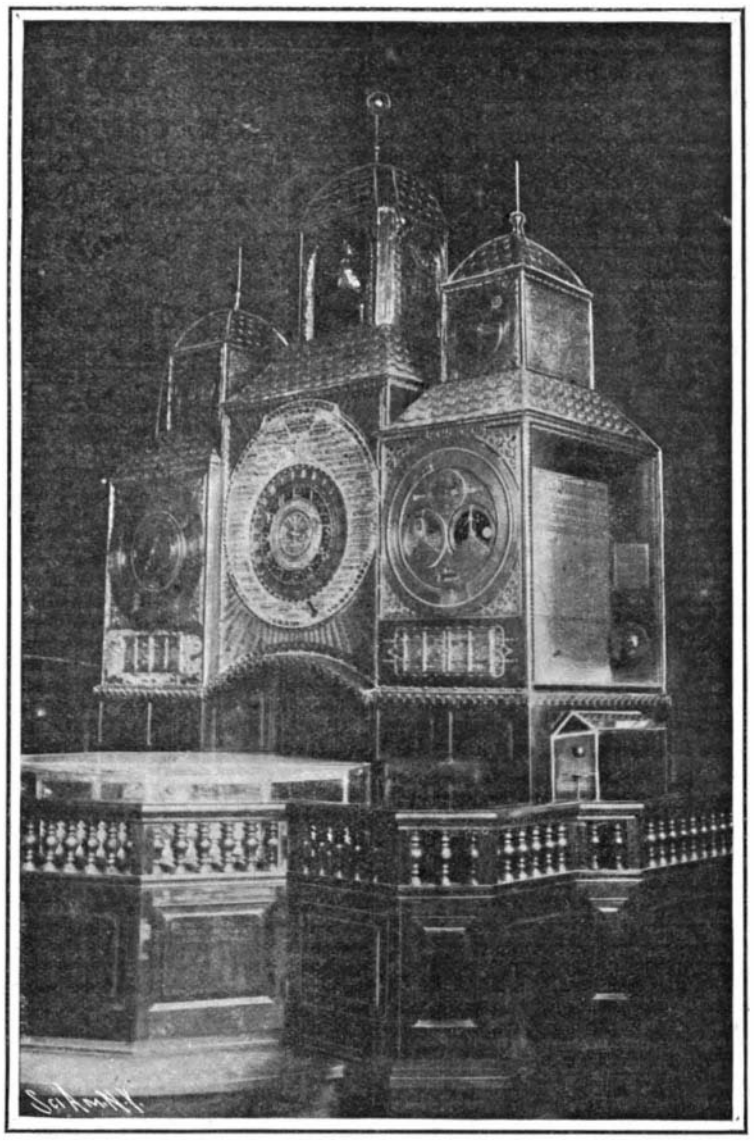
in high relief (indicating twelve hours in advance any constellations visible above the horizon of Munich) is installed on the side wall to the left of the casing. On both sides of this stellar map there are found enchased portraits of the most famous astronomers. The visible part of the astral sky with 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.



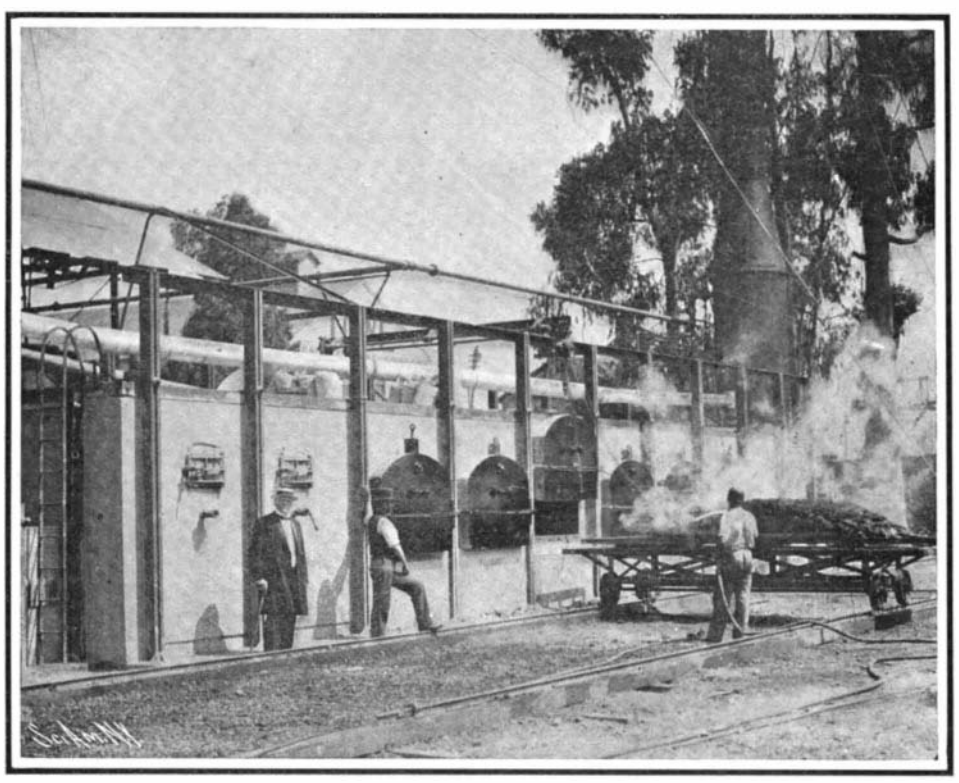
A UNIVERSAL ASTRONOMICAL CLOCK.

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.