like the Portland limestone that he called it "Portland cement," from which the commonly known name given to nearly all kinds of hydraulic cement was derived. From Aspdin's time to 1880 many mills were erected in England and on the Continent for making Portland cement, which was mostly poor stuff and of limited use.

The first Portland cement made in the United States was made by the Copley Cement Company, Copley, Pa., in 1875; their annual rate of production was 2,000 barrels.

It is not necessary to go into details here with reference to the manufacture and chemical composition of Portland cement, more than to state that the substance known as Portland cement consists largely of limestone with the addition of some silicate such as clay in certain proportions. In the process of manufacture these substances are crushed, introduced into rotary kilns under high temperature, and burnt together. The resulting clinker is taken and ground in some sort of ball or Griffin mill. It is necessary to grind cement to a very high degree of fineness, and its strength depends largely upon the degree of care with which this is done. It may be said that the modern cement mill is equipped with the machinery to do this suitably, as the requirements of engineers demand various tests before allowing cement to go into any work of importance.

The growth of Portland cement making in the United States has been rapid. In 1875 the annual production was 2,000 barrels per year; in 1890 (fifteen years later) it was 335,500 barrels; in 1900, 8,482,020 barrels; and in 1903 it was 22,342,973 barrels.

The importance of cement in the business world to-day is so great that not only have the different governments throughout the world taken up the matter of standardizing the tests determining the quality of cement, but it has also been done by various great engineering societies. Probably the standard work for testing cement is the publication issued by the Corps of Engineers United States Army entitled "Professional Papers 28." This pamphlet has been reprinted many times by private firms and translated into many languages.

The cost of Portland cement has annually decreased as the production increased, coming down from about $2.30 per barrel in 1890 to about $1.60 per barrel in 1900.

EHRLICH'S REMARKABLE STUDIES OF CANCER IN MICE.

The inoculation of mice with cancer is being practised on a very large scale by Prof. Ehrlich, of the Frankfurt Institute for Experimental Therapeutics.

The principal forms of malignant tumor are carcinoma, or true cancer, and sarcoma. Carcinoma occurs only in epithelium, the most important constituent of the glands and the outer layers of the skin; sarcoma only in connective tissue, which is found throughout the body. In man, mixed tumors (part sarcoma and part carcinoma) are very rare, and in mice they have never been known to occur spontaneously. But at Frankfurt a carcinoma that had remained true to type through nine inoculations, began to develop. The microscopical structure of sarcoma in the tenth mouse inoculated, became converted into a pure sarcoma in the fourteenth, and so remained during fifty subsequent inoculations. In another case a like change occurred suddenly, the characteristics of a mixed tumor appearing only in a single generation, the sixty-eighth. In a third case the mixed type seems to be permanent.

According to current theories carcinoma cells cannot change directly into sarcoma cells. The most plausible explanation of the transformation is that chemical changes in the carcinoma cells cause, through irritation, sarcomatous degeneration in the connective tissue and that the original carcinoma is crowded out by the more rapidly growing sarcoma.

Tissues and cells, whether normal or morbid, can be transplanted with success only from one animal to another of the same species or a species which forms hybrids therewith. Mouse cancer, for example, can be transmitted, permanently, to mice only. Nevertheless, if a rat is inoculated with very virulent cancer from a mouse, a tumor is produced which attains large size in a week, then diminishes, and usually vanishes entirely within three weeks after inoculation. Inoculations made from this tumor at the time of its greatest development have no effect on other rats but develop cancer in mice.

These facts cannot be explained by the assumption of a natural or "passive" immunity due to the preexistence of antitoxins in the rat's body, for such antitoxins would destroy the germs of mouse cancer on their introduction and the temporary swelling would not occur. An "active" immunity is certainly produced by the formation of antitoxins after, and because of, the inoculation, for a second inoculation fails to cause even temporary swelling. But this hardly suffices to account for the absorption and disappearance of the tumor, in view of the fact that the latter retains sufficient virulence to infect mice inoculated with it.

Ehrlich therefore has been led to the conception of "atreptic" immunity, or immunity due to starvation of the cancer cells. He assumes that the cell of mouse cancer requires for its growth, in addition to the general nutriment which is furnished in abundance by the rat as well as the mouse, a special nutriment which is found only in mice. The small quantity of this substance which is transferred to the rat, together with the cancer cells, in the act of inoculation maintains the growth and multiplication of those cells for a short time, but when the nutriment thus introduced has been consumed, the growth of the tumor necessarily ceases. After this moment, therefore, inoculation of a second rat with cells from this tumor can have only a negative result, because more of the special nutriment remains to be transferred with the cells, but a similar inoculation produces a rapid cancerous growth in a mouse, the body of which contains the special nutriment in abundance.

This theory also explains the often observed fact, that in a mouse in which a large tumor has been produced by inoculation a second tumor cannot be produced by inoculation from the first one. For, as the first tumor has grown rapidly and is well provided with blood vessels, it has so nearly exhausted the supply of the specific nutriment contained in the blood of the animal that the second inoculation falls, so to speak, upon barren soil.

Ehrlich explains the growth of tumors, according to the modern cell theory, by assuming that the morbid cells surpass the normal cells in the power to seize and appropriate food. Now comparatively few of the tumors which occur spontaneously in mice are transmissible to other mice by inoculation. The cells of most varieties of tumors, therefore, have no such advantage over the ordinary cells, and the spontaneous occurrence of a non-transmissible tumor is due, not to an increase in the assimilating power of the cells of which it is composed, but to a diminution in the assimilating power of the ordinary cells, that is to say, to the general debility of that individual mouse. This view is in perfect accordance with the facts learned by experience, that human cancer is most prevalent in advanced age, when the entire organism is debilitated, and that hereditary and constitutional peculiarities are also important factors in its causation.

The tumors of mice show great differences in virulence, as appears from the ease, difficulty, or impossibility of transmitting them by inoculation. Most spontaneous cases of carcinoma in mice cannot be transmitted at all, but the most virulent cases often give 100 per cent of successful inoculations. Ehrlich has proved, however, that inoculation from an ordinary, non-transmissible tumor, though it does not reproduce that tumor, has the remarkable effect of making the inoculated mouse immune to subsequent inoculation with tumors of the most virulent type. This result makes it possible to make any mouse immune to carcinoma by repeated inoculations with non-virulent growths and it has been proved that this immunity is not specific, but includes every variety of malignant tumor of either epithelial or connective tissue that has been propagated at the Frankfurt Institute. It would, of course, be premature to draw from these very interesting discoveries the inference that an effective cure for human cancer is within reach, but these results indicate that the experimental investigation is tending in a direction which provides a more hopeful view of the solution of the cancer problem than has been afforded by all previous study of the subject.

CONCRETE: ITS RISE AND ITS APPLICATIONS.

The history of concrete dates back to the Roman period, and its growth seems to have followed and is proportional to the growth of the Portland cement industry. The word "concrete" to engineers and contractors has a very definite meaning, but to those not familiar with the subject, the word "concrete" often suggests a "tar sidewalk." Concrete is a substance composed of broken stone, sand, and cement, or sand, gravel, and cement mixed together with water in certain well-defined proportions determined by experience. The resulting mixture is a pasty, jelly-like substance, which can be placed in excavations or box-like forms and allowed to harden or "set," as it is called. In the course of twenty minutes or a half hour it will have undergone what is called the "initial set." In other words, it changes its physical condition from that of a semi-fluid to that of a solid, and while it is not then hard it is a solid. The hardness of the "permanent set" will depend on many things. With good cement this hardness will grow with age, and there are some cements which show from tests a continual growth in strength and hardness for many years. There are many cements called "quick-setting" cements, which take on a permanent set in a short time and show a high strength; but it has been determined by experience and tests, however, that quick-setting cements are not so good or stable in the end as the slow-setting article, which grows in strength indefinitely.

With the increased production of Portland cement the use of concrete has been rapidly growing, and to-day it is simply a question of expense, as concrete masonry can be built for very much less than stone masonry, the result being the marked displacement of the latter. It is used at the present time for making dwelling houses, factories, chimneys, dams, water tanks, railway ties, and fence posts. In fact, it is hard to name a structure in the present day that has not been built of concrete. The introduction of armored or reinforced concrete has still more widened its field of usefulness.

FLUID LENSES.

A report from Consul-General W. A. Rublee, at Vienna, states that after experiments extending over a number of years a Hungarian chemist has succeeded in producing optical lenses by a simple and cheap process, that are not only quite as good as the best massive glass lenses at present used, but that can be manufactured of a size three times as great as the largest homogeneous glass lens heretofore made.

The importance of this invention in the field of astronomy is obviously very considerable. The largest glass lens heretofore manufactured out of massive glass for astronomical purposes has a diameter of about 1.50 meters (4.92 feet), and it required several years to make it, while the price was several hundred thousands of marks (1 mark = 23.8 cents). Such a lens can be manufactured by the new process in a few weeks at a cost of 2,000 or 3,000 marks. The price of a glass lens of the best German manufacture, with a diameter of 25 centimeters (9.84 inches), is now about 7,000 marks, whereas the price of a similar lens made by the new process is about 150 marks. Lenses of smaller diameter for photographic purposes, for opera glasses, reading glasses, etc., can be produced at correspondingly smaller cost. The lens consists of a fluid substance inclosed between two unusually hard glass surfaces similar to watch crystals, in which the refractive power and other characteristic properties are so chosen that the glass surfaces not only serve to hold the fluid, but also combine with the fluid to overcome such defects as are scarcely to be avoided in ordinary lenses. It is for this reason also that the lens is achromatic.

The fluid contained in the lens is hermetically sealed, so that no air can enter and exercise a damaging effect. The fluid does not evaporate, and its composition is such that its properties are not affected by time or by temperature. The coefficient of expansion, both of the glass and of the fluid, is approximately the same between the temperatures of 15 deg. of cold to 60 deg. of heat. Another advantage of the lens is that, on account of the fact that the fluid is not dense and the glass crystals are thin, the whole lens combination through which the light must penetrate is very slight.

RESISTANCE OF THE HUMAN BODY TO AUTOMOBILE ACCIDENTS.

The remarkable increase in the number of heavy and high-speed automobiles has not been without its effect upon the number of casualties which the newspapers daily chronicle, and which the comic papers seem to find so amusing. Dr. E. M. Foote, of New York, has unconsciously added fuel to these numerous fires by the preparation of an elaborate paper on accidents occasioned by wheels, particularly by wheels provided with elastic tires. If a sportsmanlike chauffeur has any yearning to run down human beings without actually killing them, he has but to study Dr. Foote's paper.

Dr. Foote's investigations were undertaken after a rather remarkable accident. An automobile delivery truck weighing about two tons passed over the trunk of a ten-year-old child without occasioning death. An investigation conducted by Dr. Foote for determining the cause of this abnormal result, led him to consider in a human body extended on the ground a line which he terms the "line of mortal pressure." The position of this line is dependent upon a host of factors, such as the weight of the vehicle, the width and elasticity of the tire, the speed of the vehicle, condition of the ground, clothing of the victim, mechanical resistance of the bones, contraction of the muscles. If the wheel of a vehicle strikes that line, death will probably result.

WHY DO STARS SEEM RAYED?

An attempt to account for the familiar rayed or starlike appearance of the stars when seen by the naked eye is made by W. Holtz in an article on the "Appearance of Stars," which appeared in Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse. He finds that all stars show precisely the same rays, but that in the case of the brighter stars the rays are plainer and somewhat longer. It is further remarked that the rays seen by the left and right eyes differ, and that if the head be turned the rays are rotated in a corresponding manner. It is thus concluded that the source of the rays is not in the stars but in the eye itself, the middle of the retina being not perfectly homogeneous in its sensitiveness.