

operating at a very high temperature, but this method was attended with difficulties of another sort. Later Hilary attempted to accomplish the object by joining to the retort a reflux condenser, intended to gather into the gasifying apparatus liquid parts and the condensed tars. This attempt, as well as those of Dinsmore & Krämer, was unsuccessful. The invention of the so-called "Peebles" process effected industrially, for the first time, the integral conversion of the oil into gas and solid residue.

The Peebles method consists in a fractional distillation of the oil and a washing of the gases by means of fresh oil, based on the principle of counter-current. It must be remembered that the oil contains quite a large number of very diverse products, boiling at very different temperatures. The gasification is conducted at a low temperature in such a manner that only a part of the oil is converted into gaseous products by the radiating heat of the retort. These gaseous products, as they escape from the retort, are washed by the fresh oil, which itself yields up to them its most volatile constituents. The liquid part descends to the retort, where, in its turn, it undergoes gasification.

In this process each hydrocarbon, whose gasification necessitates a temperature superior to that of the retort, is therefore gasified by fractions, and this fractionation is pursued in such a manner that at the end the oil is divided into two products: gas and coke. The proportion of coke is approximately 25 per cent of the weight of the oil. The coke forms an excellent combustible. Further, this process has the great advantage of furnishing a gas which yields no other condensation product, neither by cold nor by compression. That obtained by the other processes contains, on the contrary, some dissolved bodies in the gaseous state, which are deposited under certain conditions, while lowering, as a consequence, the illuminating power of the mixture.

The Peebles gas owes its illuminating power, for the most part, to ethylene and its homologues, as well as to acetylene. These hydrocarbons exist in the gaseous state under pressure of 12 atmospheres. The gas is used for ameliorating the quality of coal gas. In Germany no factory has made use of this system. Generally the manufacture of oil gas is associated with that of coal gas, and the retorts of the former are heated by the spent gases of the latter. The manufacture is so regulated that the gas delivered to consumers contains one-sixth of oil gas.

The method employed by me yields a gas which, under the pressure of 12 atmospheres, abandons a small fraction of its hydrocarbons in the form of minute liquid drops. On an average, 100 meters of this gas thus furnish 8 to 10 kilogrammes of liquid hydrocarbons, and the loss of illuminating power resulting from it approaches 25 per cent. The condensed liquid presents the following average composition:

Benzine	70 per cent
Toluene	15 "
Higher homologues	5 "
Homologues of ethylene	10 "

This mixture may easily be fractionated for the extraction of benzine and other useful products. The Prussian railway administration, which manufactures its own oil gas, extracts thus annually considerable quantities of benzine. Besides the employment of the latter in the manufacture of aniline, it may be used for carburizing coal gas. Krämer has also proposed a system of illumination based on the employment of 2 parts of alcohol and 1 part of crude benzine. This mixture may be employed in lamps where American petroleum is now burned, while the principal disadvantage of Russian petroleum is that they require lamps of a special pattern.

The tar of oil gas collected in the German factories has a density of 0.95 per cent. In appearance and odor it is very similar to coal-tar. Besides the aromatic carbides such as benzene and toluene and small quantities of naphthalene and anthracene, it also contains considerable quantities of hydrocarbons of the fatty series. Its composition is variable, depending on the manner of conducting the operation. Usually the proportion of aromatic carbides will be greater when the temperature of gasification is the more elevated. If the temperature is low, a part of the oil is found in the tar unchanged.

The distillation of this tar furnishes about 15 per cent of an oil, of which the greater part boils at 200 deg. C., and which is designated by the name of *crude benzol*. It may be employed like the portion of Peebles gas condensable under pressure. The residue of this distillation is employed like tar, either alone or mixed with other coal tars.

Oil gas, like ordinary coal gas, may be used directly for lighting; its illuminating power is four times as great. With an hourly consumption of 60 liters, an illuminating power of 60 candles is obtained in an Auer (Welsbach) burner. These burners are already employed with oil gas in lighting the streets and public buildings of Nettleben and Weissenfels.

The lighting of railway trains with oil gas has made considerable progress. In Germany more than 30,000 cars and 3,000 locomotives are lighted by this agent.

The Prussian Railway Company alone consumes annually 4,000,000 meters of this gas.

As to acetylene, its manipulation is not yet exempt from danger. The gas manufactured by the Pintsch company is a mixture of 80 per cent of oil gas and 20 per cent of acetylene. The illuminating power of this gas compressed is raised from 6.7 to 20.2 candles for an hourly consumption. It is true that, in this case, an oil gas of moderate illuminating power is employed. With a gas of good quality, the addition of 20 per cent of acetylene would only double the illuminating power. This mixture does not appear to be attended with danger, and may be utilized in the same burners as ordinary oil gas.

According to the statements of the Prussian Railway Company, the oil gas costs 92 centimes (17 cents) per meter. This price covers manufacture, the apparatus for storing and employment, as well as cost of all the material.

In ordinary plants, without reference to sinking fund, the cost of the manufacture of a meter of oil gas comes to 30 or 33 centimes (5.4 or 5.9 cents). For small

plants, the cost would be about 36 centimes (6.48 cents). Of this net cost, about 60 per cent must be set down for the oil itself, and 40 per cent for expenses of manufacture and the material.

SEEKING THE MAGNETIC POLE.

THE latest expedition which has set out for the Arctic regions is to engage in a comparatively unique investigation. Amundsen's purpose is very different from Peary's or Nansen's. He will not try, except incidentally, to enlarge the world's information of coast contours, and will probably have little to tell of rock formations, fossils, or existing animal or vegetable species in the field of his exploration. If successful, though, the Norwegian will make discoveries which should prove of great value to navigators in Northern seas and to those mathematicians who prepare for the sailor and land surveyor tables of correction for compass readings.

It has been known for centuries that the needle does not point exactly northward over all the Northern Hemisphere. When Greeley's party was at Lady Franklin Bay, twenty years or more ago, its compasses were directed about ten degrees south of westward. From similar observations it has been perceived that the magnetic and geographical poles do not coincide. Indeed, while there is only one geographical North Pole, there are indications of two magnetic North Poles, the chief one being situated near the northern coast of the American continent or in the archipelago beyond it. The minor pole is in Siberia. These facts alone would cause no inconvenience, perhaps, were it not that the amount of departure from the true north is forever changing. One theory which has been advanced to account for this phenomenon and kindred mysteries is that the Siberian pole has shifted its position or that its intensity has altered, thus causing a readjustment of its pull in competition with the American pole. Somehow the conviction that the latter has moved is less strongly entertained, although no one is in a position to make a positive statement.

Although experts in terrestrial magnetism have been able to make fairly trustworthy guesses about the American magnetic pole, only one previous effort has been made to find it by visitation. The first two expeditions to this part of the world by Sir John Ross were prompted by a desire to find the "northwest passage" to India. His third venture, which kept him nearly four years in the Arctic region, beginning with 1829, was a quest for the magnetic pole. His ship was frozen in and abandoned in the Gulf of Boothia. Subsequently, with boats, he worked his way out to Lancaster Sound, where whalers rescued him. Upon his return to England he reported that his dipping magnets occupied a vertical position when he reached latitude 70:07 and longitude 96:43 west of Greenwich. He was then upon the peninsula of Boothia Felix. Neumayer, the leading German authority in such matters, and the late Charles A. Schott, of the United States Coast and Geodetic Survey, located the pole in 1890, by computation only, from two to four degrees eastward, in substantially the same latitude as Ross. Owing to their lack of agreement and to the absence of any corroboration, of course those conjectures have little value.

Amundsen purposes to determine the question with precision by the only method upon which reliance can be placed. Though he may depart from Ross' programme in certain particulars, he will follow the earlier explorer's route up to a certain point. He intends to leave Baffin's Bay by way of Lancaster Sound and to push westward along the seventy-third parallel of latitude. When his work is finished he may be able to continue in the same general direction as far as Behring Strait and then come southward. The essential features of the enterprise are, however, that he will make magnetic and meteorological observations, and has food enough to last three or four years.

THE PRESERVATION OF BOOKS IN HOT CLIMATES.

By FRANK BROWNE, Government Analyst, Hongkong.

Books in hot climates quickly deteriorate unless carefully seen after. There are three destructive agencies which have to be guarded against: (1) damp, (2) a small black insect, (3) cockroaches.

(1) Books which are kept in a damp atmosphere deteriorate on account of molds and fungi which grow rapidly when the conditions are favorable. Books are best kept on open, airy, well-lighted shelves. When there has been a prolonged spell of moist weather their covers should be wiped, and they should be placed in the sun or before a fire for a few hours. Damp also causes the bindings and leaves of some books to separate.

(2) A small black insect, one-eighth of an inch long, and a sixteenth of an inch broad, somewhat resembling a beetle, is very destructive, and books will be found, if left untouched, after a few months to have numerous holes in the covers and leaves sufficiently large for the animal to pass through. If this insect be allowed plenty of time for its ravages it will make so many holes that bindings originally strong can be easily torn in pieces. All damage may be prevented by coating the covers of books with the varnish described under (3). When books are found to contain the insects they should be well rapped and put into the sun before varnishing.

(3) The appearance of a fine binding may be destroyed in a single night by cockroaches. The lettering of the binding may, in two or three days, be completely obliterated.

The following varnish has been found to prevent effectually the ravages of cockroaches and of all insects that feed upon books:

Dammar resin	2 oz.
Mastic	2 oz.
Canada balsam	1 oz.
Creosote	1/2 oz.
Spirit of wine	20 fl. oz.

Macerate with occasional shaking for a few days if wanted at once, but for a longer time when possible, as a better varnish will result after a maceration of several months.

Where it is necessary to keep books or paper of any description in boxes, cupboards, or closed bookcases, some naphthalene balls or camphor should be always present with them. If camphor be used it is best to wrap it in paper, otherwise it volatilizes more quickly than is necessary. In dry weather the doors of closed bookcases should be left open occasionally, as a damp still atmosphere is most favorable for deterioration.

THE ROMAN FORUM.

DURING the last few weeks, says the correspondent of the Morning Post, great progress has been made by the Director of the Roman Forum, Commendatore Boni, in this immeasurable field for exploration. Considerable light has been thrown on the subterranean galleries connected with the games held in the time of Cæsar in the Forum. It is now clear that there were twelve elevators, each of which was worked by four men ensconced in chambers adjoining the apertures, also twelve in number, through which the elevators were hoisted into the open Forum above. Signor Boni is confident that there was some means or communicating with all the twelve chambers simultaneously from the room in which the director of the games sat. There was probably some kind of a speaking tube or simple telephone, by the use of which at a given signal the twelve elevators could be made suddenly and simultaneously to rise from the bowels of the earth to the open Forum, and to deposit there the parties of gladiators ready for the fray. Signor Boni has had made a model of one of these elevators, instructive traces of which are still imbedded in the galleries underground. Nine of the elevators have still to be freed from equestrian statues which were set up above them at a later period, and this task must of necessity take some time. The foundations of these statues are in themselves so far interesting that they afford additional proof, if such were needed, of the callous manner in which any sort of material, whether valuable statue or portion of the Lapis Niger or some other remnant of interesting history, was utilized in later mediæval times as substructure.

Signor Boni has also just discovered the complete square basement of the Janus Medius, which used to serve as the meeting-place for the old Roman bankers. It occupies precisely the spot assigned to it by the ancient writers, near the Arch of Janus in front of the Tabernæ Argentariæ. This, too, has been greatly spoiled by the work of the builders of the middle ages, who sank wells and built latrine about it. In one of the wells have been found quantities of remains of animals, such as sheeps' jaws and goats' horns, and also fragments of pottery. In the middle of the road flanking the Basilica Julia he has also discovered ritual graves rectangular in shape, with a length of 4 and a breadth of 2 Roman feet, and divided by a space of not more than 10 Roman feet. In them he found a quantity of vases in the shape of chalices. He believes them to be augural graves used for expiatory libations after contamination with human blood.

While exploring under the substructure of the Heron of Romulus he came on a nearly complete prison composed of narrow passages leading to diminutive vaulted cells with tessellated pavements, and having a very strong sub-pavement of large, heavy flags of travertine to render the escape of prisoners impossible. As a further precaution perimetral walls of blocks of tuff lined with bricks were built outside. At the foot of the Palatine Hill, behind the Sacrum of Juturna and the Temple of Castor and Pollux, Signor Boni has discovered the remains of an old Imperial palace, consisting of a building with a large hall adorned all round with niches, and with a vestibule, transformed at a later date into a Christian sepulcher, used as late as the eighth century. The walls and columns are ornamented with frescoes finished in the eighth century, and covered with Greek inscriptions. In the central portion of the building is to be seen a painted representation of Pope Paul I., who was pontifex during the ten years succeeding 737.

In the neighborhood there are visible traces of four different layers of plaster, each decorated with paintings. On the top of one layer of plaster, which has a red surface, is another portraying a representation of the Madonna and Child, similar to those seen in the mosaics of the time of Teodorico. This painting covers in its turn another layer which shows traces of two angels painted in the sixth century. Above these, and painted during the middle of the eighth century, is a stratum of plaster showing figures of saints with nimbus in yellow and ascetic-looking faces. On the right is a series of paintings showing the figure of Pope Zacharias, the crucifixion of Christ, and the figure of Theodotus, uncle of Pope Paul I., who is represented as offering a model of the church, while in the Latin text adjoining he proclaims himself to be the "assisting advocate of Santa Maria Antica." This was the name of the Christian church which existed until the ninth century within the walls of the Imperial palace. Sixteen centuries, says Signor Boni, separate the tombs of the church of Santa Maria Antica from the Sepulcretum of the pre-Romulean Septimontium, which is now being rapidly explored.

Since I last wrote on the subject of these prehistoric tombs several new graves have been found by Signor Boni. One of them was being removed during my interview with Signor Boni, and it contained a very interesting black jar, which was tenderly placed on the table in the little museum. It was incrustated with damp earth, and has yet to be cleaned and put together. Another contained a skeleton, the head of which had been distorted by the subsidence of some blocks of tuff, with which the grave had been lined. In the grave of another skeleton, that of a child, several toys were found, and in another a lovely fibula of transparent amber hollowed out underneath in order to allow of the light entering more easily for the sake of still greater transparency.

Reopening of the Port of Mazatlan.—Consul Louis Kaiser writes from Mazatlan, Mexico, June 16, 1903, that that port has been declared open by President Díaz. All restrictions on traffic have now been removed.