of the iron due to atmospheric influences, come up for debate, and where the strength has been materially lessened, new parts are advised to be inserted. The ties, rails, and guard rails, although not entering into the problem of the safety of the bridge in a direct manner, are, nevertheless, responsible for the care of the trains, and are reported upon.

The piers supporting the bridge, and their foundations, present a more difficult task. If the piers are of iron or masonry, the work is comparatively easy. Undue settlement is readily discernible. In the case of pile foundations, the ravages of worms, being below low water line, are hid from view, and the weight the piles will bear cannot always be accurately found. The removal of one pile or more, and the condition of the remainder reasoned from its condition, is safe within certain limits.

If the exact strength of any member be in doubt, or approach too near the limit of its strength, decision is invariably cast in favor of the traveler, and the member is unhesitatingly condemned. That it will probably stand the strain is of no moment and is not thought of; but that it might possibly give way decides the question of its banishment.

HEATING AND HARDENING OF STEEL.

To understand how to properly harden and temper steel tools and other articles is fully as necessary to the machinist now, when most small tools are kept in stock by dealers, as it was twenty years ago, when each shop made its own tools. Lathe and planer cutters, cold chisels, milling cutters, and several other tools and appliances are liable to breakage, and must be redressed at the anvil, refinished, and rehardened and tempered. But many of these tools are ruined in the attempt, and this destruction usually comes in the hardening.

Some mechanics attach much importance to a hardening pickle, but probably failure comes as often by injury in heating the article as by hardening and tempering. An evenly distributed heat of the proper temperature is absolutely requisite to success, and this it is not always possible to assure by heating in an open fire. One portion of the article is liable to be overheated, while another portion is underheated; judging of the amount of heat by color is not always to be trusted; a dark corner or a cloudy day changes the conditions from a light shop and a sunny day sufficiently to make a great and telling difference in the amount of heat judged by sight.

A perfectly reliable method of heating for hardening is by means of the lead bath. It is an easy matter to keep in the shop a crucible or iron pot of lead to be used as occasion demands. The article to be heated for hardening will not suffer when in the lead bath, even if not closely watched, as is necessary at the open fire; the melted lead cannot pass to a degree of heat injurious to the steel. But one condition must be strictly observed—the lead must be pure and clean; it is best to buy the mercantile pig for this purpose. A manufacturer of pipe threading and pipe cutting tools in a New England city, desiring to abandon his old time open fire method for the lead bath, melted a lot of old lead pipe partially corroded, and mixed with it a quantity of type metal. His hardening was a failure until he used pure lead.

In order to harden well it is necessary to heat the article through and through. If the piece is of unusual thickness, as a tap or reamer of three inches or more in diameter, it is better to drill a hole through it from end to end, so that the heating can be even and the hardening be equal. A tap of four inches diameter broke squarely across in the hardening. It was of solid steel. The drilling of an inch hole from end to end was practiced, and a large number of the same size taps were hardened without a failure. The surfaces of the fracture of the broken tap showed plainly the evidences of unequal heating and uneven cooling.

ASPECTS OF THE PLANETS FOR AUGUST.

NEPTUNE

is morning star, taking the precedence of four other planets playing the same role, for the planetary interest during August centers on the morning sky. Five members of the solar brotherhood make their appearance at the beginning of the month in the following order: Neptune, Saturn, Mars, Jupiter, and Venus. This order of precedence they retain throughout the month. Neptune, if he were near enough, would be seen above the horizon about half past 11 o'clock in the evening. Saturn peers above the eastern hills half an hour after midnight. Mars follows in about twenty minutes. Jupiter rises not far from a quarter after 3 o'clock, and Venus follows half an hour later. Thus at 4 o'clock the planetary quartet may all be seen making their shining way among the stars.

Neptune diversifies his course with an event. On the 14th, at 1 o'clock in the morning, he is in quadrature on the western side of the sun, that is, he has reached the half way house between conjunction and opposition, being 90° from either point. He then rises about midnight, is on the meridian at 6 o'clock in the morning and sets about noonday. The same is true of all the outer planets, their apparent movements being regulated by the same law. Observers who keep the run of their conjunctions, quadratures, and oppositions will find it easy to follow their paths.

The right ascension of Neptune is 3 h. 16 m., his declination is 16° 18′ north, and his diameter is 2·5″.

Neptune rises on the 1st about half past 11 o'clock in the evening; on the 31st, the rises about half past 9 o'clock.

SATURN

is morning star. Though second in the order of rising, he takes the lead in the order of interest during the month, being a beautiful object in the morning sky after midnight, while every successive rising adds to the brilliancy of his appearance, and makes him more conspicuous among his peers.

Saturn is in conjunction with Alpha Tauri on the 13th at 6 o'clock in the morning. This star is better known as Aldebaran, a brilliant red star of the first magnitude. The conjunction is not a close one, Saturn being, when nearest, 3° 40′ north of the star. Planet and star will however be near enough to make a fine exhibition on the celestial canvas as they gradually approach each other, the pale gold of Saturn being in charming contrast with the ruddy hue of Aldebaran. Heavenly bodies are in conjunction when they are in the same right ascension, a term nearly corresponding with terrestrial longitude. At the same time they may be many degrees north or south of each other.

The right ascension of Saturn is 4 h. 25 m., his declination is 19° 49′ north, and his diameter is 16·4″.

Saturn rises on the 1st at half past 12 o'clock in the morning; on the 31st, he rises about half past 10 o'clock in the evening.

MARS

is morning star, and adds to the interest of the month by an incident in his slow and monotonous course. On the 29th, at 5 o'clock in the afternoon, he is in conjunction with Mu Geminorum, a star of the third magnitude in the constellation of the Twins. Mu is very near the ecliptic, or sun's path in the heavens, and near the point the sun touches on the longest day of the year. The conjunction will not be visible, Mars passing at that time 1° 4′ north of the star. But planet and star will be near enough on the morning of the 30th to make it worth while to watch their approach. An opera glass or a small telescope will assist the observation.

The right ascension of Mars is 4 h. 55 m., his declination is 22° 25′, and his diameter is 5·6″.

Mars rises on the 1st about ten minutes before 1 o'clock in the morning; on the 31st, he rises soon after midnight.

JUPITER

is morning star, and before the month closes will outshine every other star in the firmament. He holds his court in the northeast, in the constellation Gemini, a few degrees south of Castor and Pollux; but no observer of the early morning sky will fail to detect him at a glance. He will soon be near enough for telescopic observation. His return to our vicinity will be a boon to astronomers, who hope to find out something about the intense activity that now agitates his surface.

The right ascension of Jupiter is 7 h. 23 m., his declination is 22° 11′ north, and his diameter is 30·6″.

Jupiter rises on the 1st about a quarter after 3 o'clock in the morning; on the 31st, he rises at ten minutes before 2 o'clock.

VENUS

is morning star, and the last on the list to appear above the horizon. She is traveling south at a rapid pace, being nearly ten degrees farther south at the close of the month than at the beginning. Venus is now near Jupiter, but is rapidly retreating from his neighborhood, approaching the sun so closely that at the end of the month she rises less than half an hour before the great orb in whose beams she will soon be hidden from sight. She has fallen from her high estate, but only for a time. Her peerless beauty will not long remain under a cloud.

The right ascension of Venus is 7 h. 49 m., her declination is 21° 36′ north, and her diameter is 10·4″.

Venus rises on the 1st about ten minutes before 4 o'clock in the morning; on the 31st, she rises at 5 o'clock.

MERCURY

is evening star during the month, presenting but one feature of interest. He is in conjunction with Uranus on the 24th at 10 o'clock in the morning, being at that time fifty minutes south. As both planets are invisible, the event will have to be observed in the mind's eye. To those familiar with the movements of the planets, the pictures visible to the eye of fancy are not always less enjoyable than those visible to the natural eye. They also possess this advantage: Neither clouds nor the great sun himself can obscure them. Mercury makes almost a plunge toward the south during August, his declination changing from 19° north at the beginning to nearly 2° south at the close.

The right ascension of Mercury is 8 h. 58 m., his declination is 19° north, and his diameter is 5″.

Mercury sets on the 1st at half past 7 o'clock in the evening; on the 31st, he sets at twenty-two minutes after 7 o'clock.

URANUS

is evening star, and plods on his way uninterrupted, save by his meeting with Mercury.

The right ascension of Uranus is 11 h. 28 m., his declination is 4° 11′ north, and his diameter is 3·5″.

Uranus sets on the 1st about 9 o'clock in the evening; on the 31st, he sets a few minutes after 7 o'clock.

THE MOON.

The August moon fulls on the 18th at a quarter before 8 o'clock in the morning, Washington mean time. The waning moon is in conjunction with Jupiter and Venus on the 1st, and with Jupiter for the second time on the 29th. She is at her nearest point to Mercury on the 3d, and to Uranus on the 6th. On the 24th, she is very near Neptune. On the 25th, she is in close conjunction with Saturn at half past one o'clock in the afternoon, passing 1° 3′ south. In some portions of the globe between 32° and 70° south declination, where the conditions are right for observation, the moon occults Saturn for the fifth time since the year commenced. The moon completes her circuit of the planets by her conjunction with Mars on the 27th.

STORING THE POWER OF THE WIND.

As suggested previously, no method seems within the range of our present knowledge which can enable us to store the energy exerted by wind currents during the very large proportion of time when we have no need of it, and thus make its whole average force available during working hours. This, which is one of the most important desiderata in mechanics, and which is sure eventually to be secured, debars us from the benefits of the full wind power sweeping around us. But it is perhaps worth our while to consider a plan by which a portion of that power can be utilized, and, of course, just so much steam power with its attendant expense saved.

The wind of this and the adjacent regions has, as the records show, an average velocity of 7·7 miles per hour, being 676 feet per minute. At this rate of motion its pressure per square foot is $\frac{52}{100}$ of a pound, and if we could store the power we might safely calculate on that amount. But for our present purpose this is of small avail. A wind wheel of such size as formerly assumed, 12 feet by 8, gives at that pressure an effect of nominally half a horse power, and whatever it gives during working hours we are prepared to turn to account; at other times it must be of no avail.

The manufacturer or other consumer builds as many of these wheels as he deems best; the more of them the better within certain limits. On the assumption of his needing twenty horse power as before, five of them in the fresh breeze of a summer afternoon will meet the demand, while, with a strong storm-wind, a single wheel will drive his full machinery without assistance. Each wheel sends by its own air-pump its stream of air to a common reservoir. This reservoir is not, on this plan, built to contain stores of energy for future use; it is barely as an equalizer of an unsteady power. It enables the consumer to carry on his work with perfect uniformity of motion, no matter how gusty or squally the wind may be.

He chooses to run his engine, for instance, at forty pounds; setting his safety valve at sixty or eighty, or whatever he may above, he draws a regular forty without change or interruption. The only requisite is that the reservoir pressure shall be maintained sufficiently high. If his wind wheels are doing that amount of work he needs nothing further, and he can easily so construct them that the number of days in which they will need no help will be greatly in the majority in the course of a year.

But days of partial or of total calm will of course occur, and here is where the auxiliary force is required. The steam engine which he would have in use, had he no wind wheels to take its place, is called at once into play, and the machinery runs on, as on other days. The engine drives an air-pump, or pumps, of suitable dimensions, compressing air into the reservoir, that is, it does precisely what the air pumps of the wind wheels failed to do at that moment. This, of course, can be done when there is no wind whatever, and will not unfrequently need to be done when the wheels are moving feebly, and are consequently unable to keep the pressure up to the requisite number of pounds. The two sources of energy are in no way associated; they barely supply compressed air to a common reservoir, for a common purpose; they can work alone or together.

With a sufficiently liberal construction of wind wheels it is not too much to assert that the engine fire would not be lighted on more than one in three of the working days of the year, and the days when it would be needed with its full power would scarcely be one in six. Experience would soon settle all the points required, and though the introduction of the new mode of working would be watched at the first, and very naturally, with distrust, a very short time would remove it, and the two go smoothly on together.

Can any one show any reasons why this theoretical plan cannot become a practical one? It utilizes only a portion of the wind power, it is true, but is it not worth while to save what we can? If a man can save the expense of running his steam engine for two-thirds to three-fourths of the time, at barely the cost of erecting his wind engines, which will run without subsequent expense, it surely does appear that a very decided gain has been made. A.

Nickel Crucibles.

M. Mèrmet recommends nickel crucibles instead of silver ones for use in chemical manipulations. Nickel is slightly attacked by melted potash, and so is silver itself. Nickel crucibles cost at first much less than those made of silver, and they have the great advantage of melting at a higher temperature. It often happens that inexperienced chemists melt their silver crucibles in heating them over a gas lamp; but such an accident is not to be feared in working with crucibles made of nickel.

A CORRESPONDENT says that files may be readily cleaned of grease by holding them for a moment in a steam jet from a blow off cock.

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