"The gage of English railways is four feet, eight and one half inches, and while cars on American roads have a projection of over a foot on each side beyond the track, the English cars project only from six to eight inches, not measuring the plank step on each side, extending along the car outside, on which the guard or conductor passes the entire length of the train when necessary, while it is in motion.

"The English cars are much lighter in structure than ours, and by their momentum when in motion have less force against the control of the train by the engineer. It will be seen that these cars have no front or rear platform, but are kept apart from each other by spiral-spring railroad buffers. These consist of a turned iron bolt, about 2½ inches in diameter, around which is a coiled steel spring. The bolts and the coiled spring around them are inserted in a socket a foot to a foot and a half at each end of the lower side timbers of the cars, making four buffers to each car, projecting some six or eight inches beyond their sockets in the end of the timbers, and presenting a disk in the form of a bolt head toward the next car in the train some eight inches in diameter, with a wood face sunk in a circular case of iron. As the train slackens speed these disks come in contact and force back the bolts bearing them into their sockets, compressing the spiral springs surrounding the bolts within their sockets and so relieving, to a considerable extent, the force of the concussion. The lightness of the cars produces much less force in the concussion, even when the train slackens from a high rate of speed, than do the heavy cars on our roads.

"The trains have a single screw brake, operated by one brakeman inside a compartment of one of the cars fitted for the purpose. The brake is controlled by an effective power of a screw and leverage combination that answers quickly and effectively the movements of the machine. In this way two brakeman to a train, or one if the route to be run is short, do the work of from three to half a dozen, on our express trains. The conductor or guard, as he is called, has his seat in the rear car, with a compartment sometimes elevated a foot or so above the top of the train, so that he can see the entire length of the train and direct the engineer in any exigency. This is done not by a rope and bell, as with us, but the guard has a shrill metal whistle, whose various sounds are well understood between himself and the engineer.

"Most American travelers have a dread of danger by fire or otherwise, while traveling on such trains, without means of communicating with the engineer or guard. They have a kind of notion that if a kerosene lamp, which is usually let down in the top of the carriage, to light them by night or through tunnels, should explode, they would be considerably suffocated or scorched before communication could be had to stop the trains and facilitate their escape. On the trains from London to distant principal towns, a second guard, who has charge of the baggage, usually goes through. His office answers to that of baggage master with us; though he is of the same grade and authority in running trains as the captain of the train, in case it is put into his hands or the captain should be sick. Hence, the long-travel English trains have two competent guards or conductors, two brakemen, a fireman and engineer, with casual supernumeraries as porters and the like passing over the road. Next to the police, I found the guards on the railways the most obliging men in England. Their responsibility ends with the safe conducting of their train to its destination. They collect no fare by the way, and run their trains by the instructions of the head railway officer of the company in London.

"At the head office, and at the depots along the route, are a class of railway officials called 'booking agents' and porters. Half of these officials either fill sinecures or are employed in red tape details which add nothing to the income of the company. Two ticket agents at depots within our large cities, and the station agent at each intermediate station, are found amply sufficient to conduct the sale of tickets on our most traveled roads. But in Great Britain, first-class, second-class, and third-class tickets must each have a separate agent for their sale at most of the stations, and where night as well as day trains are run, a double number of these officials are usually employed. There are also nearly as many porters as booking agents, thus illustrating the proverb, that 'where the carcass is there will the buzzards be gathered together.'

"The 'luggage vans,' as they are called, are not provided in sufficient size and numbers to accommodate travel on the great thoroughfares, and this custom of loading the tops of the passenger cars has sprung up to meet the exigency. Since I am on the subject of baggage, I may as well note here that all responsibility as to the safe transportation and delivery of baggage by British railroads, is avoided as far as possible. Their system, or rather lack of system, is most villainous. The system of checking baggage, as prevailing in this country and on the continent, is entirely excluded, and the responsibilities of the company are limited by acts of Parliament to the narrowest limits. You may see your baggage put into the 'van,' but what railroad employé knows that it is yours? If a confidence man should turn up at your destination, he might carry off your baggage under claim of ownership, and you have no check by which you can identify your luggage or repel the theft. The English custom in this department seems to make the baggage say to every wander ing loafer, 'come and steal me.'

"The English railways are constructed at a greater expense per mile than those in America. The road beds are better prepared for their superstructures, rails are laid with more uniform and even supports, and the joints of the rails, while sufficient allowance is made for contraction and expansion by heat and cold, are so fished as to present a uniform surface to the wheels of the cars, so that little motion or jolting of the cars is felt by the passengers, and traveling is far less fatiguing than on our roads. On most of the lines the expense of construction is greatly increased by tunnelling and excavations to avoid curves or ascents and descents in the structure. Of course, the tunnels have to be protected by heavy masonry, and the excavations are sloped down from the surface of the ground at an angle of some 45 degrees, the slope being neatly sodded or cultivated with grass, flowers or grain, by the station men along the road. Then the stations are stone structures, erected at great expense; in many instances far beyond the necessities of the business of the roads. Every crossing of the track by highways is either tunneled under the road or bridged over it, as we stated, and at all stations are foot bridges over the road, which passengers and others who have occasion to cross the track must take, as it is a misdemeanor to cross the track otherwise, except by the employés of the road.

"The speed on English railroads varies from twenty to fifty miles an hour, according to the condition of different roads and the exigencies affecting the business interests. On the whole, their speed is about one third greater than that of trains on our own roads.

"I have stated that the rolling stock is much lighter than ours; and ordinary freight cars are limited to five tuns burthen by law, or by a legal inspection required by statute. They are mostly flats, relying upon tarpaulin coverings to protect the goods transported from wet weather.

"The fares on these railways are nearly double the fares on our own. The cost of transportation is considerably increased by the English system of caste or classes of passengers. They must go prepared to carry first, second and third-class passengers, while however over-crowded the cars of some of these classes may be, no one must set foot in the car of another class, though half a dozen cars of such class may be running vacant over the road. Hence the transportation of vacant cars is a wasting expense to almost every train run. This division of classes in passengers renders a much larger number of trains each day necessary to do the business of the road. No less than five trains stopped at Stafford on their way to Rugby and London. All were to pass over the same road within an hour of time from the earliest to the latest of the five. If there had been no classes with the passengers, three of these trains would have accommodated all the passengers, and the expense of running two of them would have been saved."

Omnibus Subways.

Mr. Peter Barlow has published the prospectus of a scheme which, if we could take his word for it, would revolutionize railway engineering—dispensing with steam, and, indeed, nearly all other power, and reducing wear and tear to almost next to nothing. He proposes to drive a system of tubular subways under London—first of all under the Thames, near the Tower, and to work carriages through them, each weighing two tuns, loaded, and containing twelve passengers, the motive power to be that of *one man!* Mr. Barlow estimates the friction of his omnibus, running on a very accurately laid railway, as four pound only per tun, and the resistance of the air at two pound more, or six pound per tun in all, or twelve pound only for the loaded carriage! He proposes to make the quarter-mile run of the Tower subway in 2½ minutes, or at the rate of six miles only an hour. With "two and half men," however, which means, we suppose, two men and a boy, the run can, he says, be made in one minute, or at the rate of fifteen miles an hour, which is more like what the public would require.

Of course, if safe railway carriages can be made to weigh no more than the weight of the passengers carried—the present ratio being as from three to five tuns of carriage to one tun of passengers, and if the resistance to motion may be diminished to but from four pounds to six pounds per tun, Mr. Barlow's scheme may answer; but so, of course, a reform could be made in all our ordinary railways, which would save something like eight millions yearly in their working expenses, equal to 2 per cent additional dividend upon the £400,000,000 invested in British railways.

Mr. Barlow proposes to drive his cast-iron tubes horizontally through the soil by means of powerful hydraulic pressure; and between stopping-places (for he dispenses with stations) he proposes to let the line descend for half way, and then rise again, so as to help the carriage off on starting, and help also to bring it up without brakes in stopping. The passengers are to be lowered to and lifted from the tubes by hydraulic lifts.

The plan reminds us somewhat of the proposition printed a few years ago by a shareholder in the Great Western Company, who insisted that the trains on the branches of the company's lines might be worked each by a horse, mounted on an endless railway in the guard's van, and who would thus work the train at ten miles an hour, while, "if whipped up," the poor brute would "easily" do twenty!—*Engineering.*

NEW LETTER ENVELOPE.—An English patent has been granted for an improved adhesive envelope named the Camden Envelope. The gum is placed upon the lower fold instead of the flap, so that the tongue comes in contact with clean paper when the flap is wetted to secure the envelope. The general form of the envelope is admirably adapted for the protection of the contents. Those who write many letters will appreciate an invention which does away with the disagreeable task of licking a gummed surface.

A FLOURISHING VINE.—In Santa Barbara, California, is a grape vine planted forty years ago, and which now measures, at four feet from the ground, three feet around it. At the hight of six feet it branches out, and the branches, which are supported by scaffoldings, spread over an area of from 1,000 to 1,200 feet. The annual crop from this vine averages four tuns, and has at some seasons exceeded 12,000 pounds.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

For the Scientific American.

ON SNOW, RAIN, AND HAIL, IN THEIR RELATIONS TO THE ATMOSPHERE.

The condensed moisture of the air is never pure water (H O) alone, as it is generally supposed, it even presents in its composition the same if not a greater variety than the springs flowing from the interior of the earth. This is easily understood when we consider that the elastic fluid which envelops the earth in an aerial ocean is not simply a mixture of nitrogen and oxygen and a small amount of carbonic acid, but also contains though in small quantities, a great many other substances, which are readily absorbed by the descending precipitates, and as the atmosphere itself is modified in its condition according to adjacent circumstances, so also the condensed moisture, which we perceive in the form of snow, rain, or hail. Though the amount of foreign substances in the air may often almost be infinitesimal, they are not always to be considered as altogether insignificant.

Nitrogen and oxygen are not met with in the same proportions in the many forms which moisture assumes, there being about one-fifth less of the former, one-third more of the latter, with still a greater proportion of carbonic acid contained in them as contrasted with dry atmospheric air.

The combustion of fuel and the continual cremecaresis (slow decay) of organic matter occurring on the surface of the globe is the origin of the presence of ammonia in atmospheric moisture. It is met with in both the free and combined state, in the latter with nitric or carbonic acid. Nitric acid is known to be formed by electrical discharges, the nitrogen of the air combining directly with its oxygen. Nitrate of ammonia is therefore constantly to be met with in rain during and after thunder storms. Boussingault even claims to have found it always in the rain, though in very minute quantities. Its amount is, however, almost always not observable a very great time after the storm has ceased, but the converse has been found to be true of a fine shower.

In snow and hail more ammonia is present than in rain, probably owing to the greater cold in which they are formed, ammonia being more readily absorbed by cold than by heat. Rain falling after a dry season abounds with ammonia, often containing six milligrams to the liter (1 milligram=0·0154 grains; 1 liter=1·0567 wine measures), this not being the case with the rain of a rainy period. Nitric acid is, as we have mentioned already, found in combination with ammonia, but only in its free state, during heavy thunder storms, when the rain will sometimes redden blue litmus paper. The average quantity of nitric acid in rain water is stated to be one-millionth part of its entire bulk. Snow has been found to contain more nitric acid than rain, and hail more than rain.

Traces of sulphuric acid have been discovered in the rain of London and Manchester, and Dr. August Smith is accounting for its presence, which doubtless finds its explanation in the sulphurous vapors produced by the combustion of coal, with the rapid disintegration of buildings in those cities. Sulphuric acid has been detected in larger proportions in the rain of Manchester than in that of London; though London is the greatest city of the world, Manchester is the largest manufacturing town and the center of a manufacturing district comprehending many hundred square miles; hence we must not be surprised to find the products of combustion existing in a larger proportion in the latter than in the former city.

The atmospheric air is also most generally impregnated with the saline products arising from sea water. Near the coast salt is found to be present in rain water to the amount of seven parts to the million, but less then half that proportion some hundred miles in the interior. The French chemist, Barral, calculates that near Paris forty pounds of salt are yearly descending in the rain on one hectare of land (1 hectare =2·471 acres), and according to Chatin the rain water in Paris during the prevalence of westerly gales is even more impregnated with salt than is the water of the Seine. Snow and hail always contain less salt, as they are formed in more elevated regions.

Chatin also holds that iodine is present in all atmospheric precipitates, which assertion, however, is contradicted by most investigators, they attributing its supposed presence to the impure reagents employed in its detection.

Sulphuretic hydrogen has been observed in the atmospheric precipitates of some parts of the western coast of Africa, where the rivers which empty into the sea abound in decaying organic matter, and phosphoric acid has been detected by Wiegmann in noxious fogs and mists.

Organic substances of an unknown nature are often found in atmospheric precipitates, but Boussingault claims to have discovered marsh gas in the rain of miasmatic sections to the amount of 0·0017 per cent, and Ehrenberg describes the inky rain falling on the 14th of April, 1849, in Ireland over an area of 700 English square miles as putrescent vegetable organism, probably brought there by passing winds.

Non-volatile substances, as meteoric, volcanic, and ordinary dust have often been found in rain, snow, and hail, but they are not of general occurrence. "Photo-chemical analysis," that recent and wonderful discovery, will surely reveal to us many other natural wonders occurring in atmospheric air.

The Hoosac Tunnel Drills.

MESSRS. EDITORS:—I noticed in your paper a short time ago a short account of the Hoosac Tunnel and drills, and credited them to Mr. Burleigh, of Fitchburg. I would merely say that I am the original inventor of the Hoosac Tunnel

Drill that they are now using. I obtained my patent in 1851 and showed a working machine to a number of the legislators at that time. They thought favorably of it, but were too skeptical. I was a number of years ahead of the times. If they had adopted it at that time they would have had a hole through the mountain and trains running a long time ago. I got my patent extended. and have since sold out to Mr. Burleigh, who had taken out a patent which he thought was an improvement. But the drills are made now substantially as I made mine over seventeen years ago. The main idea was using the direct action of the steam or air in a direct line with the drill, so that I could drill horizontally or at any angle up or down, as wanted. Mr. Burleigh, of Fitchburg, now holds the patent, and the machines are made by the Putnam Machine Company, of which he is one of the partners and superintendent, I believe. JAS. W. FOWLE.

Boston, Mass.

Replies to Questions on the Day Line.

MESSRS. EDITORS :—On page 387, Vol. XVII. of your valuable paper will be found several questions relative to the day line, which are asked by Mr. Lyman Thayer, of Burlington, Vt.; I suppose for the purpose of bringing out the thoughts of its readers on this interesting question. I think I can solve these questions to the satisfaction of all.

If a man start from New York on Monday noon, and goes west, keeping pace with the sun, he would pass from Monday to Tuesday, when he crossed the day line, which I have taken as the 180th meridian.

If the 180th meridian be taken as the day line, it is 12 minutes of 1 o'clock on Tuesday morning at Pekin, China, when it is noon at New York.

When it is Monday noon at New York, the same day (Monday) extends just 180° east of New York, or about to the 105th degree of east longitude, reckoning from Greenwich, at which point (105° E.) it is just midnight. And the same day of the week will extend west of New York to the 180th meridian, to the east of which line it is a small fraction after 5 o'clock on *Monday morning*, while on the west side it is 5 o'clock *Tuesday morning* ; thus making about 24 hours difference in time between the two sides of the day line.

To the question whether there is a point of time in the revolution of the globe when it is Monday, for example. on the entire globe, I would reply that there is such a point of time, but so inconceivably short that it is totally inappreciable to our senses, but for all practical purposes such a point of time may be considered to exist, and just 12 hours from this time it is Monday on one half of the globe while it is Tuesday on the other.

In regard to the day line itself, I cannot think such a line does really exist ; but for this very reason it becomes more important to define such a line by legislation ; and the one which answers the purpose best, I think, is the 180th meridian from Greenwich. If reference be made to a map of the world it will be seen that the only land through which this meridian passes, is the extreme eastern part of Siberia, where it would not much interfere with the day question. Another reason is that if this meridian (180th) be taken to represent 12 o'clock midnight, it brings the meridian of Greenwich at 12 o'clock noon, which is the most convenient starting point in applying the device, seen on page 324, Vol. XVII. of this paper, to all maps, as there briefly hinted at.

Much more could be said on this subject, but I will not occupy your valuable time and space.

W. R. SHELMIRE.

Philadelphia, Pa.

Heat Without Coal---Utilization of Wind Power.

MESSRS. EDITORS :—Looking forward to the exhaustion of the fossil fuel which nature affords us in the coal fields, economists have speculated on the possible discovery of some method of producing heat independent of coal, and the decomposition of water has been regarded as a probable expedient. With our present knowledge and appliances it appears not to be difficult to realize this proposition, even in competition with coal, at least in a small way. The agents are obvious, wind-power, a magneto-electric machine, oxygen and hydrogen gas holders, and the electrolysis of water. The products of combustion being only water, they could be burned for room warming without a chimney.

For use in the arts the oxy-hydrogen furnace would of course offer advantages far above any other known, and results could be reached impossible with the lower temperature of the coal fire, while the flame would be free from deleterious substances common to coal.

Owing to its gaseous form and the intensity of its heat this fuel would be manageable in many ways impracticable with coal. For instance seams could be hard-soldered with great rapidity with the jet of the compound blow-pipe, and it is probable that the joints of steam boilers could be heated for welding in a suitable oxy-hydrogen jet.

Newark, N. J. H. W. POND.

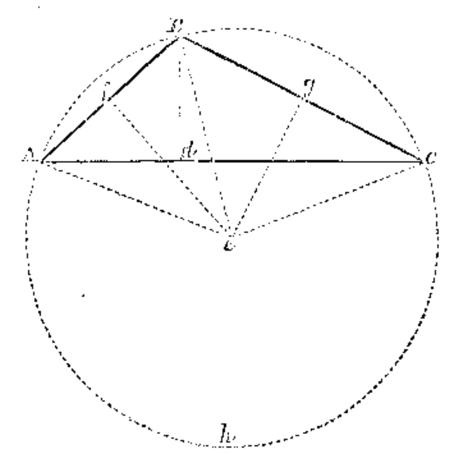
The Cold Cave at Decorah.

MESSRS. EDITORS :—There is at the village of Decorah, near the northern boundary of the State of Iowa, a cave where the operations of nature are reversed. In this cave it is cold in summer and warm in winter. The ice begins to form the fore part of June and disappears again the latter part of August, the coldest period being about the middle of July. On the fourth day of July icicles may be found from six to eight inches in diameter and from four to eight feet long, affording fine sport for the boys who take them into the market for sale. In this cave no ice is found nor sun from September to June, but June, July, and August it is extremely cold so that a man can only stay in it a few minutes. This cave has been known about twenty years and the above facts appear every year. Thousands of people have been into this cave to see icicles in summer. I wish some one would give an explanation of this strange phenomenon through your journal. O.

Hardin, Iowa.

Solution of Plane Triangles.

MESSRS. EDITORS :—Herewith I send you a geometrical problem illustrated by diagram, which has probably never before been in print. In beauty and utility I believe it stands next to the 47th problem of Euclid, which is, that the square of the hypothenuse is equal to the sum of the other two sides. Having this handed down as a text, it was supposed that the same solution might be applied to any triangle. This may be done by letting fall a line from the apex of the angle, opposite the longest side of any triangle, cutting said side or base at right angles, as seen in the figure ; the close



line, A B C, represent the sides given, and the broken lines represent the lines required.

To find A d and C d:

$$\frac{AB^2+AC^2-BC^2}{2AC}=Ad \qquad \frac{BC^2+AC^2-AB^2}{2AC}=Cd$$

$$BC^2-Cd^2=Bd \qquad AB^2-Ad^2=Bd.$$

$$Af : Ae :: Bd : BC.$$

$$Bg : Be :: Bd : AB, \text{etc.}$$

$2Ae\times 3{\cdot}14159+$ equal the circle cutting each angle of the triangle.

Let AC=10, AB=5, and BC=7. Then

$$\frac{10^2-5^2+7^2}{2\times 10}=6{\cdot}2=Cd \qquad \frac{10^2-7^2+5^2}{2\times 10}=\frac{3{\cdot}8=Ad}{10{\cdot}=AC}$$

I have sought for this solution for some fifteen or twenty years, and think that in all probability it will be, sooner or later, introduced into the common school arithmetic. It will be observed in the solution above given that it is necessary to assume the longest side of the triangle for the base. In short the beauty of the problem lies in the discovery of letting fall from the apex of any triangle upon its base a line at right angles with the base, when the base is the longest side of such triangle, and which unlocks all its intricacies to the simplest rules of arithmetic. JUSTUS F. HOYT.

New Canaan, Conn.

Removal of Obstructions in the Mississippi at Rock Island.

MESSRS. EDITORS :—I have seen a report of the wonderful performances of the "chisel boats" on the upper or Rock Island Rapids of the Mississippi, which is somewhat overdrawn. Perhaps you would like to hear the truth. The Rock Island Rapids have been a very serious obstruction to the navigation of the river in times of low water, being about fifteen miles in length and having a fall of about eighteen or twenty feet. Congress at least once before made an appropriation looking to the improvement of the channel, but the work done did not in the opinion of the pilots render the navigation less dangerous than before. The last Congress appropriated $300,000 for the same purpose, and the United States engineers decided to remove the rocks to the depth of four feet below the low water of 1864, the lowest ever seen by the white residents on the banks of the Upper Mississippi. There are seven reefs to be removed. The contract was awarded to C. G. Case & Co., of New York, who built two "chisel boats," three barges, and other craft, suitable for the work, besides buying a steamer and one of the largest and best dredges in the West.

The chisels are raised and allowed to fall like a spile driver, and are made to fall about six times in a minute from a hight of twelve feet. They are cold chisels, pointed, and weigh 6,000 pounds each. They sometimes penetrate the rock to the depth of six inches the first fall, and sometimes drop three or four times without effecting anything ; but altogether they are successful. The rock has no stratification, and yields reluctantly to the hardest blows.

The company have also coffered a space of 450 by 250 feet, and are blasting out the contained rock to the depth mentioned before, which will require the removal of 7,000 cubic yards. I send you by express an oyster can full of the most characteristic specimens I could procure. The work is more than half done on this chain (Duck Creek), and the weather all that could be desired. There has been no day in four months that could prevent men from work, and if my memory is right not a drop of rain has fallen here in that time.

THOS. DOUGHTY.

[The samples sent are limestone containing crystals of metallic sulphurets. The rock is favorable to the success of the chiseling process.—EDS.

Momentum and Inertia.

MESSRS. EDITORS :—I venture to offer an answer to that supposed paradox presented under the above title, on page 310, Vol. XVII.

There is no substance in the world so hard as not to yield at the point of contact when two such bodies should meet, as supposed in the problem. Admitting this, it contains nothing impossible or unnatural. The small body comes gradually to a rest, and is then gradually set in motion in the opposite direction, while the larger body continues to move, and loses only a part of its velocity. Within the small interval of time that this occurs, the two bodies come nearer together, while their surfaces yield at the point of contact.

The question is to be decided upon some other point, viz.: What is elasticity, and what makes a body non-elastic?

For example, a piece of lead is non-elastic, why? Suppose it strikes against some hard obstacle, by which it is brought suddenly to a dead rest. While the lead was in motion it carried a certain momentum, or, in other words, a certain amount of native power, and which I call simply "force." This force cannot be lost or annihilated, it can only be consumed by producing mechanical work or effect, for which a reasonable account can be given. What has become of this force, or of the momentum of the lead? This force was consumed by the friction of the molecules of the lead, while it was flattened or split in fragments, or otherwise changed in its shape.

If we take a piece of hard steel, as for example a small hammer, and strike against a heavy anvil of equal hardness, the hammer will be thrown back, why? Because neither of these bodies suffered any lasting indentation, because no mechanical effect has been produced which would consume the force of the blow ; consequently this force is returned, and throws the hammer back. This is elasticity.

Glass is elastic to a certain limit. When the force of the blow exceeds this limit, the excess of the force, which is not taken up by elasticity, will break the glass, in consequence of which the force will be consumed and not returned. A piece of pumice, burned clay, or charcoal, is non-elastic, because the force of the blow is consumed by breakage of some minute parts of such a porous and fragile substance,

This may suffice to show that elasticity is nothing else but the manifestation of one of the most important laws of mechanics, the preservation of force, and that if really any perfectly hard and non-elastic substance should exist, the slightest blow must cause some breakage, as may be inferred from the above example of glass. And from this it will be seen, more clearly, that the above problem supposes an impossibility in the premises, since the momentum or the force of the small body cannot be annihilated instantaneously, but can only be consumed by producing some mechanical effect, in consequence of which the surfaces of the two bodies must yield in some way at the point of contact, at least by breakage, if not otherwise. J. G. KONVALINKA.

Astoria, L. I.

Aluminum for Mathematical Instruments.---Folding Machine.

MESSRS. EDITORS ;—On page 292, Vol. XVII., I notice an interesting article on " Aluminum, its properties and uses." I am a civil engineer and surveyor, and would like to suggest, through the columns of your highly valuable journal, the advantages of the use of aluminum for the construction of civil engineering and surveying instruments. Accuracy, strength, and lightness are the requisites of a good instrument, the last quality having to give way to the two first, in the construction from the material now used. To illustrate my idea, I will take for an example one of Gurley's solar telescope compasses, with adjusting socket, which weighs 12 lbs.; if constructed of aluminum, with the same sized parts, it would weigh about 3 lbs. ; and if the metal is as strong and rigid as it is represented, the thickness could be reduced at least one-fourth, which would make the weight only 2 lbs. 4 oz. I have been informed that aluminum could be obtained in large quantities at from $6 to $8 per lb. (I do not know whether by troy or avoirdupois weight); but say that it is worth $1 per oz. avoirdupois, then the material for the instrument would cost only $36 (I make no allowance for filing and chips, as they could be saved the same as in working gold, and the weight of the glass would compensate for the unavoidable losses in working), from which take the cost of the metal now used, say $4, and it leaves only $32 as the extra cost of an aluminum instrument. Of course, if the metal can be obtained at 50 cts. per oz., the extra cost would only be $14. Now, gentleman, I do not think there is one engineer or surveyor in fifty, who would not pay even $50 extra, for an instrument that weighed only about 2¼ lbs., instead of 12 or 14. I think that manufacturers of mathematical instruments would find it profitable to turn their attention to the subject ; the first one who does, and lets me know through your columns, will get one order, sure, from the Rocky Mountains.

It would be very interesting to me, and, judging by myself, I think to the majority of your readers, if you could compile an account of the different processes now known and used for the reduction of the metal from its ores. The ores of aluminum are the most common of any known metal, not even excepting iron, and I beg leave to predict that as we now live in an iron age, so will those who live twenty or perhaps many less years hence, live in an aluminum age. As soon as the right process for the reduction of the metal from its ores is discovered, then we will see an entire revolution in mechanics and civilization, which is now beyond the comprehension of ordinary mortals. Speeds in traveling will be attained which, if told of at present, would appear wild and chimerical ; ship building and warfare will be revolutionized ; pneumatic railways will be common ; the problem of navigating the air will be solved; velocipedes and steam carriages for common roads will be as common as horse conveyances are at present; grades can be established on railways that are now perfectly impractical, and other improvements made in mechanics and engineering that are not now imagined by the most far-seeing thinker. For in the metal aluminum we have combined the maximum of strength and durability with the maximum of weight. The day is not distant when some person will discover the right process. Many more wonderful, and seemingly more difficult processes, have been brought to light in the past few years. Now, in order to give the inventive public (who all take the SCIENTIFIC AMERICAN, or ought to) a cue to the future process, please give them all the information you can in reference to the subject, and let them go to work, and they will soon ferret out the simple process needed.

I believe you like to have hints thrown out to inventors, so while I am in that line of business allow me to suggest that some inventor get up a machine to fold quarto and octavo papers; for instance, the SCIENTIFIC AMERICAN comes to me sometimes terribly askew. I am always too anxious to read it to take time to refold it and straighten out the creases before cutting, and therefore spoil the paper for the binder, and sometimes even cut the reading matter. I think you will bear me out in my assertion that some sure and easy way of accurate folding is a desideratum to both the publishers and readers of newspapers of a "several-fold-up" form.

Please hurry up your prospectus. Our club was euchred out of six numbers of the SCIENTIFIC AMERICAN by being so far away that we were not in time, and we cannot afford it again; besides, the "Noble Red Man" was in quest of science, and overhauled the mails, depriving us of eight or ten more copies. The SCIENTIFIC AMERICAN is just as welcome a visitor out here in the Rocky Mountains as it was back in "America." Our prayers are for our weekly SCIENTIFIC AMERIFAN," as well as for our "daily grub." "ALUMINIST."

Helena, Montana.

[Aluminum is prepared from cryolite, a compound of sodium, fluorine, and aluminum, procured mainly in Greenland. It is mixed with common salt and sodium, in the proportion of about 270 parts by weight of cryolite, 150 of salt, and 72 of sodium, and melted in a crucible. No feasible and cheap method of reducing the metal from ordinary clay has yet been discovered.

Folding machines for newspapers are in common use, but as a general thing they do not equal, in exactness of work, hand labor.—EDS.]

Extermination of Cockroaches.

MESSRS. EDITORS:—We have been greatly troubled for two or three years by roaches, the real, big, black fellows. By continued exertion we confined them to the vicinity of the furnace and range, but to exterminate them all sorts of traps and exterminators proved ineffectual. Somebody told us of Paris green, and it has done the work. We feel so rejoiced that we desire to give the knowledge to the public. Paris green can be procured at any apothecary store. Just sprinkle it round where "they most do congregate."

B. F. BURGESS, JR.

Boston, Mass.

NAPHTHALIN AND ITS USE.

Naphthalin was discovered in 1820, by Garden, among the products of distillation of coal, and has since been the subject of thorough investigations of Faraday, Liebig, Woehler and many other chemists. Laurent occupied himself especially with its derivates, and founded thereupon his new theory of organic compounds. Up to the present time naphthalin only was of scientific interest, and of a very limited practical use, when in 1860 Roussin, a French chemist, by his repeated experiments at once drew the attention of the scientific world to this hitherto so-considered worthless substance. He succeeded, namely, in producing a dye-stuff from it which he considered the *alizarine* of the madder, but which, though identical in its chemical composition with the natural *alizarine*, has subsequently been found to be very dissimilar to it. It therefore became suddenly lowered in the estimation of those whose interest was connected with it, and was subsequently looked upon as being as worthless as before, the more as other coloring matters which had been prepared from the same substance met with the same fate. Quite recently, however, European investigators have succeeded in producing benzoic acid from this hydrocarbon, a substance largely used in the preparation of tobacco sauces, in calico printing, in the manufacture of aniline blue and benzol, respectively nitrobenzol and aniline; and it is therefore that I call attention to this subject. I first will describe the

PREPARATION OF NAPHTHALIN.

Although this hydrocarbon (its formula is C_{20}, H_8) is a product of the distillation of coal, it does not pre-exist in them, as is the case with paraffin. [I have, in the laboratory of Prof. Bolley, in Züric, extracted small quantities of paraffin from boghead coal. The coal was previously pulverized very finely, and the extraction was performed by cold ether.] It is only generated at a high heat, such as that of the retorts in gas works when in full operation. In the manufacture of gas comparatively large quantities of tar are obtained, the conversion of which into permanent gas has puzzled the ingenuity of inventors since the first introduction of gas illumination on a large scale, and still remains an unsolved if not an insoluble problem. In distilling this tar, and in only gathering those portions which run over between 400° and 500° F., we get the so-called "pitch or dead oil," which is employed for the extraction of napthalin. The residue remaining in the still is the substance into which the blocks of Nicholson's pavement are dipped, previous to their being inserted in the street.

According to a paper recently published by Dr. Vohl, the pitch oil should be put in vats and left in a cool cellar from six to eight days, after which time most of the napthalin will have crystallized out. The latter is then filtered from the liquid portions and transferred into a centrifuge, for the purpose of separating it from the adhering oil, but as this cannot be arrived at at once, the crude naphthalin is then subjected to hydrostatic pressure, commencing with a light pressure and increasing gradually until completed.

The pressed mass is then put into an iron vessel, which is heated by steam; in order to take up the creosote, the phenylic acid and other impurities, it is first melted with a small percentage of caustic lye, and stirred well; after a while the lye is drawn off, the same process being then repeated. After this the napthalin is washed with boiling water, then it is treated with oil of vitriol of 45° Baumé, and finally mingled again with lye and left at 212° F. for three hours.

The naphthalin being thus treated is poured into a cast iron still, which can be heated on an open fire. It commences to flow over at 410° F., in a thick stream, and in twenty minutes generally 20 to 25 per cent of napthalin may be obtained. The water of the condensing tank must be kept at 170° F., the receiver being also kept in water of this temperature. When the latter reaches 450° the distillation is fractioned, as then an oily yellow product is obtained. Finally the liquid and purified distillate is run into conical cylinders of glass, metal or moistened wood, in which it solidifies rapidly, and in contracting separates from the sides. It is thereby obtained in sticks, like solid brimstone.

PROPERTIES OF NAPHTHALIN.

The naphthalin thus obtained is of great beauty. It forms brilliant, white, crystalline sticks, in which the interstices and crystalline vegetations have the appearance of spirals. Its specific weight is 1.151 73, its melting point 174°, and its boiling point 452°. The following new properties are added to the already known ones by Dr. Vohl, in Cologne. When a naphthalin stick is rubbed with a silk cloth it gets strongly negative electric. Melted naphthalin absorbs a great amount of atmospheric air, which it gives off in cooling. When put in quantities of from one to two pounds the expulsion of the air is so turbulent at this stage that the liquid appears to be boiling. The air absorbed by melted naphthalin is abounding in oxygen; perhaps it is pure oxygen. This phenomenon has therefore a great similarity with the peculiar movement taking place in the cooling of silver, and called "spratzen," in German. Melted naphthalin dissolves indigo with great ease, forming a dark-blue violet liquid, from which, in cooling, the indigo separates again, in brilliant copper-like needles. The sulphurets of arsenic, tin and antimony are taken up abundantly in their amorphous state, in cooling they separate in crystals. Phosphorus and sulphur are also solved rapidly by liquid napthalin.

TEST FOR NAPHTHALIN.

To detect this hydrocarbon in a product of distillation, the latter is, according to the writer of this, treated with fuming nitric acid, in order to transform the napthalin into its nitro-compound; this being insoluble in and lighter than water, it will rise to the top. It is then gathered and converted into naphthylamin, by any known method. The best is that of Béchamp, who uses iron filings and acetic acid. In adding chloride of iron to an alcoholic solution of the naphthylamin a deep blue color will be produced.

ITS TRANSFORMATION INTO BENZOIC ACID.

The first step in the two or three processes known, is the production of naphthalic acid, a body of the chemical formula C_{16}, H_4, O_6. While, however, the brothers Depouilly, in Paris, directly convert the latter into benzoete of lime, separating therefrom the benzoic acid, Laurent and Casthelay change the naphthalic acid successively into phtalamid, benzonitoil and benzoate of soda, a process lately fully described by me in one of the meetings of the New York Polytechnic Association. The method recommended now by high scientific authorities is a combination of a French and German one, namely, of

a. The process of Dr. Vohl for the preparation of naphthalic acid, and

b. That of the brothers Depouilly, as indicated.

Naphthalic Acid.—While hitherto naphthalic acid was obtained by a very tedious way of preparation, which was not only injurious by the highly irritating gases escaping, but also yielded a small percentage, it may now conveniently and cheaply be produced by the process invented by Dr. Vohl. According to the same, 12 parts of naphthalin are dissolved in 109 parts of concentrated oil of vitriol, and to this 89 parts of finely pulverized bichromate of potassa are gradually added. The reaction ensuing being over, the product is solved in boiling water, and the liquor thus obtained is oversaturated with carbonate of soda; it is then left to settle for a quarter of an hour. By filtration, a rich orange-colored liquid is obtained, which, in evaporating on the water bath, yields the naphthalic acid.

Benzoic Acid from Naphthalic Acid.—This process is based upon the fact that naphthalic acid in presence of a surplus of an alkaline base (lime), and at a temperature of 625° to 660° F., is changed into benzoic acid. The process, however, has to be performed in vacuum.

The brothers Depouilly indicate the reaction taking place as follows:

Naphthalate of lime=C_{16}, H_4, O_6+2 Ca, O, and hydrate of lime=Ca, O, H, O, yield in heating to the above temperature.

Benzoate of lime=C_{14}, H_5, O_3+Ca, O, and carbonate of lime=2 (Ca O, C O_2).

As seen from this equation, decomposition of water and formation of carbonic acid is taking place. As the success of this operation, however, is often depending upon mere chance, it requires great skill and practice. From the benzoate of lime, the benzoic acid is separated by hydrochloric acid. In distilling the naphthalate of lime in presence of lime, *benzol* is formed, an operation which is nearly always of success.

NAPHTHYLCARMIN.

If the orange-colored liquor, containing the naphthalic acid—vide above—is oversaturated either by hydrochloric or sulphuric acid a precipitate in floes of a most beautiful carmoisin red is obtained. The same is undoubtedly identical with the *carminnaphte* of Laurent, which this investigator obtained once in heating naphthalin with bichromate of potassa and sulphuric acid, but could not produce again at any subsequent trial. This substance combines readily with alkalies, yielding yellowish-red lacs, and dyes silk and woolen without mordants, either orange or violet red. It is soluble in acetic acid and alcohol, and is precipitated again from its compounds by mineral acids.

On the Formation of the Diamond.

Researches on this subject have lately been made by Messrs. Goeppert and D. Brewster. The black diamond of Bahia is, according to Mr. Goeppert, a mixture of amorphous carbon and diamond. M. Liebig's experiments on its combustion also agree with this statement. It often happens that the diamond incloses other crystals; iron pyrites, particularly, have been noticed in it by Mr. Hartwig. Sir David Brewster calls attention to the microscopic cavities existing in this as well as in other gems, as in the topaz and emerald. These cavities are found to be often very numerous in certain dark diamonds, they thus dispersing the rays of the light, are therefore of no value in jewelry. Mr. Goeppert remarks that the diamond must originally have possessed a certain plasticity; we notice, in fact, in a diamond belonging to the emperor of Brazil, the impression yet of a sand grain. The black as well as the crystallized white ones bear also the signs of analogous impressions produced by foreign bodies. Some investigators believe to have recognized the cellular tissue of plants in the ashes resulting from the combustion of this gem. Mr. Goeppert, however, has not yet detected with certainty any traces of organization, neither in the diamond nor in its amorphous form, the plumbago. As to the question so often discussed, whether the diamond be formed by platonic or neptunic action, the latter naturalist is of the opinion that the first hypothesis is scarcely admissable, the experiments of Depietz having shown that the diamond is changed into a kind of coke, whenever exposed to the intense heat of a galvanic battery. The second hypothesis, attributing its formation to neptunic action, is sustained by the authorities of Newton, Brewster, and Liebig, being also that which is best in accordance with all that is known about the gneiss, itacolumite, and the metamorphic rock in which it is found. The character of these rocks, however, do not allow us to attribute to them a plutonic origin.—*Cosmos.*

A Daring Explorer.

At the last meeting of the California Academy of Science, a letter was read from William H. Dall, Chief of the Scientific Corps of the Western Union Telegraph Company, dated at St. Michaels, Alaska Territory, and acknowledging his election as corresponding member of the Academy. When the telegraphic party returned from the wilds of those northern regions, as we noticed in a late issue, this gentleman remained behind to prosecute scientific researches and gather information respecting this country. That the work he has undertaken to perform is no easy one, an extract from his letter will show. He says:

"I have traveled on snow shoes about 400 miles, camping in the open air, with the thermometer from 8° to 40° below zero. I have seen the thermometer down to 68° below zero. In the spring I started from Nulato, on the Yonkon River, where poor Kennicutt died, and paddled up stream 650 miles in an open canoe to Fort Yonkon, being the first American to make the trip, and one of the only four men out of the whole expedition who have been there. We met two adventurers returning from a trip of 600 miles further, and all hands came down together to the sea and round to St. Michael—a nice little trip in an open canoe of 1,300 miles. We had plenty of rain the last part of the journey, and made the trip in 16 days. This is the first trip ever made to the sea from Fort Yonkon direct. I have acquired sufficient knowledge of Russian and one or two Indian dialects to get along very well. I do not like the country. It is full of mosquitoes in spring; the summer is constant rain and fog, and the only pleasant time is the winter, when it is very cold. But in consideration of the work, I can stand it another year."

NEW GALVANIC BATTERY.—We have had in use in our laboratory a most singular looking piece of apparatus, devised by Moses G. Farmer, Esq., the well known electrician of this city. It is a new form of instrument for converting heat into electricity, and most satisfactorily does it perform its work. All that is necessary to put it into active operation is to light a gasjet, and in a few moments the electrical impulses are manifested, and the battery is ready to be set to work. It deposits metals with great facility, and the development of the agent is constant and uniform so long as the heat is supplied. It resembles a "fretted porcupine" as much as anything we can compare it with. The metals employed in its construction are antimony and copper. The strips or arms of copper protrude outward from the bars of antimony, so as to secure the cooling influence of an air current, while the gas is heating the other extremity. A portion of the heat of the flame is transformed over into electricity, thus showing the easy convertibility of one imponderable into another, and the correlation of the forces.—*Boston Journal of Chemistry*