themselves and recuperate their electric strength, when the horses remaining drive them to the shore, where they are easily captured by harpoons attached to ropes.

"Professor Farraday has described the characteristics of the electric discharge from these fish. By the aid of two metal plates joined to the extremities of the galvanometer and applied to various points on the body of a *gymnotus* he succeeded in determining the direction of the discharge. He discovered that the anterior portion of the eel always formed the positive pole, and the posterior portion the negative pole, so that the direction of the current in the galvanometer was from the head to the tail. By causing the discharge of the *gymnotus* to pass over a wire arranged in a spiral, in the interior of which several needles were placed, he succeeded in magnetizing these needles in the required direction, by the direction of the discharge from the head to the tail of the fish. The same philosopher obtained chemical decomposition by the employment of iodide of potassium, and produced the electric spark by introducing into the circuit an electro-magnetic spiral, having a cylinder of soft iron in its interior.

"The electric apparatus of the *gymnotus* extends over the entire length of the back and tail, and consists of four longitudinal fasciæ, composed of a large number of membraneous laminæ, nearly horizontal, parallel, and very close together, and united by an infinite number of scales placed vertically and crosswise. The little prismatic, transverse cells formed by the junction of these laminæ are filled with a gelatinous substance. The whole apparatus is supplied with very large nerves emanating from the spinal nerves.

"The *silurus electricus* of the Nile is about two feet in length. Its mouth is provided with six fleshy tentacles. It is to be found chiefly in Egypt and Senegal. The Arabs call it RAASCH, *anglice*, thunder. Its galvanic power is considerable. Geoffroy Saint-Hilaire made many curious experiments upon this fish during the siege of Alexandria. The electric apparatus of the *silurus electricus* consists of a species of fatty cellular tissue extending over the whole body between the skin and the muscles.

"In conclusion, the phenomena presented by electrical fish may be said to be of the same order as those produce by our scientific apparatus, viz.: deviation of the needle of the galvanometer, elevation of temperature in conjunctive wires, magnetization, chemical decomposition, and, lastly, electric sparks."

THE Pacific Ocean covers seventy-eight millions of square miles the Atlantic twenty-five millions.

Correspondence

Toughening Steel by Hot Water.

MESSRS. EDITORS:—I am a constant reader of your truly valuable journal, and have been since the first number; now it has become one of the indispensables, and I look with eager interest for each number. I am always instructed and often amused at the questions asked, and the answers to them by your numerous readers. I have been a worker in steel since 1815 for edge tools and machinery, and all other purposes for which it is used in this country, and am particularly interested in all I see written on the nature of that metal. Some time since I saw the question asked, "Why is a Razor Put in Hot Water?" I felt competent to answer the question, but not being accustomed to writing for the public prints, I felt a diffidence to appear before your hundreds of thousands of readers, and waited to see some one explain it. I will explain why a razor should be put into hot water before using.

Every degree of heat there can be put into a razor or any other tool, without injuring the temper, strengthens the steel. A razor has, or should have, the most delicate edge of all edge tools, and the highest or hardest temper; unless strengthened by heat, it would not stand the harsh usage that its delicate and hard edge is put to, as any man can prove by trying without heating it. He will find it broken out in notches wherever it has come in contact with the beard. The saw appearance of the edge, as one of your correspondents explains it, is caused by sharpening it. Any one examining a beautifully polished razor with a microscope is astonished at the rough and scratched appearance, and when examined carefully the scratches will be found to be cut through its delicate edge, producing a sickle instead of a saw edge. Hot water is the safest way to heat any tool and give it strength without danger of injuring the temper. All tools should be heated that are to be put to harsh usage, especially in cold weather. Most tools that cause great friction by use will produce the heat after they get to work.

Every wood-chopper does, or should, understand that if he attempts to work with a frosty ax he will break it, but when once at work the friction produces the necessary heat to strengthen it.

In my experience, the most difficult tool to make stand for the purpose intended, and the severest trial for steel, is a pick edge for cutting French burr-mill stones. These stones are the third hardest substance in nature, and a pick to answer has to be of the best steel, and must be the hardest temper of all tools whatever. In this case the hot water answers an admirable purpose, and is really indispensable in cold weather; in a great many trials and experiments I find it very beneficial, even in hot weather, as it allows the edge to be made very hard, and prevents the steel from flying if it is kept sharp by grinding.

I would say, for the benefit of millers, never use a pick so dull that it does not cut freely, as it should be made too hard to stand much hammering. If you use it dull it shatters the steel and is pronounced too hard, when the fault is improper usage.

D. C. STONE.

Kingston, N. Y., Nov. 4, 1865.

[Our correspondent need have no diffidence in writing to this paper. Some of the most valuable communications that we receive are from practical men, making known some fact that has come under their personal observation. While we leave communications with as little alteration as possible, we always correct grammatical errors, and if the matter is not new, or if we think it will interest few or none of our readers, we throw the letter into the wastebasket, and it gives us no trouble whatever. We frequently receive the same explanation or statement from several correspondents; then we generally publish the first received, and, of course, throw the others away.—EDS.

Negative Slip.

MESSRS. EDITORS:—In the SCIENTIFIC AMERICAN of the 21st October, page 257, "Negative Slip," of the screw propeller is noticed from an English publication, and variously, but I think erroneously, accounted for. This so-called "negative slip" gives a greater speed to the vessel than demanded by the rotation of the screw.

An article from the present writer, T. W. B., of Oct. 8, 1864, page 233, on "The Peculiarities of the Paddle Wheel," contains the following solution of the above phenomena:—"Experience shows an advantage of the screw propeller over the paddle wheel, of 10 to 15 per cent, and the cause of this superior efficiency may be found in the partially dead water against which the screw acts, and yet without drawing back the vessel, owing to the continued advance of the vessel beyond the immediate influence of the backward ejected water."

This saving effect attends the stern-wheel and screw steamers of the West.

THOMAS W. BAKEWELL.

Cincinnati, Oct. 27, 1865.

Power Required to Drive Machinery.

MESSRS. EDITORS:—I take pleasure in giving you my experience as regards the amount of power I obtained from a water wheel I put up two years ago. I was at that time manager of a wood-turning establishment. We were running four of Weymoth's patent wood-turning lathes, at the rate of 3,500 revolutions per minute, by a three-inch belt on each spindle, stretched to its utmost capacity. Also, a gage lathe, using two three-inch belts, running at about the same rate of speed; one common turning lathe; one two-foot circular saw, at 1,800 revolutions per minute; one twenty-inch circular, 2,000 revolutions; one sixteen-inch, 2,500 per minute, and one small eight-inch circular saw, 3,000, with a circular cross-cut saw, of twenty inches, for cutting slab, plank, etc. We were also running a muley saw rotary feed, put up in the best manner, cutting 1,500 feet of hard-maple boards, or 2,500 feet of pine boards in ten hours. The whole was driven by one water wheel, four feet in diameter, using 360 inches of water under an $8\frac{1}{2}$-foot head and fall. The wheel was one of my own make, and is what we call a "direct-action" wheel, with a reaction bucket attached underneath the direct-action floats. The wheel, with its upright shaft, only cost me $110 to build and put up, it being principally made of wood. It ran perfectly steady, and almost as even as a steam engine with a governor.

B. A. STRATTON.

Towanda, Pa., Nov. 1, 1865.

Tarnishing of Silver-plated Ware.

MESSRS. EDITORS:—In the SCIENTIFIC AMERICAN of August 19, 1865, you published correspondence on the causes of tarnish on silver plated ware. Your correspondent says, if it would be interesting to your readers, he could give the best modes of preventing the tarnishing of silver ware and of removing the same from silver-plated or solid silver articles.

There are a great many in the retail trade that would like to be informed of the best modes of doing the same—myself being one of them. Please ask "E. W. C." to be kind enough to publish the information on the subject, and he would oblige a great many of your readers in this section of the country.

H. P., Watchmaker.

Peoria, Ill., Oct. 28, 1865.

SPECIAL NOTICES.

Alfred Platt, Waterbury, Conn., has petitioned for the extension of a patent granted to him on the 13th day of January, 1852, for an improvement in buckwheat fans.

Parties wishing to oppose the above extension must appear and show cause on the 25th day of December next, at 12 o'clock, M., when the petition will be heard.

Byron Densmore, New York City, has petitioned for the extension of a patent granted to him on the 10th day of February, 1852, for an improvement in grain harvesters.

Parties wishing to oppose the above extension must appear and show cause on the 22d day of January next, at 12 o'clock, M., when the petition will be heard.

OBITUARY.—Chief Engineer Cushman, U. S. N., who was upon the *Kearsarge* when she cruised for and sunk the *Alabama*, died on Thursday last.