long to perform its duty, for it is easy to see the great advantage to be derived from the use of an oil having every drop impregnated with solid lubricating matter.

This seemingly simple problem, however, is one that has until lately baffled engineers of experience, but it has now been found that amorphous graphite when reduced to an impalpably fine powder, when mixed with oil in the proportion of about one teaspoonful to the pint of oil, will remain in perfect suspension long enough to feed through lubricator tubes without clogging, thus causing every drop of oil to carry its mite of graphite.—The Railway and Engineering Review.

BLOOD PRESSURE AND MENTAL CONDITIONS.

In addition to those bodily movements which are called "voluntary," various bodily phenomena which are clearly involuntary accompany violent mental excitement. The blush of shame, the distinctive flushes of joy and of anger, the pallor and sweat of fear, the tears of grief, and the "creeping" of the flesh provoked by horror, are familiar examples. The respiration is quickened by joy, and retarded by anxiety, and the feeling of relief finds expression in a deep sigh. Violent emotions often disturb the digestion. The heart "bounds with joy," "is paralyzed by horror," "leaps to the throat" in terror. The connection between the heart and the emotions is so intimate that the heart was long regarded as the seat of the soul.

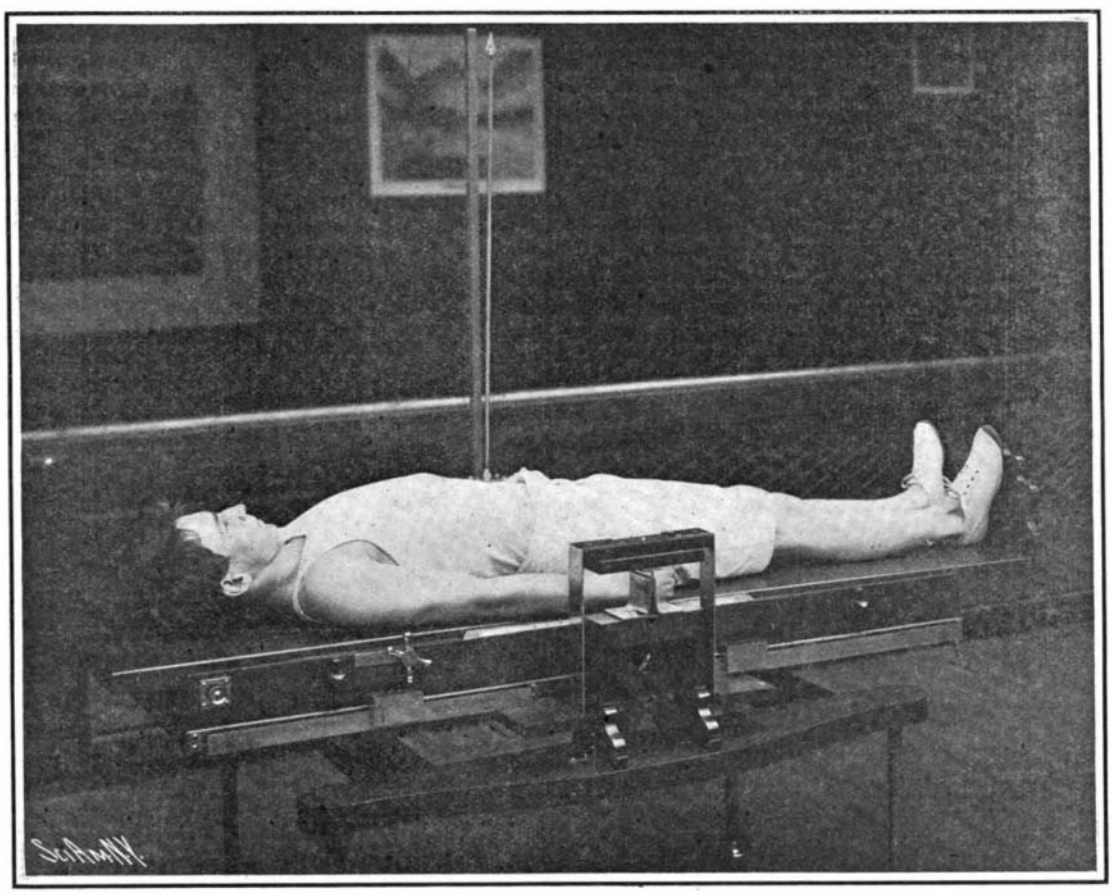
Most of these involuntary physical concomitants of mental excitement are brought about by a special part of the nervous system, the sympathetic nerve and its branches which ramify to every part of the body. The best known branches are those that govern the dilatation of the blood vessels, which are profoundly affected by mental states. These phenomena are susceptible of exact quantitative determination by means of a method devised by the Italian physiologist Mosso. The result is fairly accurate measurement of the variation of blood supply in the brain. The subject is laid on a board which is balanced on a fulcrum at the center of gravity in the manner illustrated in the accompanying engraving. When the subject is quiet and undisturbed the board lies horizontal. Now, if an unpleasant sensation or emotion is induced in the subject his head is involuntarily elevated, indicating diminution in the quantity of blood in the brain. An agreeable sensation or emotion produces the opposite effect.

In the course of the last twenty years, a great many experiments of this character have been made by many investigators, and have led to substantially identical results. The method of experiment should be adapted to the character of the subject. In many cases the feeling of pleasure can be aroused by offering a coin or other gift. At the moment of presentation the head-end of the board is tilted sharply down, indicating a sudden rush of blood. Then if the gift is taken away, with the explanation that it was presented in jest, the blood vessels contract and the head-end is elevated. Similar results are obtained by giving students favorable or unfavorable reports of examinations, reading poems to persons of fine sensibilities, etc.

There are great differences in the intensity of the physical effects of various mental processes. Difficult tasks in mental arithmetic, performed in private, cause only slight contraction of the blood vessels but the same calculations made in the presence of several persons, especially persons regarded with awe, cause great contraction. In general, emotional excitement, which common experience proves to be more fatiguing than purely intellectual activity, also affects the board more strongly.

Like many other modern discoveries these revelations are not absolutely new. Variations in the pulse were regarded in antiquity as indications of mental perturbation. Nearly 2,500 years ago Erasistratus, by feeling the pulse of the son of King Antiochus in the presence and in the absence of his young and charming stepmother, successfully diagnosed the young prince's puzzling malady as an "affection of the heart."

Severe bodily pain is commonly attended by alterations in the pulse and the pupil of the eye. This method of ascertaining whether a patient's suffering is as acute as he pretends was introduced by French physicians centuries ago.



BALANCED BOARD USED TO ASCERTAIN THE RELATION BETWEEN BLOOD PRESSURE AND PSYCHICAL CONDITIONS.

The Lost Continent in the South Seas.

The contention that Fiji and contiguous islands are remnants of a lost continent is supported by the investigations of Dr. Woolnough, of the Sydney University. Recently he spent several weeks in Fiji, when he directed special attention to the occurrence of granite recorded by Kleinschmidt some years ago. The main difficulty in the way of reconciling existing conditions with an original great area was that depths of 2,000 fathoms occur between the islands under notice. The Solomons and other islets were undoubtedly the visible links in the chain which ended at New Guinea. But against this theory had to be placed the immense volcanic and coral areas of Fiji, which were of more recent origin than the rocks forming the basic fabric of the continental area. It was necessary, therefore, to look for land evidences of faulting or breaking to account for the submarine depths. The granite area in Viti Leva was found to be from 400 to 600 square miles in extent, underlying the modern volcanic rocks. He was, however, unable to determine the relationship between the granites and slates, although he traced the lines of junction to some extent. A range of granite mountains with precipitous cliffs on each side gave evidence of heavy faults, creating chasms of great depths. He found the rivers forming a marked rectangular network, an upraised coral reef 200 feet above sea level, conglomerate rock showing sea-shells at a height of 800 feet above the sea, certain earth tilts and tuffs which had formerly been submarine and were now at a height of 4,500 feet. All these indicated a tremendous uplift, sufficient to cause greater faulting in the original continent. The rivers of Fiji were of comparatively youthful development, and even at present passing through their cañon cycle. Many beautiful examples of hanging valleys were observed.

The Scientific American Trophy.

The Scientific American Trophy is now on exhibition in the window of Messrs. Reed & Barton, 32d Street and Fifth Avenue, New York. It is attracting much attention. It will be competed for at St. Louis October 22, 1907.

Change in the Time of Allowance of United States Patents.

As most inventors know, it has hitherto been the practice of the United States Patent Office to issue patents on inventions three weeks after the date of allowance on payment of the final government fee. The Commissioner of Patents has given instructions that hereafter the period between the date of allowance and the issue of the patent shall be four weeks.

Farmers have always considered that hogs should be turned loose in an orchard. By picking up the windfalls they destroy many insects, whose presence is often the cause of the fall. It is stated on good authority that they are very destructive to the larvæ and pupæ of the codling moth, and will grow fat in an infested district.

A UNIVERSAL ASTRONOMICAL CLOCK.

BY DR. ALFRED GRADENWITZ.

The astronomical clock which is illustrated herewith is a most marvelous example of horological and mechanical skill. It was designed and constructed by Christian Reithmann, astronomer and scientific mechanician, at Munich, and involved four years of work (not including two years of preparatory calculation; the mathematical rate calculations were worked out to from six to ten decimal places, in order to dispense with any future readjustment of the works). It is intended for the tower of the new Munich town-hall, and pending the completion of this building has been exhibited at the German Museum of that city.

This clock, the decorative part of which was executed by Prof. Otto Hupp, has the form of a three-tower structure, and is fitted with thirteen artistic dials. The lower part of the construction, in front of which there is a projecting balustrade, together with the planetarium, is made of stained wood, and the middle and upper parts of ornamental gilded copper. An enormous number of wheels was required to perform the manifold functions of the clock, the planetarium alone comprising no less than 400 wheels with an aggregate number of 20,000 teeth, in order to represent with astronomical accuracy the revolution round the sun of the eight main planets and their satellites.

The central dial of the clock consists of twelve parts. Two of the hands will indicate the local time of Munich, and a third the mean European time. Adjoining this central panel is a *polytopical clock*, comprising a twenty-four-hour ring, the hours of the day being marked in white, and those of the night in black figures. On another ring surrounding the whole there are marked in artistically arranged panels the names of the eighty principal cities of the world. Each of these panels is provided with a golden arrow pointing toward a given part of the ring, which bears the Roman figures, thus allowing the local time of the city in question to be read at any moment. All of the dials and hands are real masterpieces of art.

The main dial to the left of the polytopical clock is the *astrolarium*, showing the actual position of the sun and moon among the constellations, as well as the right ascension, declination, and longitude of these bodies. The dial of the astrolarium comprises several movable rings, one of which gives the nodal position of the moon's orbit, the position of perigee and the distance of the moon. Whenever the sun and moon meet in one of the nodes of the lunar orbit, there is known to occur an eclipse of the sun; if, however, the moon at the same moment enters the earth's shadow, it will traverse the latter, producing an eclipse of the moon. The motions of the moon and sun are represented by Mr. Reithmann's mechanism with their characteristic irregularities, thus reproducing with absolute accuracy the relative positions of the two bodies, and the times of eclipses. On the inner part of the astrolarium dial there are shown the phases of the moon and seasons of the year, as well as the length of day and night for the actual date. A smaller dial on the left-hand tower will mark sidereal time, which is known to correspond to two successive passages of a fixed star through the meridian. This time is the most important to astronomers, allowing the *mean time* (according to which our clocks are adjusted and regulated) to be calculated.

The *calendarium* dial, to the right of the central dial, will indicate automatically the day of the week and the month, as well as leap days and leap years, while by means of an extensive mechanism the movable holidays are readjusted automatically, on the last day of December. The same dial further comprises two smaller dials, the apertures of which are opened more or less according as required for illustrating the duration of visibility of the sun and moon above our horizon. The rising and setting of these heavenly bodies are represented as well. The phases of the moon are likewise shown above a crowing cock (marking the hours) on the top of the middle tower. On the lateral tower of the clock, above the calendarium, there is marked *true solar time*, that is to say, the time given by sundials, and which corresponds to two successive passages of the sun through the meridian. A *movable stellar map* with the various constellations

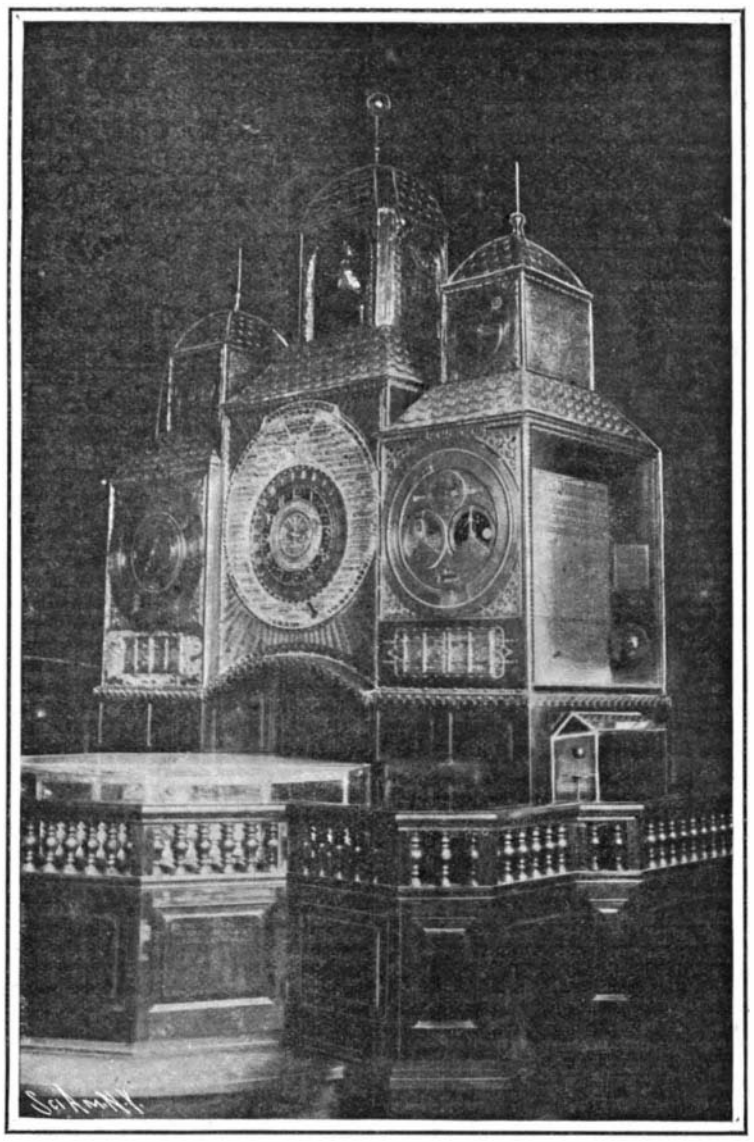
in high relief (indicating twelve hours in advance any constellations visible above the horizon of Munich) is installed on the side wall to the left of the casing. On both sides of this stellar map there are found enchased portraits of the most famous astronomers. The visible part of the astral sky with its constellations is represented on one of the upper panels on a smooth polished plate. A counterpart to this is a moon relief, showing the surface of the moon as visible through a telescope.

Below the stellar map there is situated the *lunar tellurium*, which represents the actual position of the earth and moon in relation to each other and to the sun. A molded solar system will be found on the left side wall of the case; and also statistics representing true conditions as regards the distances, forms, and positions of the planets. On a large *solar hemisphere* situated underneath are marked the ratios of magnitude of the sun and planets, on the scale of 1 meter to 1,000,000 (German) miles. In the left upper corner are given the data relating to the apparent diameters of the sun and planets, according to their distance from the earth. In a special compartment is located a *planetolabium*, illustrating the free axes of the planets and positions of the lunar orbits, as well as the resulting changes of seasons, origin of eclipses, etc.

One of the most interesting parts of the clock is the *planetarium*, which with far greater accuracy than any existing similar mechanical construction, will represent the various motions of the planets and satellites, illustrating with an extraordinary faithfulness the structure of our planetary system. On a tablet situated at the left of the planetarium there are given any necessary data as to the times of revolution of the planets, as well as their varying distances, and the orbit eccentricities of the positions of the planets mutually and in regard to the sun. The planetarium (which it took two and one-half years to complete) comprises elliptical orbits of non-uniform motion, which strictly correspond to nature. This part of the clock is shown from time to time at the German Museum with an accelerated motion (five seconds corresponding to one day), automatically reducing the bodies to the orbit corresponding to the actual time, thus allowing lay visitors to get some insight into the peculiar differences in the orbits traversed by a planet in a given time. Five driving gears are required to operate the above-mentioned astronomical mechanism, four of which are occupied by the calendarium, while the fifth will operate all the remaining dials and instruments inclusive of the planetarium. The shaft of the hour clock is the main shaft, and is designed for connection to an electrical or tower clock, disengaging the driving gear at intervals of a minute each.

The material value of the clock has been estimated by the constructor at about $15,000, while the ideal value of this masterpiece obviously is far greater.

The constructor of the clock is the son of another famous Munich mechanician and watchmaker, who, besides his inventions in the art of horology, is the inventor of the first four-cycle gas motor.



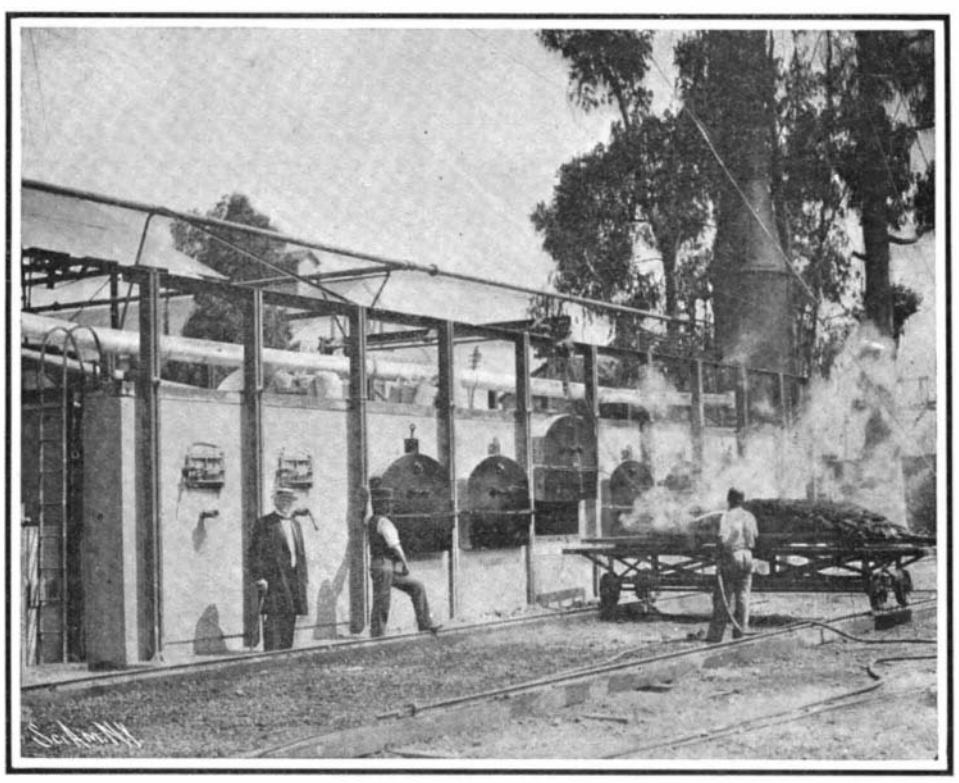
A UNIVERSAL ASTRONOMICAL CLOCK.

GAS AND COKE FROM CRUDE OIL.

BY WILLIAM H. KNIGHT.

By a new chemical and mechanical process which has now reached a successful commercial stage, a perfect carbon coke may be derived from crude oil as a by-product, or perhaps we should say, as a co-product, in manufacturing an illuminating water gas from California mineral oil.

For some years Prof. Thaddeus S. C. Lowe, inventor of the illuminating water gas system, by which process about 80 per cent of the gas consumed in the United States and Canada is now manufactured, has been working to perfect a system of manufacturing gas from crude oil alone, which would show a satisfactory commercial efficiency. Under modifications of the old system approximating this result, the cities of Los Angeles, San Francisco, and other towns of California are now being furnished with gas made wholly or in part from crude oil. In manufacturing gas from crude oil alone, there is produced a large amount of lampblack and tar, which have no marketable value in this part of the country. It is to be noted that these materials are separated, in the Lowe process, in accordance with the chemical and physical laws governing the constitution and transformations of the crude oil, and are not due to any inherent imperfection in his gas-making system. The problem which Prof. Lowe undertook to solve, and which has engaged his attention for some years, was how to utilize the carbon in the lampblack, consisting of infinitely fine free particles, and in the tar which retained much of the useful gaseous elements. He proceeded to mix the lampblack and the tar in various proportions, until at length, upon placing this mixture in the reverberating ovens and subjecting it to a very high temperature, a large additional amount of gas was evolved and carried as before to the gasholder. But here a result was produced that was unexpected; the residuum was changed into an entirely new substance. In short, it was a true coke, of the highest grade, firm, hard, dense, of a silvery color—an ideal coke—with not more than a trace of sulphur or other impurities usually found in the article produced from coking coal.



BATTERY OF OVENS FOR PRODUCING GAS AND COKE FROM CRUDE OIL, SHOWING THE QUENCHING PROCESS.

The coking plant constructed by Prof. Lowe consists of a series of reverberating ovens connected with each other by flues arranged in a special manner, and connected at each end of the series with heating and superheating chambers of special design, and having boilers and stacks at both ends, the boilers being operated by the waste heat from the ovens. As the battery of ovens has superheaters, stacks, and boilers at either end, the operator is enabled to work it first in one direction and then in the other, thus enhancing the efficiency and capacity of the apparatus, as the reverse blast is heated by the waste heat of the superheaters. The oil, injected into these ovens as a fine spray, soon reaches a temperature so high that the hydrocarbons of which it is composed are dissociated, and the resulting permanent gases are forced through the so-called washers (specially constructed tanks filled with water) Here the precipitated carbon is deposited in the form of lampblack, which is used in making some kinds of ink and is also the basis of certain lubricating compounds. The gases are then carried through the scrubber (a large vertical cylinder containing several chambers), which serves to eliminate all the tarry substances. These substances also have various uses, being a basis for the manufacture of the beautiful aniline dyes and other so-called "coal-tar products." The gas then passes through the condenser and the purifier, finally reaching the holder, whence it is pumped into the mains and distributed throughout the city under a uniform pressure.

But Prof. Lowe's experiments went further. He received a carload of slack non-coking coal from Tennessee and piled several sacks of it into one of his ovens, and subjected it to the high temperature his system produces. The slack coal was melted into a pasty compound, dissolved, vaporized, and its dissociated gases were carried forward as in the case of the crude oil, leaving a rich residuum in the ovens as before. This yielded a coke scarcely inferior to that derived from the best coking coal. It was evident that this process had opened up possibilities of new applications of the mechanical arts, and new and larger fields of utility in the industrial world.

One of the iron foundries in Los Angeles which uses Connellsville coke, recently made a melting of 5,500 pounds of iron with 700 pounds of the Lowe metallurgical coke, the melting stage being reached in 9 minutes, as against 13 to 15 minutes for eastern coke in the same cupola. At the end of the melting there was no slag, but considerable of the coke was left, and used again the next day.

Municipal Motor Cars.

Consul Halstead reports that in Birmingham, England, the tramway, water, electricity, and fire departments have already adopted motor cars, and the results are reported to be satisfactory. Every car used is of British construction. The tramway department has a car that has been used for two and a half years, which is employed for inspection purposes. Another car is used for the purpose of collecting tramway receipts from the various depots. This car has also a large platform space so that it can be used for delivering stores. There is, further, a motor tower wagon for inspection and repair of overhead wires and another wagon for general maintenance of overhead equipment. As Birmingham's water is brought 75 miles from Wales, it has been found desirable for the municipality to employ two motor cars for inspection purposes. The electricity department employs two motor cars for inspection purposes as well as for visiting prospective consumers of electricity. The fire department has two large cars which are sent ahead of the engines at the time of a fire in order to prepare for their coming. It is likely that later on Birmingham will follow the example of several other English municipalities and adopt motor fire engines.

The cars which will run through the new tunnels connecting Manhattan with Long Island will have doors on the sides, thus insuring quick loading and unloading.