

from eighteen to thirty-five degrees below zero, the ice in the path of the "Pere Marquette" varies from hard blue ice of a foot thickness to fifteen feet of snow ice where it has windrowed; and yet the vessel has never consumed more than forty-eight hours in making any one trip.

All of these car ferries are provided with the necessary jack-screws, chain, clamps, etc., for firmly securing the railroad cars; and the loading and unloading docks are equipped with a novel device corresponding to a giant gang-plank, which adjusts itself to the movement of the waves and thus enables cars to be transferred even though a heavy sea be running. There have been occasions in rough weather when cars have been loosened from their fastenings while in transit, and have collided with other cars, inflicting considerable damage; but, of course, these instances are rare.

Occasionally, too, the smaller and less powerful car ferries, such as those in service across Lake Erie from the American to the Canadian shore, become imprisoned in floating fields of ice, and a year or two ago the ferry steamer "Shenango" was thus imprisoned for nearly a month.

At almost every port on the Atlantic coast from Boston to the Chesapeake car-ferry steamers, of a distinctive American type, are in service transporting cars for comparatively short distances. Few of these boats, however, are capable of carrying more than a dozen cars, and in many cases the capacity does not reach that figure. Some of these vessels have cost as much as \$200,000, so that it will be seen that a fleet of a dozen or more boats, such as some of the more important railroads operate, represents quite an investment. Car ferries are also in service at some points on the Ohio, Mississippi and other inland rivers; but they conform to the general type, except so far as they are of light draught, drawing in some instances only two or three feet of water.

#### VACCINE VIRUS—ITS PREPARATION AND ITS USE.

Variola or smallpox is said to have found its way into Europe in the seventh century, and to have been almost continuously present since. It was a permanent plague, against which no one was safe. Queen Mary, of England, and Louis XV., of France, both died of the disease. So widespread and deadly were the epidemics in the first three decades of the eighteenth century that seventy-four out of every thousand deaths were caused by smallpox. Helvetius, physician to the King of France, about 1723 referred in one of his works to the "almost unavoidable necessity of undergoing it at one time or another." The prevalence of the evil led English physicians to adopt the practice of inoculation with smallpox in 1721; but it was soon recognized that, although the individual thus treated usually suffered only a mild illness and escaped another attack of smallpox, the practice not only failed to reduce, but even multiplied the

cowpox." It was a belief which, although common enough at the time, was held by most medical men to be based upon an imperfect induction from the facts. But Jenner, being a man of discernment and reflection, began a series of observations, and at last of actual experiment. On May 14, 1796, he inoculated an eight-year-old boy with matter taken from a vesicle in the hand of a dairy-maid smitten with cowpox. So perfect was this vaccination that the boy was inocu-



GRINDING AND EMULSIFYING THE PULP.

lated with smallpox on the first of the following July without taking the disease. Two years later (1798) Jenner published his famous work, "An Enquiry Into the Causes and Effects of Variola Vaccinæ." In the following year vaccination was introduced in the London Smallpox Hospital; and in 1800 the practice was begun in this country through the efforts of Dr. Benjamin Waterhouse, of Cambridge, Mass.

In the early part of the century vaccination was effected almost entirely from arm to arm—a method which is largely followed in London to this very day. But toward the middle of the century vaccine virus obtained directly from an animal began to be used in Italy. Although first regarded as the whim of an Italian physician, the custom of vaccinating with

at this admirably-equipped New York laboratory.

Until 1876 arm-to-arm vaccination was usually practiced in New York, the lymph being taken only from a primary vaccination vesicle of a child a few months old and only on the eighth day. But human lymph has always been objectionable, in that it is a possible source of infection of a most serious blood disease. In 1876 the city Health Department started a vaccine farm, and out of this has grown the present vaccine laboratory. This laboratory at present occupies a three-story building of brick, the ground floor of which is divided into a stable, a receiving-room, an operating-room, and a sterilizing-room, and the second floor of which contains, besides laboratories for general bacteriological work, two preparing-rooms into which the virus is received after it has been collected in the operating-room.

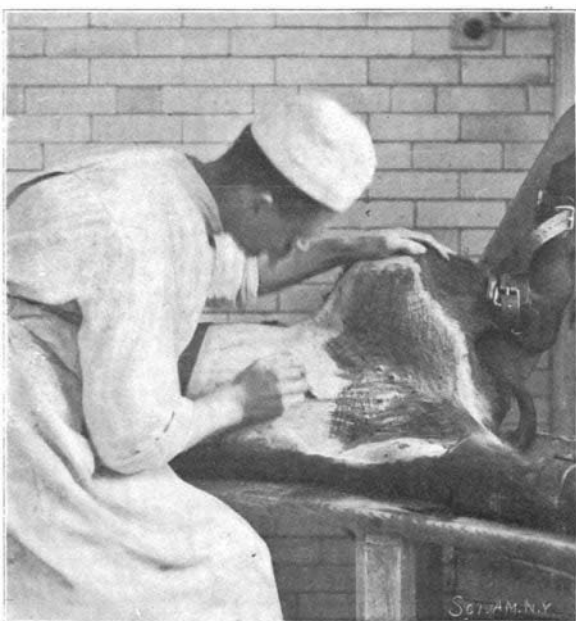
The stable contains fourteen calf-stalls, having iron posts and side guards, revolving stanchions, and removable flooring. The operating-room resembles a hospital operating-room; it has a cement floor, enameled brick walls, and contains merely the operating furniture, a special table, enameled stools, wash-basins, and tables for instruments.

The preparing-rooms are provided with hydraulic pumps, each connected with two metal pipes used respectively for suction and blast. The free ends of these pipes are distributed along narrow benches at which the virus is drawn into capillary tubes, and the tubes hermetically sealed.

A calf before it is admitted to the stable is weighed, and its skin carefully examined. The body is curried and brushed; the feet are washed and scraped; and the hair is clipped from the tail. While at the laboratory the calf is fed exclusively on milk. Its condition is noted each day on a card hung beside its stall.

Placed beneath a window in the stable is a table of suitable form to which the calf is securely strapped. The posterior abdomen and inside of the thighs are washed with hot water and shaved—the first step in the preparation of vaccine. From the stable the calf is led to the operating-room and

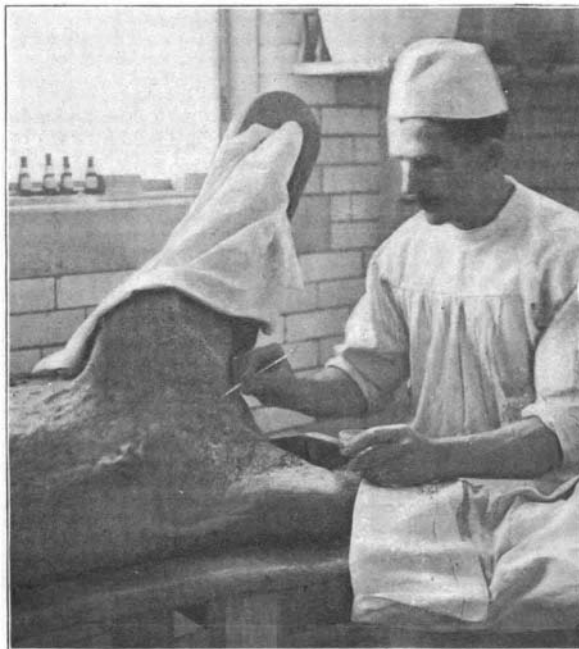
strapped on the operating-table. The shaved abdomen and thighs are again washed and then scarified with superficial linear incisions made with a surgeon's knife—a process which is not painful and entails but slight discomfort. The calf is now ready for inoculation. Into the bleeding incisions made by the knife, vaccine (cowpox) virus is carefully smeared with an ivory or metal instrument, after which the calf is returned to the stable. In a few days the entire scarified vaccinated surface is covered with vesicles, and from these the virus is obtained. On the sixth day the calf is led again to the operating-room and laid on the table. The area is most carefully cleansed. With a curette, a scoop-like instrument generally used by surgeons for digging out dead bone or morbid matter, the vesicles, technically called "pulp," are picked off, deposited in a small cup, and weighed. In the operating-room, and removed but a few feet from the table, a pulp-grinder is seated, whose duty it



SCARIFYING A SHAVEN HEIFER.

sources of contagion and thus indirectly increased the number of deaths. During the present century the frequency of the disease has decreased wonderfully. In the five years extending from 1893 to 1898 there were but one hundred and twenty-six deaths in all England and Wales; and from 1895 to 1899 there were but thirty-six deaths in the city of New York.

About 1768 a woman said in the hearing of Edward Jenner: "I cannot take that disease, for I have had



COLLECTING THE PULP WITH THE CURETTE.

animal virus spread rapidly throughout Europe and the United States. In most European and a few American cities there have now been installed laboratories for the preparation and distribution of bovine virus. Many of the American laboratories have been patterned after the vaccine laboratory of the Health Department of New York. In order to show how vaccine is made, it is our purpose to describe in the present article the methods which are followed



THE INSTRUMENT-TABLE.

is to emulsify the collected matter. Before him is a small mill comprising four glass rollers superposed in pairs, geared together, and turned by a crank; and upon the rollers 60 per cent glycerine in water is allowed to drop from a burette such as every chemist uses in volumetric analysis. As it is ground in the mill the pulp is emulsified in the glycerine. The hard pulp collects on a scraper and is returned by the grinder to the top rollers in order to be

reground and further subjected to the action of the glycerine. The glycerinated virus from each calf is clinically tested in three insertions on each of five or more previously unvaccinated children. As a general rule 100 per cent insertion success is secured. During the tests, which extend over many days, the glycerinated virus is stored in large, hermetically-sealed tubes, properly labeled to insure identification. If the results are favorable, these tubes are taken to the preparing-room and emptied into small conical cups. From these cups the virus is drawn up into small capillary glass tubes, each tube containing enough virus for one vaccination. The ends of the tubes are then hermetically sealed with a blow-pipe. In order to ascertain whether this sealing is perfect, every tube is tested.

From the preparing-room, the filled and tested capillary tubes are taken to a packing-room, where each tube is inserted in one of the four grooves of a wooden holder shown in one of the illustrations. The other three grooves receive respectively a little rubber tube, a needle, and a small wooden spade resembling a toothpick. Thus charged, the wooden holder is slipped into an envelop on which directions for using the virus and the simple instruments by which it is accompanied are printed. According to these directions, the surface of the skin is to be scarified with the needle, the ends of the capillary tube are to be broken off, the small rubber is to be slipped over one broken end, and the virus is to be blown upon the wooden spade and thoroughly rubbed into the scarification. These printed envelops and their wooden holders are distributed by the Health Department to its various supply stations throughout the city and sold for ten cents each.

The theory of the action of vaccine on the human organism depends upon the relation of smallpox to cowpox. The novel elements of Jenner's discovery consisted not only in inoculating his patients with cowpox, but in boldly declaring that cowpox was "smallpox in the cow." For his temerity Jenner has been either sharply rapped over the knuckles by his contemporaries and by many modern physicians, or fulsomely praised as one of the most brilliant of investigators. Thousands of experiments have been made for the purpose of refuting or confirming Jenner's assertion; but even to this day the relation of cowpox to smallpox is almost as mysterious to us as it was to the physicians of Jenner's time. Inoculation of smallpox virus in the eighteenth century produced a disease which was extremely mild, and which frequently manifested itself by a single vesicle at the

it has been shown that vaccine virus can be collected from horses, pigs, rabbits, monkeys, guinea-pigs, sheep, goats, and white rats; while attempts to inoculate the disease in dogs, cats, and mice have so far failed.

The duration of the immunity secured by vaccination varies considerably. Rarely does a single vaccination give immunity for life. Susceptibility returns between the seventh and tenth years, as a general rule. A second vaccination may, or may not, give immunity for the remaining period of life. Susceptibility may return again and again. But widely



FILLING THE CAPILLARY TUBES.

as the effects of vaccine inoculation may vary, it is certain that an attack of smallpox in a vaccinated person is generally milder than in the unvaccinated, and is rarely fatal. Failure of vaccination by active virus means merely that the person vaccinated is, at the time, immune, but tells absolutely nothing of the conditions which may prevail a few months later. Sometimes susceptibility to smallpox returns in a year after vaccination. Even an attack of smallpox itself, contrary to popular belief, does not always confer total immunity.

#### Athens Observatory.

The Annals of the Observatory of Athens have been recently published in two volumes by M. Demetrius Eginitis, Director of the Observatory. This establishment was founded, 1843-1846, by the liberality of the Baron George Sinas, consul from Greece to Vienna. It has undergone many vicissitudes during the latter half of the century, and the regularity of the observations has been many times compromised by the events which have occurred in the peninsula. The Observatory was completely reorganized in 1890 and placed under the direction of M. Eginitis; since that time it has worked regularly and rendered great service to Greece and the neighboring regions by its meteorological and seismic observations. The result of this work is contained in the present volumes. The first of these contains a long study of the climate of Athens; the author has collected, verified and condensed the ancient observations and those of the last fifty years; the first fourteen chapters thus relate to the barometric pressure, temperature, winds, rain, etc., as well as optical phenomena (halos, rainbows, etc.), and to the temperature of the soil and sea. The portion of the work relating to observations proper includes a description of the meteorological instruments of the Observatory and of such observations made at Athens in 1894 and 1895. The second volume contains an important memoir upon the ancient observations of meteorite showers. The author finds that in the works of Nikephoros, Theophanes and Kedrinios, mention is made of three meteorite showers which he fixes at 752, 532 and 558 of the Christian era. The circumstances which accompanied these showers indicate that they belonged to the Bielides, and this hypothesis is confirmed by our knowledge of the periodicity of this group. But the different showers do not appear to have belonged to the same group of meteorites; those of 532 and 752 belong probably to the same fragment of the Biela comet, other than that which gave rise to the shower of 558, in the same way that the Bielides of 1798 and 1838 seem to belong to a group of corpuscles different from that producing the showers of 1872 and 1892. This confirms the idea of the author as to the slow disaggregation of the Biela comet. The second part of the volume contains observations upon meteorites, meteorological observations made at Athens in

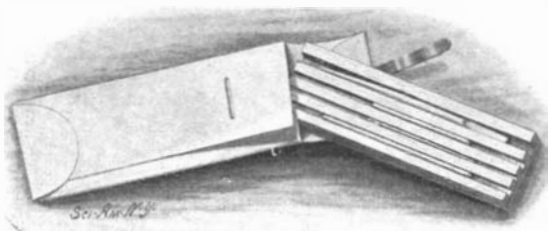
1896 and those upon earthquakes made in Greece from 1893 to 1898.

#### Method of Recognizing Blood Spots.

One of the interesting points brought before the Congress of Medicine at Paris was a new method discovered by Dr. Ladislas Deutsch, of Budapest, by which the origin of blood-spots may be recognized; this will no doubt be of great value in legal decisions. Recent experiments have shown that if cells of a definite nature, such as the red globules of blood, are introduced into the organism of an animal the serum of this animal acquires the property of destroying these specific elements, becoming thus hemolytic, according to the term used. This solvent power is specific, and the author proposes to take advantage of it in the medico-legal diagnosis of blood-spots. This diagnosis has been one of the most difficult problems; the red globules of mammals could be separated from those of birds, but owing to the small variation in size those of the different mammals could scarcely be separated. With the use of hemolytic serums the diagnosis now becomes quite easy. It is only necessary to take up the stains with salt water (9 per cent) and add a few drops of the different serums. The serum which dissolves the most rapidly the globules in question, that is, in a few minutes, indicates exactly the origin of the globules. Thus, supposing that according to the testimony of the accused the spots come from a sheep, it only need be observed whether the corresponding serum for such globules dissolves it or not; if so, the origin is determined, if not the trial is continued by treating another portion with the serum for human globules, which is easily obtained by immunizing a laboratory animal (rabbit, guinea-pig, etc.) against these globules. This latter serum, by dissolving the globules of the spot in question, show clearly their human origin. This diagnosis is easily made and appears to be certain in its results. It is only necessary to be provided with the serums for most of the common animals and for human globules, and with a dozen or more serums it is easy to determine in most cases the origin of the blood-spots.

#### The Current Supplement.

The current SUPPLEMENT, No. 1307, is an unusually attractive number. "Electrical Illumination of the Pan-American Exposition" is accompanied by a number of engravings. "The Telegraphone" is by V. Poulsen. "Contemporary Electrical Science" has a number of short notes. "The Geological Society of America" is an abstract of the papers read at the meeting of the society, and is compiled by Edmund O. Hovey. "Recent Science" is by Prince Kropotkin. The usual Trade Notes and Receipts are also published. Prof. Robert H. Thurston's important paper upon the "Steam Turbine: Steam Engine of Maximum

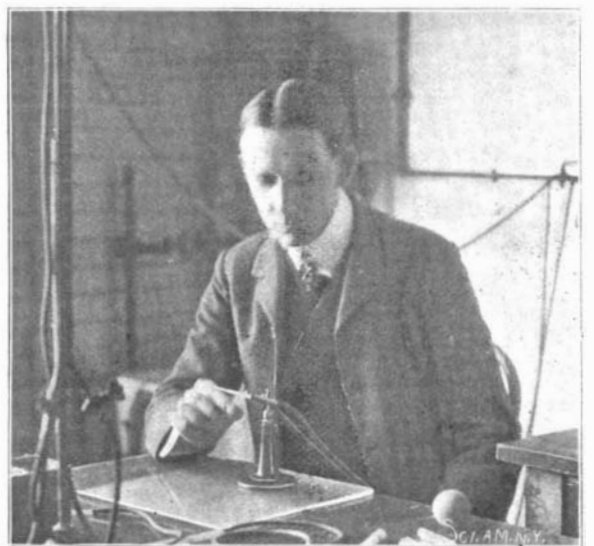


THE HOLDER AND ITS ENVELOP.



PACKING THE WOODEN HOLDERS FOR DISTRIBUTION.

point of inoculation. In the early part of the century such inoculation was sometimes mistaken for vaccination. Smallpox, it is certain, can be modified; and if cowpox be merely a modified and attenuated form of smallpox, the protection which the former affords against the latter is comparable to the immunity conferred by many other infectious diseases which occur usually but once. Cowpox is an infectious disease which is found not only in milch cows, but in other animals as well. Jenner himself traced cowpox back to the "grease" found on horses' hocks; and "grease" was successfully used by Jenner and many continental physicians for vaccinating purposes. At the New York Health Department Vaccine Laboratory



SEALING THE CAPILLARY TUBES.

Simplicity and of the Highest Thermal Efficiency" is continued in this issue.

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