is about 80 feet, and having 20 feet clearance between the top of the rail and the bottom of the girders at the street crossing, as shown in our sectional plan of the subway. The side walls of the tunnel are vertical and are built of rubble masonry in the best manner. At Twentieth Street the subway opens out into a large yard which is triangular in shape, and is one of the most impressive pieces of work in the whole subway. It will contain the new engine house, freight houses, and repair shop. None of these are built at present. From a point east of Twenty-second Street a tunnel extends to a point near the entrance of the B. & O. R. R. tunnel west of Twenty-sixth Street. From this latter point to Thirtieth Street the tracks ascend with a 1·3 per cent grade to the original grade at Thirtieth Street. In order to carry on the work along the line of the Pennsylvania Avenue it was necessary to lay temporary tracks on Hamilton Street from a connection at Tenth Street with the Willow Street branch to the main line at Twenty-second Street, and from this point westward to shift the old tracks on Pennsylvania Avenue to the south side so as to admit of the construction of the northern wall of the tunnel, after which the temporary track was shifted to the extreme north side of the avenue and supported in part by the newly constructed wall. This, of course, allowed the south wall of the tunnel and the arches to be built. Railway facilities were maintained with business establishments by means of temporary tracks during the construction. After the completion of the temporary tracks, buildings on both sides of Pennsylvania Avenue were underpinned, and where the tracks ran down into the subway at Thirteenth Street it was necessary to lower this street about 13 feet in order to avoid the grade crossing. The work on the south side of Pennsylvania Avenue west of Fifteenth Street included heavy retaining walls. At one or two places along the line of the subway, sharp inclines will permit cars to ascend to the level of the street, and at one place, at least, there is an opening made from the subway into the present ground floor of buildings by means of a hydraulic lift.

It is a most interesting walk to descend to the subway by one of the inclines and walk through it. The workmanship has been of the best, and the subway and tunnel solve the problem of rapid communication through a city as far as Philadelphia is concerned. The tunnel itself consists of a segmental arch with 52 feet span and 8 feet 8 inches rise; the crown is 22 feet above the top of the rail and the arch radius is 43 feet 4 inches and it is designed for four tracks. The arch roof is of brick 3 feet thick at the crown and 4 feet thick at the springing line. Over the top of the tunnel and in the center of Pennsylvania Avenue are thirteen openings for ventilation. These are constructed of steel protected by a terra cotta covering. The visible openings in the street are 10 feet wide by 47 feet 10 inches long for twelve of the openings and 10 feet by 78 feet for one. These openings are surrounded by a rustic masonry wall 3 feet 8 inches in height, around which vines will be planted, and around this wall is a grass plat 6 feet wide, in which shrubs will be planted. An ornamental iron fence, protected by an 8-inch graphite curb, will surround the whole. In appearance Pennsylvania Avenue will soon resemble Park Avenue in New York, although it does not do so at present. There is no doubt that the tunnel will cause a vast improvement in the section of the city through which it runs, for the avenue itself is now 120 feet wide and the sidewalks 20 feet in width; the six feet nearest the curb are sodded and planted with selected trees. Between the main curbs, 80 feet apart, the street will be of asphalt, the distance between the main curb and the ventilating openings being 27 feet on each side of the street. At the western end Pennsylvania Avenue widens out into a plaza where the Washington monument is located. When the tracks are finally removed and the streets properly repaired, it will be a most advantageous means of access to Fairmount Park. There is an open subway east of the tunnel. When the original plans of the tunnel were prepared, an artificial system for ventilating was devised, but owing to the expense it was not carried out, and the tunnel is so admirably ventilated that it would hardly seem necessary to install such a system. The total weight of the bridges is 7,529,783 pounds and of the vent openings 1,710,000 pounds, making a total of 9,239,783 pounds, or about 4,600 tons. The work of constructing the subway and tunnel has been carried out under the direction of the Bureau of Surveys of the Department of Public Works, of which Mr. George S. Webster, M. Am. Soc. C.E., is chief engineer, and we are indebted to him for courtesies in the preparation of the present article.

A DOUBLE-TRACK drawbridge over the Chicago River was recently shifted bodily a distance of 83 feet. The method employed was to jack it up 26 inches from its central pier, thus allowing a cradle to be built underneath it. This cradle ran on ways which were lubricated with tallow and the weight of the bridge having been transferred to it the whole was hauled bodily to its new position. The weight was over 600 tons.

## Correspondence.

### The Eruptions of Mauna Loa and the Sunspot Period.

To the Editor of the SCIENTIFIC AMERICAN:

In your number of September 2 you furnish some very interesting details concerning the recent eruption of this celebrated volcano and give the dates of the known eruptions. Having lately read a paper (not yet published) before the Royal Irish Academy on the relations observable between the dates of volcanic eruptions and the sunspot period, and with reference to five volcanoes of Europe, I was greatly interested by learning the dates of the Mauna Loa eruptions as communicated in your article, and beg leave to submit the following details as representing the connection observable between the dates of the eruptions mentioned and the years of Maxima and Minima sunspot periods as known, the Maxima being marked + and the Minima–

| Years of Eruption as mentioned. | Intervals in years. | Corresponding sunspot period years. | Differences. |
|---|---|---|---|
| 1789 | | +1789 | |
| | 34 | | |
| 1823 | | –1823·2 | 0·2 |
| 1824 | | | |
| 1825 | | | |
| | 17 | | |
| 1840 | | –1837·2 | 2·8 |
| | 12 | | |
| 1852 | | | |
| | 3 | | |
| 1855 | | –1856·2 | 1·2 |
| | 4 | | |
| 1859 | | +1860·2 | 1·2 |
| | 9 | | |
| 1868 | | –1867·2 | 0·8 |
| | 13 | | |
| 1881 | | –1879 | 2·0 |
| | 6 | | |
| 1887 | | –1889·6 | 2·6 |
| 1899 | | (–1901 ?) | |

It may be observed that the sunspot year's herein presented are for the most part years of Minima (there being in fact, but two years of Maxima). This would be quite in accordance with Kluge's theory as to the correspondence of years of marked volcanic activity with Minima sunspot years. It would be very interesting to treat in the same way the data ascertainable as regards the other American volcanoes and I have the certainty that the results would prove very interesting and help to the elucidation of the causes of volcanic activity in general.

J. P. O'REILLY,
Ex-professor Mining and Mineralogy, Royal College of Science, Dublin.

September 12, 1899.

### The Twentieth Century Problem.

To the Editor of the SCIENTIFIC AMERICAN:

I have just noticed an article in your excellent paper under the caption of "Some Calendarial Facts About the Twentieth Century." In this article you make the statement that, "of course, the first century began with the year 1 and closed with the year 100." This seems a trite statement, and yet even in this there is room for cavil. Some of those who have been discussing the question on this coast are prone to get mixed up on just what they mean. A child is not one year old until it has passed the last day of the twelve months since its birth, and yet it was in its first year during the whole of the time up until it can be said to be a year old. The fact of its being one year old, or being in its first year, are two entirely different things. But the mistake of confounding these two ideas is what makes the difficulty in the minds of many in the application of the same principle to the counting time when we have to deal with centuries. A century is not one year, old, if you will allow that expression, until the first year is passed; so likewise the hundredth year is not so denominated until it has also passed. When we write dates we write the time that has passed, counting from the supposed birth of Christ up to and including the day which is then in progress. For instance, when we write the present date we say that 1899 years have passed away, and that we are in the 9th month and the 26th day of that month, which month and day belong to the 1900th year. Or, in other words, we are now in the 1900th year; and the 1900th year will close on December 31, 1899. We do not begin to write our date (which refers to time passed) as 1900 until after the real year is passed.

As soon as we have passed into the 1901st year, we begin to write our date as 1900, and so many months and days. But the month and days belong to the new year. Hence, we can but conclude that we are now in the 1900th year, and that the year closes the century. If this be true then the 20th century will begin on January 1, 1900.

Will you please let me know whether I have your idea or not, and, if not whether my reasoning is correct? I would like to have this subject set clearly before your readers, for, although it is of minor importance, yet it is a question which puzzles many of them.

E. H. VAN PATTEN.

Dayton, Washington, September 26, 1899.

[The first century began on Jan. 1 of the year one. January 1st of the year 100 was still of the first century, otherwise that century would only have continued ninety-nine years. The second century began on January 1st of the year 101.

The same custom holds true with reference to numbering years that is in vogue with reference to naming months and numbering the days of a month. We name a month or number a month as soon as we enter upon it, and it retains that name or number during its entire term, so the moment we enter upon a new year, the year is identified with its own number in the series of years, which number it retains to the close of the year. Hence the date referred to is not the 26th day of the 9th month of the 1900th year, but the 26th day of the 9th month of the 1899th year. Putting it otherwise, we may say that the length of time from the beginning of the Christian era to the close of September 26, 1899, was 1898 years 8 months 26 days. It is evident, therefore, that the length of time from the beginning of the Christian era to the close of December 31, 1900, is just 1900 years, which completes the 19th century, this century having been so called ever since the first moment of January 1, 1801. The moment we enter upon January 1, 1901, we begin the 1901st year, which is the first year of the 20th century. That we really begin to write the number of a year as soon as that year has begun, and not after it has passed, as our correspondent maintains, is a matter not to be settled by logic, of course. It is a simple matter of fact, universally recognized by historians and astronomers, such having been the custom from the beginning of the Christian epoch, and even in earlier times in other epochs. Whether we write "September, 26, 1899," or "9—26, 1899," we have simply an abbreviated form of writing in full "the 26th day of September in the year of our Lord 1899."—ED.]

### Automobile News.

In Germany trials are being made with ambulance carriages provided with 5 horse power petroleum engine, with sufficient fuel to run for fifteen hours. The engine drives a dynamo, and a powerful projector is also furnished.

An automobile party to make a journey to the Mammoth Cave, of Kentucky, is being organized. The party will be made up of eight persons, traveling in two automobiles, while a third will carry the baggage of the party. The start will be made about October 15.

One great reason for the popularity of the automobile is that it can be more readily managed by women than horse-drawn vehicles. Many women object to driving horses on account of their liability to shy or bolt. The automobile offers marked advantages in this respect, but no lady should try running an automobile until she thoroughly understands the mechanism.

The Mechanical Science Section of the British Association is in favor of an amendment of the laws regulating the use of motor wagons on the highways. At present all motor cars in England are limited to three tons weight unloaded. It is now found that the economical load is from 8 to 10 tons, and to carry this it is considered desirable to be allowed a heavier weight when unloaded than 3 tons. Of course some light metal can be used in the construction of motor carriages, but it is not considered desirable in heavy wagons. It is believed that the whole matter will be brought up before Parliament during the next session.

Dr. Lehwess proposes to undertake an automobile trip from Pekin to London, or a distance of 8,000 miles, the greater portion of which is through a practically unknown country. A special carriage, built to order for the extraordinarily severe work, is being made by a Paris firm. The car has a carrying capacity of fuel and water sufficient to propel the car 300 to 400 miles. The start will be made about the end of February or March. The car will be run through Brindisi and from there it will be taken by water to the East. The doctor's companions will be two mechanics. There is no question that this is a serious attempt which is being made. The automobile industry has always suffered from races, excursions, etc., which are not properly planned or which are beyond the limits of present construction. We are afraid that the present instance will be no exception to the general rule.

### German Amber Production Acquired by the State.

By virtue of the law of May 1, A. C., the entire amber production of East Prussia has passed into the hands of the government. Paragraph 1 of the law reads: "The Imperial government is empowered to apply the sum of M. 9,750,000 ($2,450,000) to the purchase of the real estate situated in the districts of Fischhausen and Memel and in the city of Konigsberg i. p., belonging to the firm of Stantien & Becker or Privy Councilor Becker of Konigsberg i. p., as well as the entire business and establishment carried on under the said firm in Germany for the production and working up of amber and trade in raw amber, ambroid, melted amber (colophony) and by-products.—Farben Zeitung.

### Science Notes.

The chalk plate process is being used with satisfaction in the various monthly reports of the Climate and Crop Service.

On October 6, a statue of John Ericsson was unveiled in the presence of an enormous crowd at Gothenburg, Sweden. Nearly 40,000 school children with banners marched by the statue which was modeled by the Swedish sculptor Fahlstadt.

Work has begun on the renovation of the façade of the Cathedral of Milan. An attempt will be made to remove some of the inconsistencies of style due to the fact that four centuries were taken in the completion of the cathedral. The plan adopted is that of Guiseppe Brentano, who won the prize over 120 competitors.

The American Horological Society held its second annual watch and clock trade exhibit in Chicago. The exhibit opened on October 2, and closed October 14. The exhibit include watches and clocks, tools, and novelties of all kinds. The process of diamond-cutting, lens grinding, electro-plating, engraving, etc., was shown.

Nine columns of the hypostyle hall of the Temple of El-Karnak, at Thebes have fallen. The Temple of El-Karnak is one of the most magnificent temples of ancient architecture in the world. The hall measures 170 × 329 feet. The stone roof was originally supported by 134 columns, the tallest of which were nearly 70 feet high and 12 feet in diameter. It was built by Setee I. of the nineteenth Egyptian dynasty.

Prof. R. T. Hill, of Washington, accompanied by a party of five men, has started on a perilous voyage down the Grand Canyon of the Rio Grande. They left Presidio October 7. They will not be able to get out of the canyon until Del Rio, about 200 miles below their starting point, is reached. The Mexican guide who is with the party made a trip through the canyon a few years ago, and he is the only person known to have made the dangerous voyage. Recently there have been severe rains in this region which has caused a large flow of water in the river so that it is thought there will be little difficulty in making the trip in boats,

The Society for Checking Abuses of Public Advertising, or "Scapa" as it is usually called in England, is having considerable success. The Building Act Committee of London County Council have recommended the prohibition of offensive signs, and in many places the Society has obtained the concessions it desired. The Northeastern Railway Company has commenced to remove some advertisements which were considered unsatisfactory. The Society has awakened considerable interest in foreign countries. Notwithstanding the value of the work the Society is doing its work with an expenditure of less than $500 per annum.

The Export Exposition at Philadelphia is gradually getting in shape. The cool days and the 50-cent rate of admission make the esplanade and exhibition aisles look dreary until 6 o'clock. A large proportion of the exhibitors are not found at their spaces until the evening. Many of the exhibitors of moving machinery defer their exhibitions until the evening. It is said that the management is considering the feasibility of continuing the exposition until November 30. Work has begun on a covered passageway to connect the main building with the Agricultural Building. Only a few exhibitors are still behind with their exhibits.

The Treasury Department will shortly put into operation a new plan for refining at the mints, which will save the government $60,000 or $70,000 a year. It is always necessary to mix a certain amount of silver with gold in refining it, and the mints have been in the habit of using their own silver over and over again, gaining nothing by it either in profit nor in the quality of the work done. The government is authorized by law to do refining for individual customers as well as for its own coinage, provided that the charges do not exceed the actual cost of the work. The present scale of charges for refining silver is probably twenty years old, and the Treasury now intends to lower its charges so as to attract silver held by private parties and thus get what it needs for its gold refining with compensation thrown in.

It may not be generally known that the by products of fruit stones are of considerable value. The pits of peaches, apricots, nectarines, plums and prunes which have heretofore been thrown away or used for fuel have a market value. This is specially true of the peach and apricot pits. There is now a strong demand for them at $8 to $10 a ton, delivered in San Francisco. The kernel is of course what is sought. From the kernel of the apricot Turkish "nut candy" is made which has almost displaced the almond. The same substance is used for the adulteration of cinnamon, allspice and nutmeg. Prussic acid, and essence and oil of almonds are made from the peach and prune pits and these flavors are used in many ways. The pits are cracked in San Francisco and the kernels are then sent East.

### Engineering Notes.

A bicycle geared to 240 will be sent to the Paris Exposition. The front sprocket contains 60 teeth and the rear sprocket 17 teeth.

At the southern entrance to the Suez Canal, at Port Tewfik, there is an oil installation. The oil is stored in vast quantities in tanks for use either by ships or in houses. The tanks each have a capacity of 4,000 tons of liquid fuel for such steamers as may be fitted to burn it. Special trucks are provided for sending oil by rail and the wants of the neighborhood are supplied by small oil tanks.

The new air power cars in use on the Twenty-eighth and Twenty-ninth Street lines, New York City, are doing excellent service and the noise of the exhaust air is not disagreeable, but it leaves a filthy trail of mingled grease, graphite and moisture on the roadway close to the tracks, which is unpleasant in appearance and in odor. It ought to be a comparatively simple matter to remedy this by putting in proper drip pans.

The St. Lawrence canals will attract a great deal of trade when they are completed. The capacity of the canals now nearing completion will at first be about 3,000,000 tons a year in one direction, but by degrees as ships are built more to the requirements of the trade, the capacity may be doubled and when the power of the Falls for lighting purposes is fully used and the canal system comes under government control 12,000,000 tons each way may be handled.

A shaft which has just been completed by the Bethlehem Steel Company for the Boston Elevated Railway, is 27 feet 10 inches long, and the diameter of the fly-wheel fit is 37 inches; the diameter of journals, 34 inches; the diameter of the crank disk fit 32 inches. The shaft is hollow, the axis hole being 17½ inches in diameter. The weight is 65,410 pounds. The shaft is of fluid compressed nickel steel hydraulically-forged on a mandrel, oil tempered and annealed.

A natural soap mine and a paint mine were two of the latest curiosities which have been discovered in British Columbia. Several soda lakes have been found in the foothills near Ashcroft, British Columbia. According to Feilden's Magazine their bottoms and shores are encrusted with a natural washing compound containing borax and soda. It is quite equal to the washing powders in common use for cleansing purposes. About 275 tons of the compound have been cut and taken out of one lake. It is handled exactly the same as ice. One lake alone contains 20,000 tons.

The manager of the Chicago Electric Traction Company has devised a new transfer ticket which is believed to be quite original and which is illustrated in the "Street Railway Review." The ticket in many respects does not differ from those already in use. The date of the month and the hour of the day is indicated by punching out the proper figures in the top or margin in the usual manner. For indicating the destination a diagrammatic sketch of the company's lines is placed in the lower part of the ticket, and it is only necessary for the conductor to punch the proper point on this miniature map.

At St. Johns, New Brunswick, the use of lead for making joints in a 24-inch water main has been superseded by wood. This practice was decided on in view of the satisfaction given by wooden joints in a 12-inch main laid in 1851 and a 24-inch main laid in 1857. The plugs are made from pine staves free from knots and gum. The staves are driven home and tightly wedged. The joints are tested by filling the pipe with water before covering it. Where for some reason the pipe had to be covered before it could be tested or the joints were too open or too close to permit the use of wooden plugs, lead joints have been substituted.

Secretary of War Elihu Root has issued an order calling the attention to a formal order dated August 24, 1897, which prohibits persons from visiting the fortifications of the United States. The Secretary declares that the formal order has frequently been disregarded and he directs a rigid enforcement of its provisions hereafter. The immediate cause of the order is said to be that a military attaché of one of the foreign governments recently visited the military posts at the mouth of the Columbia River. No one can question the justice of the order as in no country can foreigners inspect modern fortifications, and in most countries they are entirely closed to all.

The Holland submarine torpedo boat made another excellent run on October 6, in Little Peconic Bay, in a heavy snow storm with head winds and against the tide. It caused the sea to run so high that it was impossible at times to see the vessel from the deck of the steam yacht "Josephine" from which guests witnessed the run. A German naval constructor who is visiting the United States to inspect shipbuilding plants, and to investigate the naval methods in vogue in this country, was on board the submarine boat. He was favorably impressed with the mechanism of the vessel and was pleased with her performance. He was of the opinion that in the hands of competent men the boat would prove a formidable weapon.

### Electrical Notes.

A long distance telephone line has been opened between Chicago and Dallas, Texas. The tests have been very satisfactory.

In the harbor at Honolulu, telephone service between vessels and the shore may be obtained by connecting with the permanent telephone cable in the harbor.

In the Tesla interrupter, the interruptions are obtained by a stream of mercury impinging upon a rotating disk having projecting teeth. The interruptions take place in a gas under pressure, thus permitting a much higher frequency than would otherwise be possible.

Work on the Northwestern Elevated Railroad in Chicago is progressing favorably. Nearly six of the seven miles of road is now completed. The traveling crane used in hoisting the structure into place has been worked to its full capacity, erecting on an average of eight spans or about 250 linear feet per day.

Notwithstanding the recent destruction by fire of all the buildings of the exposition at Como, Italy, the ceremonies to commemorate the centenary of the discovery of the voltaic pile were held at Como, September 18 to 23. Remarkable energy was exhibited in the rebuilding of the burned structure and the gathering of new exhibits.

Twenty-three miles of aluminum cable will be used to transmit 2,000 horse power at a pressure of 10,000 volts from Tariffville to Hartford, Conn. The cable is three-fourths of an inch in diameter and consists of seven strands, each made of seven wires of No. 11 Brown & Sharp gage. At the present price of copper, the saving to be made by using aluminum will amount to $3,500.

The Batignolles Railway tunnel near Paris is to be lighted by lines of 10 candle power incandescent lamps. They are placed a meter apart and they are the same height as the carriage windows so that if any train is stopped in the tunnel it will be lighted from the outside. Another interesting feature is that the lamps are automatically lighted and extinguished by the passage of a train, which operates switches automatically by means of the rims of the wheels.

Three electric fountains have been started at the Crystal Palace, near London, and they are drawing large crowds. Electric fountains have been known for many years in both France and the United States, but we believe that this is the first time they have been shown in London. The fountains were designed and erected by F. E. Darlington, of Philadelphia, who has had considerable experience in building such fountains. The power is supplied by two vertical triplex power pumps built by the Goulds Manufacturing Company.

The New York and New Jersey Telephone Company during the recent visit of the "Olympia" installed a set of long distance telephone apparatus on that vessel. Two copper sheathed cables were laid between the war vessel and the main land at Tompkinsville, S. I. The cable was laid after dark with the aid of the search lights of the fleet. It is thought that this is the first time in America at least, that a warship has been connected by cable with the shore in this way. A good deal of business was transacted over the telephone while the vessel remained at anchor off Tompkinsville.

The Eastern Railway Company, of France, is using what might be called a central station on wheels for repairing the Torcenay tunnel. It is mounted on a railway truck and includes a petroleum engine which serves to drive a dynamo which furnishes current for propelling the truck by means of a motor and for lighting the works in the tunnel. The dynamo furnishes sufficient current for propelling the truck by means of a motor and for lighting the works in the tunnel. The dynamo furnishes sufficient current to drive 4 to 6 arc lamps or 30 or 40 incandescent lights. It has also been found of great service for night work and for use on other tunnels.

The Paris Exposition administration has taken all the measures possible to offer security to exhibitors and visitors against fire. The rules which are laid down in great detail are admirable, and they deal with stairways, doors, emergency doors, etc. An emergency light system for night use will consist of electric lamps of one candle power bearing a distinctive red color. All wood of the framework in the building will be covered with an insulating coat of non-inflammable material, and all stairways will be fireproof. Great attention is to be paid to the floors of all the exhibition buildings, cafés, etc., and before being accepted will be tested at the expense of the directors. All decorated canvas, awnings, and canvas coverings must be fireproof. All motive power other than electricity will be admitted only under rigid conditions. The regulations for heating and lighting provide that it can only be done by gas or electricity. The use of any form of hydrocarbons, acetylene, or other gases, than coal gas, is positively forbidden. All theaters. concert halls, etc., must have iron or asbestos curtains, and the lighting of such places will be exclusively by electricity.