would be done, but unfortunately this exaggerated estimate of the strength of a wire cable has already postponed the construction of a great public utility for nearly three years; for, to-day, the present Bridge Department has nothing to show for its incumbency but a couple of piers built by its predecessors, and a serious lawsuit induced by its own faulty contract.

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

In all probability we shall see a fine display of shooting-stars about the middle of this month. We cannot be quite sure about it, however. It is certain that the earth will cross the path of the meteors which follow in the wake of the lost Biela's comet; but we have no means of knowing whether they will be thickly or thinly spread along this track, and so we cannot tell how much of a shower there will be.

All that can be done is to predict the date of the possible shower, and even this is not as simple a matter as it seems. The orbit of Biela's comet—which these meteors follow—used to intersect the earth's orbit at a point which the earth reaches on November 27 of each year; and for several successive returns the shower came at about that date. But the meteor-swarm has since then passed close to Jupiter, and its orbit has been considerably altered by the planet's attraction. It is a very laborious matter to calculate how large this alteration is, but Dr. Downing, an English astronomer, has done the work. He finds that the orbit has been so changed that the place where it comes nearest the earth's orbit is more than 15,000,000 miles distant from its former position at a point which we reach on November 18. The orbit has also been shifted sidewise, so that those meteors which previously just missed striking the earth will now pass about a million miles away from it, on the side remote from the sun.

If the meteor-swarm, measured in this direction, is more than a million miles in extent, we will pass through part of it, and there will be a conspicuous shower; but if not, we will only see a few straggling shooting-stars, as we did in 1899, when the Leonids suffered the same fate. The Leonids themselves are due on the 13th or 14th of this month, but the thick part of the swarm went by several years ago, and there is no chance of a great display this year.

The Bielid meteors are more convenient to observe, for they appear in the early evening, radiating from a point in Andromeda, which is well above the horizon at sunset, so there will be no need to sit up all night to see if we are to get a shower this year.

THE HEAVENS.

The principal constellations visible at 9 P. M. in the middle of November are as follows: Beginning in the west, where the Milky Way cuts the horizon, we see Aquila with its bright star Altair. On the right, and higher up, is the still brighter Vega in Lyra. Above Lyra is Cygnus. The large cross which is the most prominent figure in this constellation is now almost erect. Still following the Milky Way we pass over Cepheus and come to the zigzag line of Cassiopeia, now almost overhead. Then follows Perseus, and below it Auriga with the very bright yellow star Capella. Below this again is Gemini, whose twin stars, Castor and Pollux, have just risen.

To the right of this, a little south of east, Orion is also rising. Above it is Taurus, one of the easiest constellations to remember, since it contains the two star-clusters of the Pleiades and the Hyades. The latter name belongs to the V-shaped group of stars of which Aldebaran is the brightest. The planet Jupiter is at present between these two groups, and far outshines anything else in the sky.

The southeastern sky contains two of the largest and least brilliant of all the constellations, Eridanus and Cetus. Above the latter, southeast of the zenith, is the little triangle which forms the head of Aries. The great square of Pegasus is almost overhead, and Andromeda lies northeast of it, toward Perseus. The uninteresting zodiacal constellations Pisces, Aquarius, and Capricornus occupy the southern and southwestern sky. Lower down is one bright star, Fomalhaut, in the Southern Fish. Higher up and farther west is the planet Saturn. Mars, which is in Capricornus, has just set, but is visible earlier in the evening.

THE PLANETS.

Mercury is evening star in Scorpio. On the 27th he reaches his greatest elongation, but, as he is very far south, he will not be easy to see, though he sets rather more than an hour after the sun.

Venus is morning star in Virgo, and rises about 5:30 A. M. in the middle of the month.

Mars is evening star in Sagittarius and Capricornus, and sets at about 9 P. M. in the middle of the month.

Jupiter is in opposition on the 24th, and is visible all night long. He is farther north now than he has been for seven or eight years, and is admirably placed for observation. Transits and eclipses of one or more of his satellites are visible almost daily, and afford one of the most interesting spectacles that can be seen with any telescope, small or large.

Saturn is in Aquarius, and sets about 11 P. M., so that he is still observable in the evening. Uranus is in Sagittarius too near the sun to be satisfactorily seen.

Neptune is in Gemini in R. A. 6 h. 43 m., dec. 22 deg. 6 min. N. on the 15th, and comes to the meridian about 3 A. M.

THE MOON.

First quarter occurs at 9 P. M. on the 3d, full moon at midnight on the 11th, last quarter at 9 P. M. on the 19th, and new moon near noon on the 26th. The moon is nearest us on the 25th, and farthest away on the 10th. She is in conjunction with Mars on the 2d, Saturn on the 5th, Jupiter on the 13th, Venus on the 25th, and Mercury on the 28th. The conjunction with Saturn is quite close.

THE SUN.

At the date of writing (October 23) two large sun-spots, visible to the naked eye, are in sight at once. No one can say with certainty how long they will last, but if they endure for another rotation of the sun (which is probable) the first of them, which is a large diffuse spot with several nuclei, will reappear at the sun's eastern limb on or about November 7, and remain visible till the 20th. The second, which is smaller but blacker, came into view on October 21, and will pass round the sun's western limb about November 3, reappear on the 17th, and stay in sight till the 30th. Both spots can be seen without other aid than a piece of smoked glass, but their outlines can be better seen with a field-glass, holding the smoked glass close to the eye.

Observatory, Princeton.

TUNNEL BORING IN ANCIENT PALESTINE.

Unmistakable evidence exists that 2,500 years ago certain Hebrew engineers (in the time of King Heze-Kiah) executed exactly the same kind of work which was carried out in the Simplon tunnel, though perhaps on a slightly smaller scale. Dr. Bertholet, a professor at the University of Basle, is the gentleman who claims to have made this discovery. The Jewish records state that King Heze-Kiah, or Ezekias, who reigned at Jerusalem 727 B. C., was much troubled at the bad state of the water supplied to the people of that city. He accordingly had a vast reservoir made at the gates of the city, to which water was fed from various springs lying at more or less greater distances from the reservoir in question. At first his project seemed doomed to failure, as there existed, between Jerusalem and the springs, from which the water was to be derived, a high chain of hills, over which it would be impossible to convey the water. It was therefore determined to open a passage for the water through the solid rock; one of the Sirach MSS. dating from this period states in this connection: "Heze-Kiah fortified his city by bringing water thereto, and he bored through the solid rock by means of bronze, and he collected the water in a reservoir."

It is true that, about fifteen years ago, an open conduit was found in the vicinity of the Holy City, but this appears to have been made by a predecessor of Heze-Kiah's, which seems to be clearly proven by an inscription in old Hebrew characters found close to Jerusalem and preserved in the Constantinople Museum. Translated, this inscription reads: "The piercing is terminated. When the pick of the one had still not struck against the pick of the other, and while there was yet a distance of three ells, it was possible to hear the voice of one man calling to another across the rock separating them. And the last day of the piercing, the miners met pick against pick. The height of the rock above the heads of the miners was one hundred ells. Then the waters flowed into the reservoir over a length of 1,200 ells."

Recent explorations have enabled this predecessor of the Simplon to be thoroughly identified; it is said to be the Shiloah tunnel, by means of which water was brought down from a source to the east of Jerusalem, and poured into the Pool of Siloam mentioned in the Bible. This conduit is 360 yards long. The distance as the bird flies between the two mouths of the tunnel is also only 360 yards, which proves that the work was not executed in a perfectly straight line—due doubtless to the difficulties which the engineers encountered in their task, which (for the period) was of a really marvelous nature. That the work was commenced from both ends of the tunnel is not only proven by the inscription, but also by the fact that the marks of the boring tools, picks, etc., may still be seen, all bearing in opposite directions. The direction of the tunnel was altered several times during the construction thereof, as there are several short galleries, which were evidently abandoned as soon as it was noted that working was being done out of line. The floor of the tunnel is finished with the greatest care, and the workings vary from five-eighths of a yard to one yard in width by from three feet to nine feet in height, more or less, according to the hardness of the rock.

In the light of modern engineering science, the following questions suggest themselves: How did these old-time engineers gage their direction, recognize and remedy their errors in alignment? What tools did they use to execute a piece of work which has remained without equal or rival for 2,500 years? To these inquiries no answer can be given; the wondering student can only turn away with the exclamation: "In good sooth, my masters, there is nothing new under the sun!"

SCIENCE NOTES.

Theoretical crystallography, approached by Steno (1669), but formally founded by Haüy (1781, "Traité," 1801), has limited its development during the century to systematic classifications of form. Thus the thirty-two type sets of Hessel (1830) and of Bravais (1850) have expanded into the more extensive point series involving 230 types due to Jordan (1868), Sohncke (1876), Federow (1890), and Schoenfliess (1891). Physical theories of crystalline form have scarcely been unfolded.

The evolutionist is spared the surpassing difficulty of the human element, yet he needs imagination. In its lowest form his imagination is that of the detective who reconstructs the story of a crime; in its highest it demands the power of breaking loose from all the trammels of convention and education, and of imagining something which has never occurred to the mind of man before. In every case the evolutionist must form a theory for the facts before him, and the great theorist is only to be distinguished from the fantastic fool by the sobriety of his judgment—a distinction, however, sufficient to make one rare and other only too common.

The science of architecture, if under this head we include the principles of building construction, and the heating and ventilation of buildings, has done and is doing much of interest and importance to the student of public health science. The air supply, especially for the modern civilized and too often sedentary form of mankind, is in the long run quite as important as the water supply, the milk supply, or any other supply. Surely, we can not be too careful of the purity of a substance which we take into our bodies oftener, and in larger volume, than any other, and which has come, rightly no doubt, and as the result of long and painful experience, to be known as the very breath of life. Human beings may survive and seemingly thrive, even for long periods, in bad air, but for the best work, the highest efficiency, the greatest happiness and the largest life, as well as for perfect health, the very best atmosphere is none too good. Hence the permeability of the walls of houses and other buildings, and the heating and ventilation of dwellings, school houses, churches, halls and other public places, require, and in the near future will receive, a much larger share of our attention than they have to-day.

Aside from their economic value, grape vines are often cultivated for purely ornamental purposes, owing to their beautiful foliage and the rich coloration they assume, the shade they afford, and their hardihood and longevity. The vine is one of the few plants that can be conveniently grown in cities or towns either as bushes or for making delightful arbors that not only beautify the home, but furnish cooling shade and luscious fruit. The more tender sorts can be grown in graperies in many regions with good profit, and when grown in pots not only serve as handsome decorations in the dwelling and on the table, but add one of the choicest of morsels to the menu as well. To quote the language of an enthusiast: "The grape is the poor man's fruit, especially one who has only a house lot of the smallest possible dimensions. He can plant vines beside his cottage and their roots will extend and profitably occupy every inch of ground underneath it, and from that small space produce all the fruit his family can consume, while the vines afford shade and protection and add beauty to his little home, occupying no space, either above or below the ground, to interfere with other interests, and producing more fruit in less time and with less labor and attention than any other thing that was ever planted."

Information is being sought by people all over the country on the subject of testing of clays for the various purposes for which they are used, other than road building. Special tests are now carried on to that end. A furnace has been installed by the Department of Agriculture and actual burning tests on clays are now made. In order to further stimulate interest in the development of native clay bodies, a special circular was issued on "The Useful Properties of Clays." The aim of this circular was to give information in the simplest possible way to people who were not supposed to possess technical knowledge of clays. The circular particularly points out that for the year 1902, the last year for which the official figures are valuable, the total imports of foreign clays to this country were valued at $1,154,805, while the domestic clays produced were valued at $2,061,072. Since the country possesses unusually fine clay bodies, a great many of which up to the present time await development, any stimulation of interest among the people to develop our native clays must be of great value.