crystalline, as pure and hard as best American or Norwegian ice.

Examining now the two German ice-making machines, we find that their construction is in nearly every respect identical; and although based on the same thermodynamic principle, these machines differ nevertheless considerably from the English machine, in appearance as well as in working. The English machine appears to us a compact, thoroughly well considered construction, while the German machines show a great number of tubes, and vessels, and cocks, which require a good deal of attention. The general *modus operandi* of the German machines is as follows: A boiler is partly filled with a concentrated solution of hydrochlorate of ammonia, which is heated, and ammoniacal gas is thus generated. This gas is forced through serpentine pipes in a condenser to a refrigerator, and from there it is admitted into the serpentine pipes of the ice box. The ammoniacal gas is exposed on its way to the ice box to a pressure of 8 or 10 atmospheres, while it is considerably cooled in the condenser, the serpentine pipe of which is surrounded by cold water, the results being that the ammoniacal gas becomes condensed to a fluid form. The serpentine pipes of the ice box are surrounded by a solution of hydrochlorate of lime; and the liquefied ammoniacal gas, passing through these pipes, resumes its gaseous form, and absorbs heat from the soluton of hydrochlorate of lime. The boxes with the water to be changed into ice are placed in the ice box, and immersed in the solution of hydrochlorate of lime. The fluid gas evaporated in the serpentine pipes of the ice box passes into an accumulator, where it is absorbed by the fluid freed from ammonia, from which the gas has been produced by heat, this fluid having passed from the boiler through the refrigerator to the accumulator. The fluid is then again forced back by means of a pump into the boiler, whence it passes off again as ammoniacal gas.

These ammonia machines are built in six different sizes, for the production of from 10 pounds to 1,000 pounds of ice per hour, requiring for the same time from 5 to 500 cubic feet of water, and from 5 pounds to 60 pounds of coals. The space occupied by the smallest machines is 6 by 4 feet, and that required for the largest is 45 by 20 feet. The ordinary shape of the ice produced by the machines is a square plate, 2⅜ inches thick, 7¼ inches wide, and 29¼ inches long, weighing about 20 pounds.—*Engineering.*

Correspondence.

Hydraulic Mining in California.

To the Editor of the Scientific American:

An article copied from the *Calaveras Chronicle*, appearing in your issue of November 15, is calculated to mislead your readers, as it entirely mistakes the process of hydraulic mining as it was five years ago, or even twelve years ago. No doubt that changes have been made, in that the great power of water has been more universally adopted for mining purposes. I am an old Californian, and will now simply relate a trial that I witnessed in the summer of 1859, in the county of Placer, near Forest Hill, being one of a committee to test the different nozzles, in order to ascertain which among the various constructions would produce the best results in cutting down an embankment.

The water was brought in a flume on the mountain side. The conducting pipe was of iron, 8 inches in diameter, except that, near the lower end where the nozzle was attached, there was about 50 feet of five ply canvas, wound spirally with rope ⅜ of an inch in diameter, all made solid together. The perpendicular pressure was 196 feet; the bore of the nozzles used varied from 1½ to 2 inches in diameter; the nozzles were of various tapers, some being tapered to within a few inches of the end, then going straight; and there were various other forms. The character of earth was cemented gravel, so hard near the bed rock that it was said that a man could not pick up, by hand, four ordinary wheel barrow loads in a day. The embankment worked upon at that time was about 25 feet in depth, but it grew deeper as they worked up into the mountain.

The work of the hydraulic was fearful to behold, and one could scarcely believe one's own eyes. Taking hold of the stream of water as, in its fury, it poured from the nozzle, I could compare it to nothing better than a piece of polished ivory; and it could not be penetrated with the finger. I tried to split the stream with my pocket knife blade, by holding the edge against the nozzle at the end, but could not hold the knife sufficiently firmly to do it. The operator stood about 22 feet from the embankment, the water pouring with terrific fury into the bank, roaring, clashing, and filling the air with stones, the gravel flying in every direction. The stump of an oak, newly cut, about 18 inches in diameter, stood near the edge of the embankment, with a few roots hanging over. The operator requested us to mark the time required to wash it from the bank clear; in less than 20 minutes it was undermined and rolled down hill, and every root was washed clean. As an experiment, the bark was peeled from a green oak, 20 feet distant, by the furious water. When the top dirt was washed off, down to within a foot or so of the bed rock, the operator directed the stream under the lower edge and raised large flakes (or lifters, as he called them) hurling them over and over, breaking them up among the rocks, and sending them into the long sluice, where (with rocks, some weighing more than a tun) they went thundering down for near half a mile in length, where most of them were ground up, leaving the bewitching contents at the bottom of the sluice.

Directing the stream against the side of large boulders, which four men could not have turned over by hand, they were easily rolled over and over by the force of the stream. The nozzle which carried off the prize was some 6 inches at the large end, where the water entered, and I think 1⅞ inches at the discharge end; it was very long (7 or 8 feet) and a portion of the small end bored out perfectly smooth to an exact focus of 22 feet, being the distance from the bank at which it was most commonly used. If used at a sharper focus, the currents seemed to cross each other and confuse or scatter the stream beyond; with a portion of the end bored straight, the stream seemed to scatter from the point of discharge. As the washed rocks occasionally accumulated on the washed bed rock below the embankment, impeding the course of the dirt to the mouth of the sluice, the operator would (with a kind of sweeping stroke) direct the stream so as to sweep everything before it, often shoving ten cart loads or more at a single sweep over the bank into the sluice.

Even before this time, I had seen hydraulic mining (at Alpha and Omega, and at Nevada, as well as in other localities) of which, even in this day of improvements, California need not be ashamed; it leveled the mountains and often buried men alive. J. E. EMERSON.

Beaver Falls, Pa.

Petroleum as Fuel.

To the Editor of the Scientific American:

A series of trials have been made here recently, on a small scale, to determine what may be done with petroleum as a fuel under steam boilers. The boiler used was an ordinary eight horse upright one, about three feet diameter and six feet high, with the usual number of one and a half or two inch vertical flues, the lower flue sheet being about fourteen inches from the grate. The device for burning the petroleum was placed upon the grate, and a stream of oil, scarcely larger than a No. 16 wire or the rapid dropping of the oil (about six quarts an hour), mingled with a certain quantity of air under pressure, was sufficient to raise steam to thirty pounds to the inch in thirty-five minutes. Considering that during this time the furnace door was kept wide open for the purpose of observation, and that the boiler was in a cold room and entirely unprotected by jacket, I think this may be regarded as a good result.

It seems to be requisite that the air should have considerable tension, and mingle with the burning oil in jets, and in quantity proportionate to the quantity of oil, in order to ensure perfect combustion; for it was noticed that, while the apparatus was being adjusted, considerable smoke occasionally arose; but as soon as proper adjustment was reached and the boiler and apparatus had warmed up, the consumption was quite free from smoke and gas.

Although these tests (some half dozen in number) have been upon a small scale, consuming only about one barrel of oil, all told, they certainly indicate that petroleum has the qualities of a strong and economical fuel.

Worcester, Mass., Nov. 6, 1873. F. G. WOODWARD.

Tracks in the Solid Sandstone.

To the Editor of the Scientific American:

Having heard that there were numerous mule, deer and turkey tracks to be seen on a ledge of rocks, situated about four miles northeast of this place, on the farm of Mr. John Stevenson, I visited, in company with Mr. Louis Graff of this place, and made a thorough investigation of the surface of the spot. We found that the rocks, which are a very hard sandstone, extended thickly over several acres of ground. The top surface of almost every loose rock was marked plainly with tracks like those of small mules of various sizes; some few were not over an inch in diameter. We found one very distinct track, showing the hollow of the hoof, and of the size and exactly like that of a common sized horse. We found a few tracks like those of deer, some such as a deer makes when leaping, others made as when walking. Several tracks were made in slipping; some shewed notches, as made by the notched hoofs of the wild horses on the western plains. We found, where the unbroken stratum had been exposed by the washing of the rains, that its surface was also covered with the same kind of tracks as those on the loose rocks.

We were informed that many rocks had been hauled away as curiosities; and that there used to be found on the rocks distinct turkey tracks, and perhaps the tracks of other kinds of birds. A. M. BOURLAND, M. D.

Van Buren, Crawford county, Arkansas.

Railway Religion.

To the Editor of the Scientific American:

Many an attentive reader of your valuable paper has been pained to read an article under the above caption, on page 297 of your current volume. Knowing your reputation for fairness, I had rather believe that the article spoken of found its way into your columns by accident than by design. There may be some "divines" who believe that "the world was made in a week," but they are not the index of the Christian ministry of today. Clergyman are not of all men most ignorant; and they that are not altogether unacquainted with the modern developments of science, is clearly proved by the fact that not a small number of them are among the readers of the SCIENTIFIC AMERICAN. We have searched in vain among the utterances of the late Evangelical Alliance to find one which came anywhere near calling scientific men "servants of the evil one, infidels, and scoffers." Yet it is taken for granted that the delegates will do so from their pulpits on the first suitable occasion.

There can be no real controversy between science and religion. Fanaticism and ignorance may get into collision, but the intelligent clergyman is just as apt to adopt the teachings of pure science as the scientist is to respect the claims of religion. JAMES PITCHER, Principal,

Hartwick Seminary, N. Y.

LABORATORY NOTES.

BY S. P. SHARPLES.

ELECTROTYPING WITH IRON.

M. Klein, a Russian chemist, has succeeded in electrotyping with iron. He used a bath consisting of a concentrated solution of sulphate of iron and ammonia, and four Meidinger cells. For an anode he used an iron plate having a surface about eight times that of the cathode, and connecting this also with a copper plate. He found by this means he could get a perfect coating of iron. On leaving the bath, the iron is as hard as tempered steel and very brittle; heated to a cherry red, it becomes malleable, and may be engraved as easily as soft steel.

CEMENT FOR PIPES, STILLS, RETORTS, ETC.

J. Spiller recommends a mixture of pulverized iron borings, kaolin, and sirupy silicate of soda as a lute for fixing on the heads of stills which are required to stand a high temperature. We should judge the same might be found useful in other situations, such as the joints of cast iron furnaces, for instance.

PRESERVING GELATIN SOLUTIONS.

Lanjorroic finds that the addition of 1 per cent of fuchsin to a solution of gelatin will prevent its putrefaction. A quantity prepared in this manner was kept 11 months without change. The addition of a very minute quantity of aniline violet to gelatin or to an infusion of coffee was also found to prevent its putrefaction entirely. It is hard to understand how these substances do this, if they have no poisonous properties.

COPYING MEDALS.

Copies of medals or other similar articles may be readily made by a very simple piece of apparatus. A cast of the medal is first taken in wax. This is done by moistening the medal or coin slightly, and then pouring the melted wax over it. The object of the moistening is to prevent the wax sticking to the surface of the metal. While the wax is still warm, a piece of copper wire should be imbedded in it to serve as a support, and to connect with the zinc in the decomposing cell. After removing the medal from the mold, the surface of the mold is dusted over with fine plumbago until it appears quite black; all excess of the carbon is then carefully removed with a soft brush. If fine iron filings can be had, a few of them are sifted over the face of the mold, and a solution of sulphate of copper is poured on it. It is then carefully washed; this serves to give a very thin coating of copper, and facilitates further operations, but may be omitted if not convenient. Care must be taken, in putting on the plumbago coating, that it comes in contact with the copper wire. A very convenient way of applying this wire is to bend it into a ring slightly larger than the medal to be copied, lay it on the table around the medal, and pour the wax over both at the same time. Scraping with a knife exposes it completely. The mold being prepared, take an ordinary glazed earthenware basin four or five inches deep, and in it set a small flower pot, having previously plugged up the hole in the bottom of the pot with a piece of wood, a little wax, or other suitable material. The flower pot is to be filled with a weak solution of common salt. The outer basin is then filled with a strong solution of sulphate of copper, and a little bag holding crystals of sulphate of copper is hung in it to keep it saturated. Add a few drops of sulphuric acid to both solutions, place a piece of zinc in the flower pot, and connect it with the wire of the mold. The mold being now put in the outer solution, a coating of copper soon shows itself. The mold may be left in the solution two or three days, if a thick coating is desired.—*Boston Journal of Chemistry.*

Trees as Historians of the Past.

M. Charles Gros has recently communicated a note to the French Academy of Sciences on the study of the yearly rings, shown when the trunk of a tree is transversely divided. These layers by which, as is well known, the age of the tree may be determined, do not diminish in relative thickness by a constant law. In view of this, M. Gros seeks a cause for the irregularity, and, it seems, has arrived at the conclusion that the data, mean and extreme, of meteorological phenomena, when known and tabulated, might be compared year by year with the annual ligneous layers formed during such periods in many different varieties of trees.

From the comparison it is not impossible that some interesting ideas relative to the laws of development of trees may be obtained. But, moreover, these laws once established, the trees in their turn might become precious collections of meteorological evidence for places and times where observations cannot be made. *Les Mondes* suggests rather a striking example of what might be learned from ancient trees, as follows: "Suppose that there should be found in Egypt a very old though living tree, the origin of which dated back to the time of Joseph. If, on cutting the trunk, the rings corresponding to that period showed seven thick and seven thin layers, there would be tangible evidence of the truth of the Scriptural tradition of the seven years of plenty and seven years of famine, besides of the immediate causes of humidity, temperature, etc., to which such phenomena might be due."

DRIER FOR OIL COLORS AND VARNISHES.—Water, 100 parts; gum lac, 12 parts; borax, 4 parts.