Completion of the Great Bridge across the Niagara River.

The great international bridge across Niagara River from Buffalo to Fort Erie, in Canada, has b en lately completed. The Buffalo *Commercial Advertiser* furnishes the following interesting description:

"To state the fact roughly but plainly, the entire length of the bridge is about three quarters of a mile. But more in detail the length is as follows: In the main river, 1,800 feet; over Squaw Island, 1,300 feet (trestle work), and over Black Rock Harbor, 450 feet. The entire length of the superstructure in the main river is 1,890 feet; in Black Rock Harbor, 440 feet. There are nine spans in the portion on the main river and three in the Black Rock Harbor: four of 190 feet in the clear, and three of 240 in the clear. Over the main river also are two draw openings, of 160 feet each; total length of draw girder, 362 feet. In Black Rock Harbor are two draw openings of 90 feet each, and one fixed span 220 feet in length. In the main river are eight piers and two abutments; and in the harbor, two piers and two abutments. The abutments are 40 feet long by 30 wide at the bridge seat level. Over the bridge is laid a track for railroads, and a common sidewalk for foot passengers. The piers and the abutments are built of sandstone from Georgeown and Acton, Canada, and from Berea, near Cleveland, Ohio.

The iron of the superstructure was from the Phœnixville Iron Company's Works, Phœnixville, Pa. The first caisson was launched on the 13th of July, 1870, and work progressed steadily up to the time of completion. It must be remembered that the current of the river, at the point where the bridge is located, runs from five and a half to ten miles an hour, according to the state of the wind. This was throughout one of the greatest difficulties encountered, and frequently retarded progress. Then, too, the depth of water varies from twelve to forty-five feet. The ice in winter, some may think, would damage the bridge in course of time, but the ice breakers afforded ample protection, and cut to pieces blue ice two feet thick with comparative ease. Another remarkable thing connected with the history of the bridge is that, during the whole course of the work, not a single life has been lost. The workmen have, many of them, often been exposed to dangers, but always have escaped.

The respective weights of the different spans over the river are as follows: 190 feet, 130 tuns; 240 feet, 208 tuns; 362 feet draw, 353 tuns; and the entire quantity of iron used in the whole bridge amounts to upward of 2,000 tuns. At the request of Captain Tyler, the English Government Inspector of Railways, who visited the bridge in November, 1871, on behalf of the English shareholders, one of the spans of 190 feet was loaded with 210 tuns of iron rails, equally distributed over the floor beams (a weight greater than that of a continuous train of locomotives covering the span), and left in that condition for three days. This test was highly satisfactory, the deflection being found to be only about one inch, and the truss returning exactly to its former condition on the removal of the load.

The bridge has been leased, to the various railroads which will cross it, for twenty years. The roads are the Grand Trunk, the Great Western, the Canada Southern, the New York Central, the Erie, and the New York, West Shore and Chicago. Most of these railroads have already constructed their approaches to the bridge, and will commence sending trains across at as early a day as possible. The original plan contemplated a carriage way, but this was abandoned for the reasons that, as the bridge was three quarters of a mile long and so many trains were to cross it, there would very seldom be a chance for carriages to cross without interfering with the trains.

The entire cost of the bridge, in round numbers, is not less than $1,500,000. Of its practical benefits we leave the reader to judge, merely stating in conclusion that it supplies a want long felt by the different railroads which have for so many years been obliged to cross the Niagara River on the steamer International.

New Comets.

The present year is marked by the discovery of quite a number of new comets, and the re-observations of others previously noted but since invisible. Particularly is this the case in comparison with 1872, when only one of these vagrant bodies, and that a fragment of Biela's comet, was seen. Up to the current date seven have been observed, which were found as follows: No. 1 on the 3d of April, by Stephan at Marseilles. This comet is identical with No. 2 of 1867, originally discovered by Tempel. The second body is a new one, and of short period, and was noted by Tempel on July 3 at Milan. Another new comet was observed by Breolly at Marseilles on August 20, and a fifth, of considerable brilliancy, passing southwardly, by Paul Henry at Paris, on the 23d of the same month. On September 1, Stephan, of Marseilles, obtained feeble views of Brorsen's, and on the 3d of Faye's, comets. Another new discovery was made on November 10 by Le Verrier at Paris, of a comet which has a slight motion to the southwest, and the last new arrival has been found on November 11 by the Vienna Academy of Sciences.

Professor Kirkwood suggests that persons having the use of comet seekers will do good service to astronomy by searching for these wandering celestials at the present time. It may be added, as an incentive, that the Vienna Academy offers a gold medal for every new discovery.

PARDEE HALL AND ITS FOUNDER.

We recently noted the formal donation, by Mr. Ario Pardee, of a large and handsome edifice to Lafayette College, at Easton, Pa. The building, which has been named Pardee Hall, is to be used as the scientific department of the institution. We give herewith an engraving of the structure, and a portrait of its liberal founder. The edifice, to the erection and fitting up of which $250,000 has been devoted, is situated on an elevated knoll in the eastern portion of the college grounds. It has a total frontage of 256 feet, and its main building is five stories high, and extends back for a distance of 61 feet. On each side are lateral wings, 61 feet in length and 31 in width, joining which, at their extremities, are cross wings, 42 feet front by 82 feet in depth.

MR. A. PARDEE, FOUNDER OF PARDEE HALL.

The architectural effect is quite imposing, the handsome mansard roof and two turrets giving a massive appearance to the whole. The material used in construction is Trenton brown stone, with light Ohio sandstone trimmings.

The first floor contains metallurgical lecture rooms and private laboratories, apartments for the study of blowpipe analysis, assaying, ore dressing, and similar branches. Extraordinary facilities are afforded for instruction in the science of mining, there being, among other interesting objects, a complete model of coal mine plant operated by steam, from which the functions of all the different machines and processes can be seen at a glance.

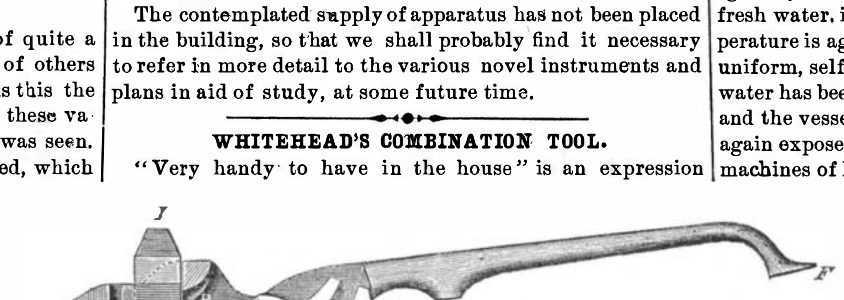
PARDEE HALL, LAFAYETTE COLLEGE, EASTON, PA.

The second story is devoted to geological and mineralogical cabinets, which are arranged to adjoin a spacious lecture hall. Valuable collections of specimens relating to the sciences of mineralogy and geology have been provided, together with necessary apparatus, books, etc. The third floor contains the cabinets and lecture rooms for the classes in the various branches of engineering, and the two upper stories are fitted up with every requisite for the study of chemistry.

The contemplated supply of apparatus has not been placed in the building, so that we shall probably find it necessary to refer in more detail to the various novel instruments and plans in aid of study, at some future time.

WHITEHEAD'S COMBINATION TOOL.

"Very handy to have in the house" is an expression which may be unhesitatingly applied in reference to the useful little invention depicted in our engraving. It is a small tool chest compressed into a single implement which may be readily carried in one's pocket.



There is a double flanged frame or casing, A, which is connected by supports, B. Pivoted at C are the handles which, at their rounded ends, have teeth, D. On a projection on one of the handles is a punch, E, and at their ends are longitudinally projecting pieces, F, the inner extremities of which serve as calibers and the outer ends as the points of a pair of dividers. Both handles are provided with conical holes, G, corresponding to similar apertures in the frame. These are not placed centrally above each other, but some distance to the right and left of the longitudinal axis of the tool, so that the sides of the orifices act, on closing after opening the handles for the admission of a wire, like shears, cutting the same at the point desired. Two straight shanks, H, are wedged transversely into the frame, and slide on the guiding supports. Their lower sides are supplied with a series of teeth which gear into teeth, D. Attached to the shanks, and at right angles, are jaws which act as pliers. One of the shanks is also provided with a steel blade, I, which serves as a screwdriver. The curved slots, J, correspond with longitudinal slots in the frame which guide the connecting bolt, K. The latter is formed in square shape so far as it moves in the lower guide slot, and at its upper end is threaded and provided with a thumbscrew; when the thumbscrew is loose, and the handles are opened and closed, the bolt, K, is caused by the slots, J, to traverse in the longitudinal slots of the frame, and to produce a parallel movement of the jaws and their application as pliers. By tightening the thumbscrew the jaws may be set and used as a hand vise. The tool may be made of malleable iron, steel or any other suitable material.

It was patented June 10, 1873, through the Scientific American Patent Agency, by Mr. H. B. Whitehead, of Holly Springs, Marshall county, Miss.

Ice-Making Machinery at the Vienna Exposition.

The making of ice by artificial means is a matter of rapidly increasing importance, not only on account of the increase it affords in our domestic comforts, but also on account of its usefulness in many manufacturing branches. The ice-making machine has already been of great service in breweries, as it renders the brewer independent of the supply of natural ice, while the ice machine may also be used for the direct cooling of the air and the wort. Besides, ice made artificially by machinery is colder and therefore harder than natural ice, a fact which has clearly been proved by experiments lately made, when equal weights of both artificially and naturally produced ice were placed in warm water of equal temperature, the result being that the artificial ice took more than twice the time for melting that was required by the natural ice.

At Vienna were exhibited three ice-making machines, one by Messrs. Siebe and West, of Lambeth, London, one by Messrs. Vaas and Littman, of Halle on-the-Saale, and a third by the *Actien-Gesellschaft für Fabrication von Eismaschinen*, formerly Oscar Kropff and Co., of Nordhausen, Prussia. The principle applied in Messrs. Siebe and West's machine consists of the production of a cold temperature by means of the evaporation of ether, and of the continued use of the same ether without any significant loss. The machine consists of a refrigerator, a condenser, an air pump, and an icemaking box. The machine works in the following manner: As soon as the air pump is put in motion, the ether in the cooling vessel evaporates, and, of course, absorbs heat from the tubes by which the cooling vessel is traversed. The ether vapor thus produced is forced by the air pump into the condenser, where, under the combined influence of the pressure and the cooling action of the water circulating through the condenser, it resumes the liquid form and returns through a small tube to the refrigerator, in order to be there again changed into gas.

This process is continued with the use of the same ether as long as the machine is kept working. The great cold produced in the cooling vessel acts on the fresh water to be frozen in the ice box by means of a current of salt water introduced into the tubes which pass through. The temperature of the salt water decreases quickly on its way through the refrigerator on account of heat being absorbed from it by the ether changing into gas, and it then circulates, with a temperature considerably below the freezing point in the ice box, round a number of iron or copper vessels filled with the fresh water to be frozen into ice. The salt water, the temperature of which increases again by coming into contact with the vessels containing the fresh water, is taken back to the refrigerator, where its temperature is again reduced. The process of freezing is thus uniform, self-regulating, and uninterrupted, until the fresh water has been changed into ice. The latter is then removed, and the vessels are filled again with fresh water, and are again exposed to the cooling of the brire current. These machines of Messrs. Siebe and West's are now constructed like horizontal steam engines; they are exceedingly simple and compact, and have a steam engine attached, or may be worked from an existing shaft. The ice is made in single cakes, weighing between 8 pounds and 100 pounds, according to the size of the machine. If these cakes are placed one upon the other, they freeze together, so that blocks of any size may be formed. It is stated by Messrs. Siebe and West that they can produce from 10 pounds to 30 pounds of ice with their machines for two cents, and that one pound of coal produces between 3 pounds and 10 pounds of ice. The time taken in removing the ice and refilling the freezing vessels for the next operation occupies from 30 to 60 minutes. Messrs. Siebe and West state further that a temperature of 50 degrees below zero Fah. has been obtained with this apparatus, and that from 50,000 to 500,000 cubic feet of air may be cooled per hour to 30 degrees Fah., or a smaller body of air to a lower temperature. The ice made by this machine at the Vienna Exposition was beautifully clear and 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, $2\frac{3}{8}$ inches thick, $7\frac{1}{4}$ inches wide, and $29\frac{1}{2}$ 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 $\frac{5}{8}$ of an inch in diameter, all made solid together. The perpendicular pressure was 196 feet; the bore of the nozzles used varied from $1\frac{1}{2}$ 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 $1\frac{3}{4}$ 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.