AMERICAN CAR FERRIES.

BY WALDON FAWCETT.

There would appear to be but small doubt that the car ferry, at least in anything approaching its present form, is an American invention, and certainly the process of development through which it has passed during the past few years has resulted in the evolution of a singular type of craft. Car ferries may, perhaps, be best described as connecting links in railway systems crossing stretches of water so expansive that to bridge them would be either impracticable or very costly. In appearance they are suggestive of the flat-bottomed boat, being somewhat "tub-like," in order that space may be provided on the main deck for the storage of the greatest possible number of railroad cars.

In size the car ferries in service in American waters range all the way from the small ferry steamers in service on some rivers, and which mayhap have not room for more than one or two cars, to the immense vessels built especially for this work which are in commission the year round on the Great Lakes and are capable of transporting at one time nearly three dozen loaded freight cars. The car ferries in the great fleet now in service in the United States include both steamers and barges or floats, which having no power of their own, must be towed either by tugs or car ferry steamers. Some of the vessels have only a single railroad track down the center of the deck, while others have four tracks abreast, each only a little short of 300 feet in length.

The greatest interest attaches to the car ferries on the Great Lakes, not so much because they are the largest and most powerful in the country, as from the fact that they have been constructed especially for ice-breaking, in order that communication might be maintained throughout the winter on the frozen inland seas. They served as the models for the great ice-fighting steamers which the Czar's government has had constructed at great expense during the past few years in order to keep open some of the more important Russian ports, heretofore closed to navigation during many months of the year. The Russian engineers visited the Great Lakes in the dead of winter and studied the operation of the car ferries, and the Detroit naval architect, who designed most of the American vessels, was later summoned to St. Petersburg for purposes of consultation.

The car ferry of ice-crushing propensities is, it may be noted, a comparatively recent acquisition, even in this country. Until a decade and a half ago the railroads having termini at ports on the Great Lakes were dependent solely upon iron-shod ferry-boats. At some places, as for instance at Detroit, where the cars need be ferried only across a river with a fairly swift-running current, little difficulty was encountered by these vessels in keeping communication open, but farther north, at the Straits of Mackinaw and in other localities where there is a considerable expanse of open water, it was frequently found impossible to keep a path open through the ice fields, and the interruptions of freight and passenger traffic which resulted were both annoying and expensive to the railroad companies. The idea of the ice-breaking car ferry steamer, as at present constructed, was discovered purely by accident by a party of railroad officials and ship builders who stood, one day, watching one of the old-fashioned ferry-boats backing away from an ice-bound wharf. As the vessel made successive trips back and forth across the river, it was noted that she made her way against the ice better when going astern than when steaming forward in the usual way. To an engineer who was present this circumstance suggested grave possibilities, and he undertook experiments immediately thereafter, with the result that he discovered that a disrupting influence of considerable magnitude was exerted upon the ice by the disturbance of the water due to the rapid revolutions of the propeller wheel.

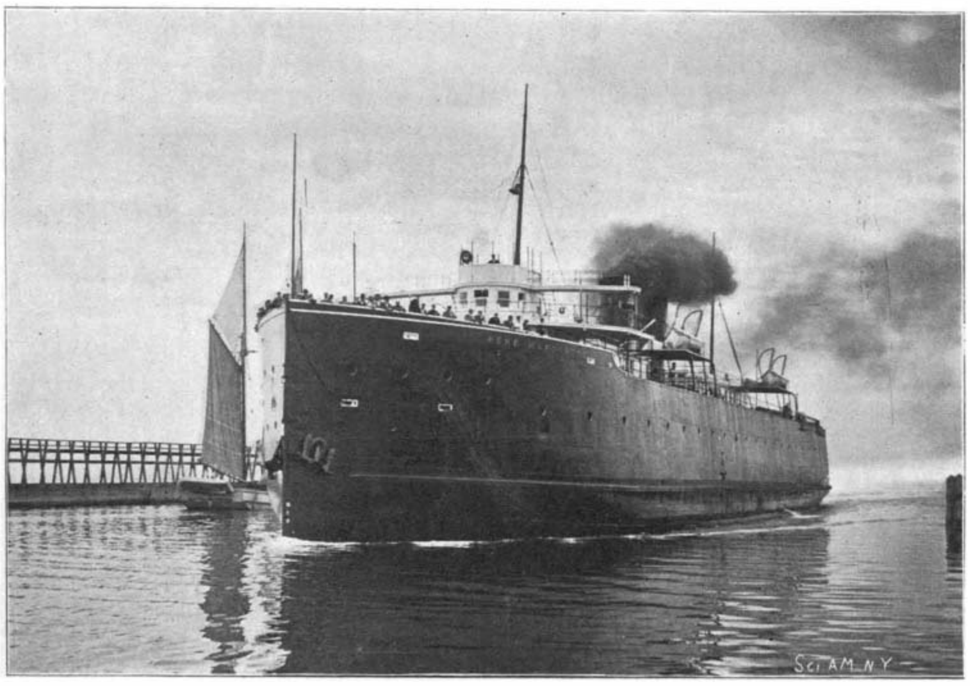
The outcome of the matter was the submission of a proposition for the construction of a car ferry steamer fitted with a screw propeller at each end. It was argued that, thus equipped, a vessel would not only have the requisite force to drive her forward at the speed required, but would also be provided with a weapon which could be used effectively against ice of great thickness. How meager, however, was the original conception of the magnitude of the project may be imagined from the fact that whereas $75,000 was the original estimate of the cost of such a vessel, it was found when it came to placing the contract that the expenditure would necessarily exceed $285,000.

Three of the principal railroads in Michigan made the construction of the vessel a joint project, and in 1888 the "St. Ignace," as she was called, went into service between Mackinaw City and St. Ignace, a distance of eight miles, and henceforth passenger and freight trains were transferred complete between these two ports. The "St. Ignace" was 235 feet in length, 52 feet beam, and of 1,200 tons burden. The slanting prow, which had been a distinctive characteristic of the old-fashioned car ferries, was retained in the new boat. It aided in the crushing, a work which was, of course, rendered all the easier by the action of the forward propeller in sucking the water from under the frozen field.

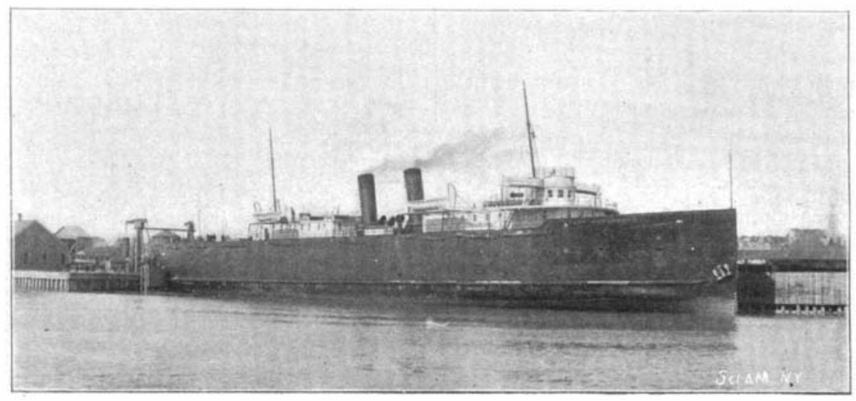
After half a dozen years of efficient service the "St. Ignace" was found to be incapable of accommodating the increasing railroad traffic, and there was constructed, at a cost of a third of a million dollars, that powerful ice-breaking ferry steamer the "Sainte Marie," which weighs upward of six million pounds and plows her way through ice several feet in thickness. The "Sainte Marie" is 305 feet in length and 53 feet beam. The hull below the water-line is of the heaviest oak construction, sheathed with quarter-inch steel, and the vessel is fitted with engines of 4,500 horse power.

Probably the most remarkable car ferry steamer on this continent, if not in the world, is the "Pere Marquette," which is operated between Ludington, Mich., and Manitowoc, Wis., and which has succeeded in keeping navigation open on her fifty-six-mile route across Lake Michigan during the severest winters of the past decade. This vessel is 350 feet in length, 56 feet in breadth, and 36 feet deep. She displaces over 4,000 tons on a draught of twelve feet, and her usual cargo consists of thirty loaded freight cars. When the "Pere Marquette" went into dry dock for repairs in the autumn of 1899, she had traveled more than 40,000 miles without any attention from the refitters, and when it is explained that much of this service had been at a speed of ten miles per hour through ice fourteen inches thick, some idea of the wonderful staunchness of the vessel may be gained.

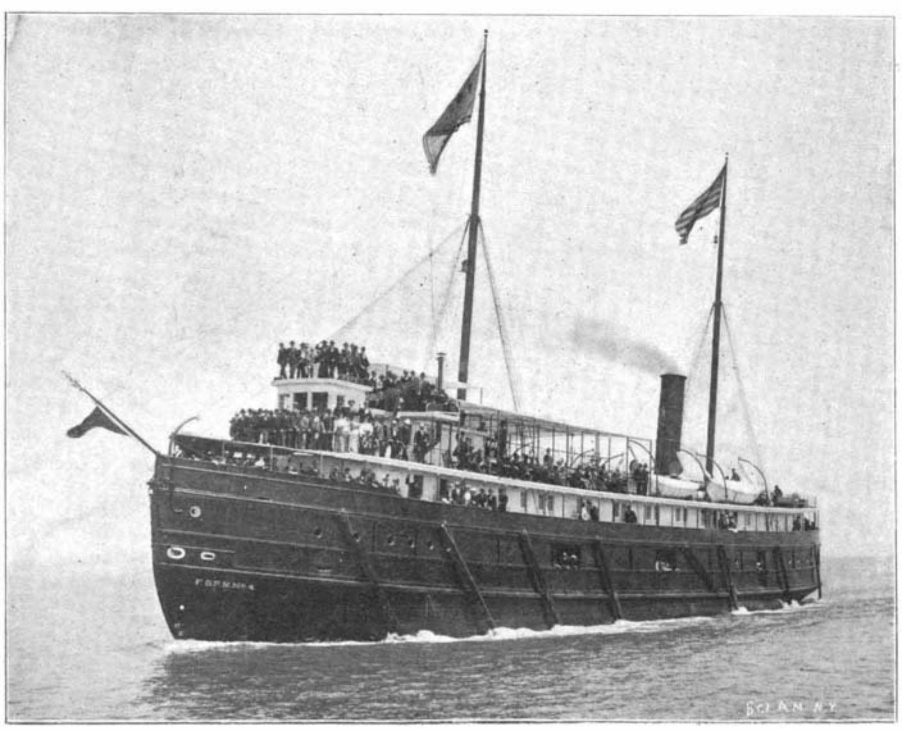
It will doubtless surprise many readers to learn that officers of the Flint & Pere Marquette Railroad Company, which operates the vessel just described, are unanimous in the declaration that she does more satisfactory work in the intensely cold weather than when a milder temperature prevails. Very frequently in the dead of winter, when the thermometer ranges



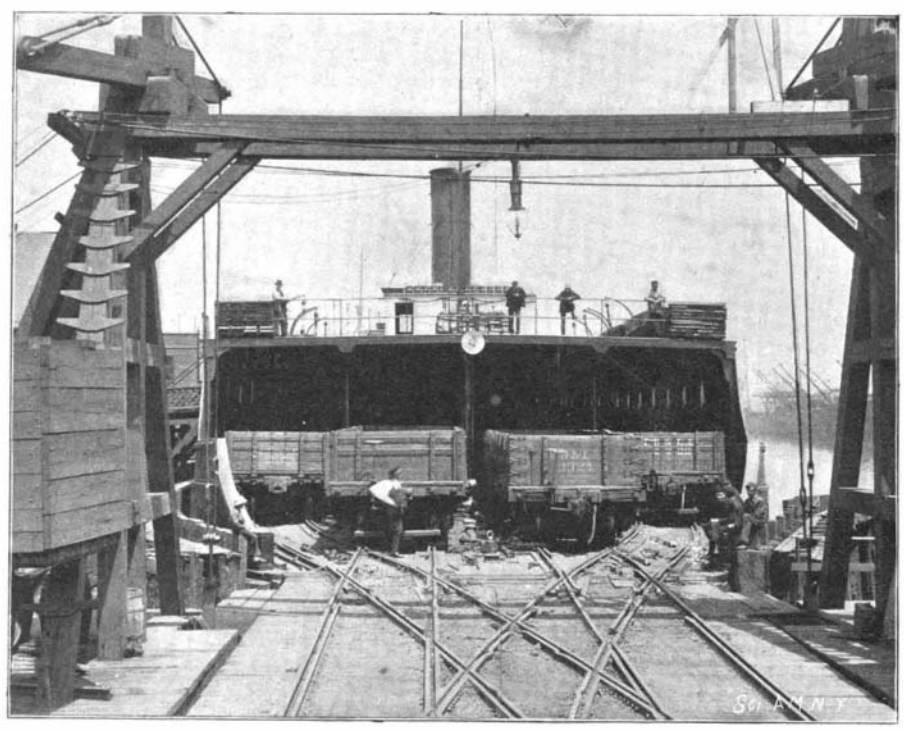
THE "PERE MARQUETTE."
Length, 350 feet; beam, 56 feet; depth, 36 feet; displacement, 4,200 tons; capacity, 30 loaded freight cars.



THE "PERE MARQUETTE" BACKED INTO HER LOADING SLIP.



AN "OLD TIMER."



LOADING CARS ON A FOUR-TRACK CAR FERRY.

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.

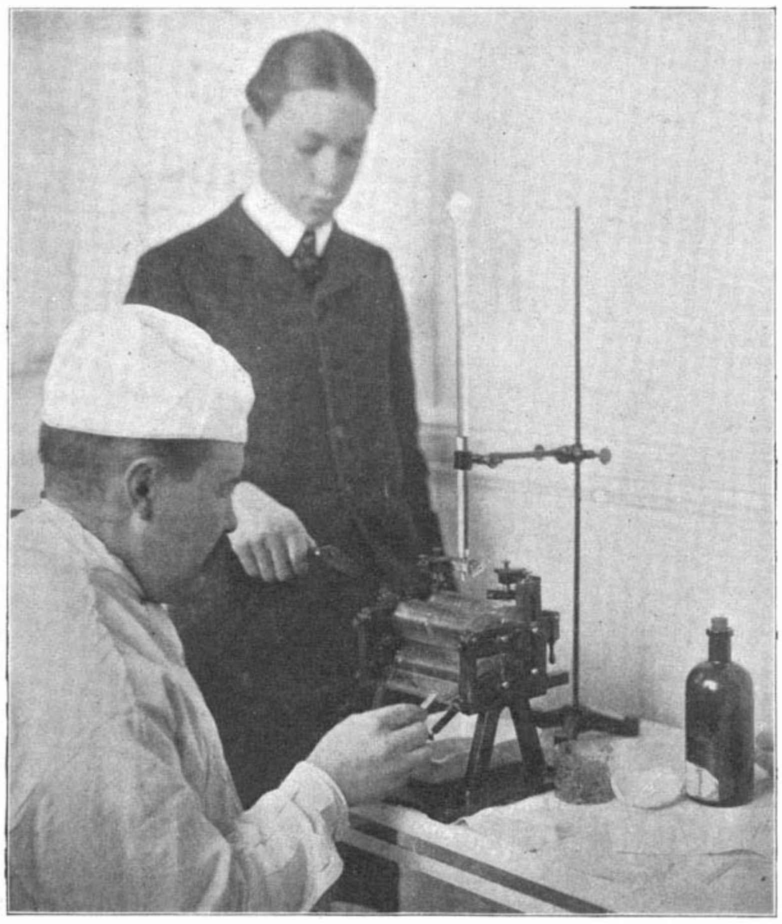
Occasionally, too, the smaller and less powerful car ferries, such as those in service across Lake Erie from the American to the Canadian shore, become imprisoned in floating fields of ice, and a year or two ago the ferry steamer "Shenango" was thus imprisoned for nearly a month.

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.

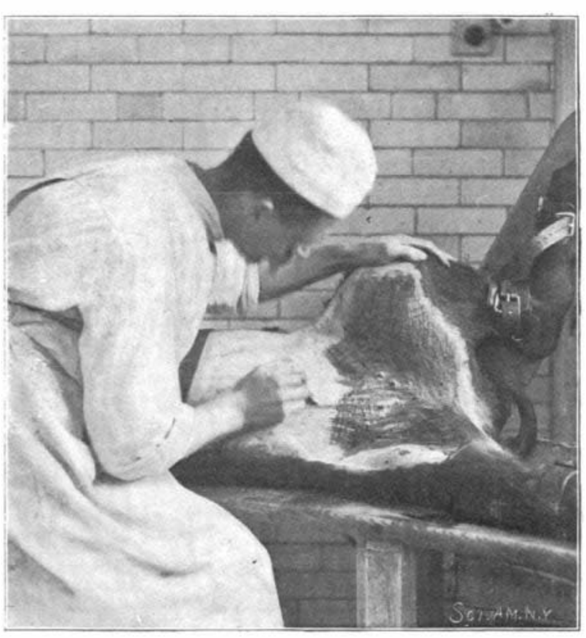
VACCINE VIRUS—ITS PREPARATION AND ITS USE.

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 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.

bout 1768 a woman said in the hearing of Edward r: "I cannot take that disease, for I have had 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 inoculated 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.

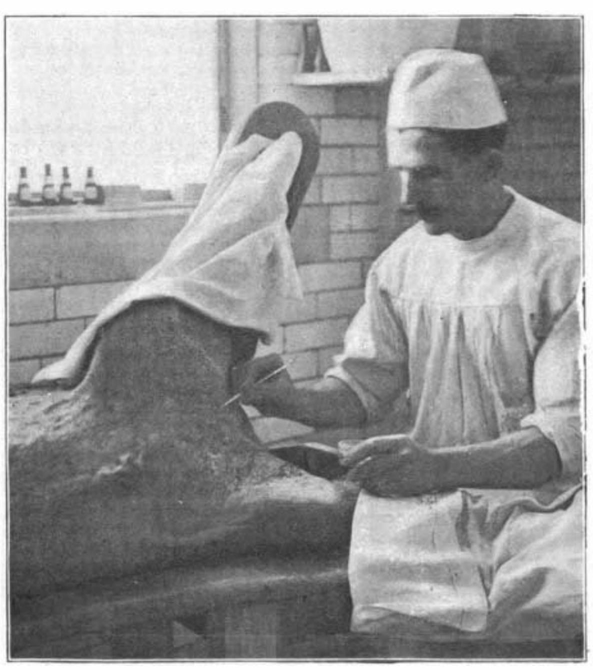


GRINDING AND EMULSIFYING THE PULP.



SCARIFYING A SHAVEN HEIFER.

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 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 at this admirably-equipped New York laboratory.



COLLECTING THE PULP WITH THE CURETTE.

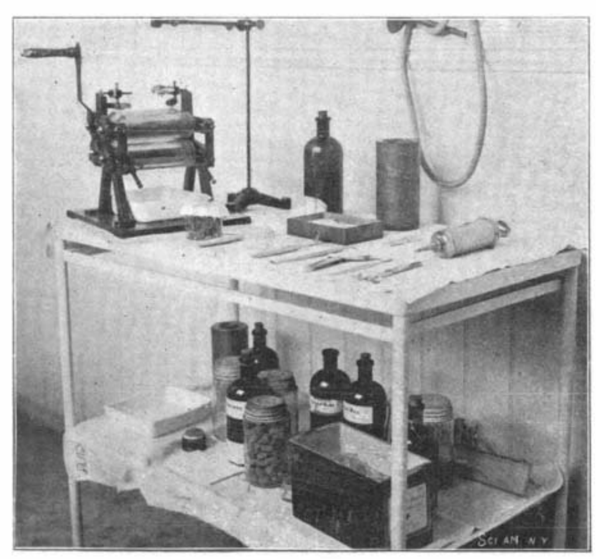
Until 1876 arm-to-arm vaccination was usually practised in New York, the lymph being taken only from a primary vaccination vesicle of a child a few months old and only on the eighth day. But human lymph has always been objectionable, in that it is a possible source of infection of a most serious blood 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 sterlizing-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 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



THE INSTRUMENT-TABLE.