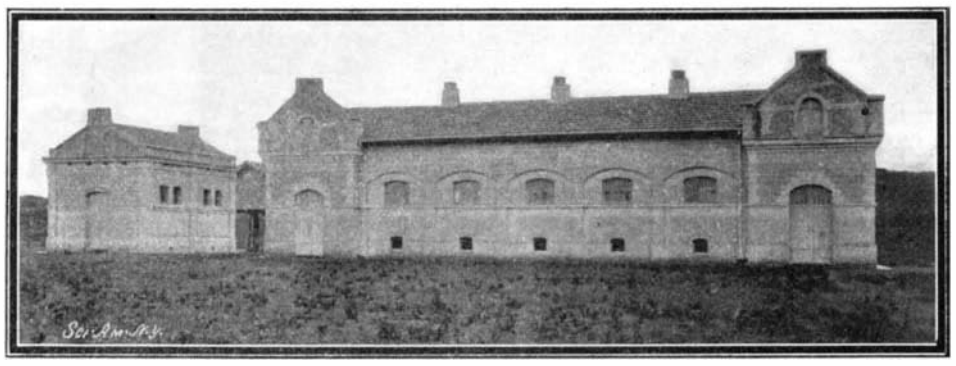
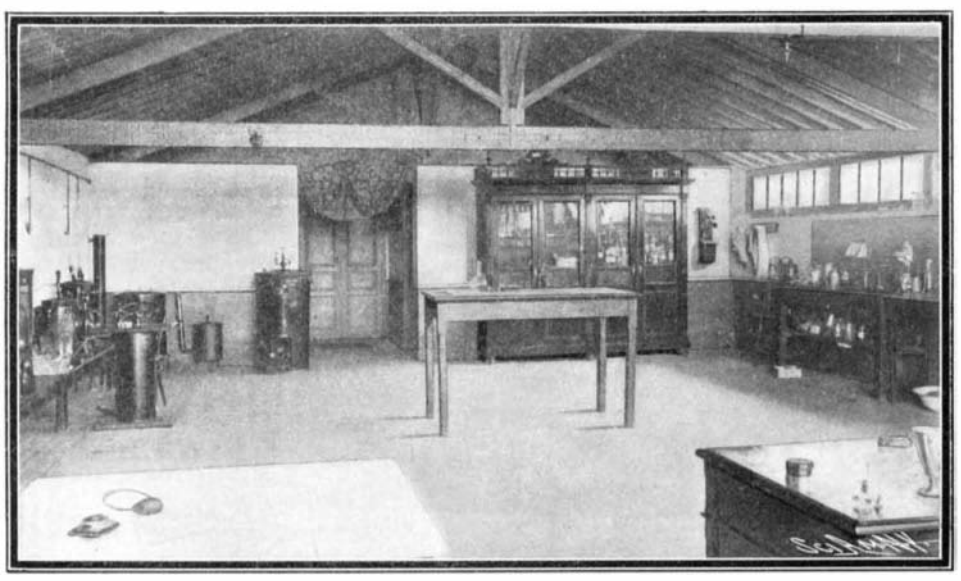
THE UTILIZATION OF SNAKE VENOM IN PREPARING ANTI-BUBONIC SERUM.

BY A. F. SHAW.

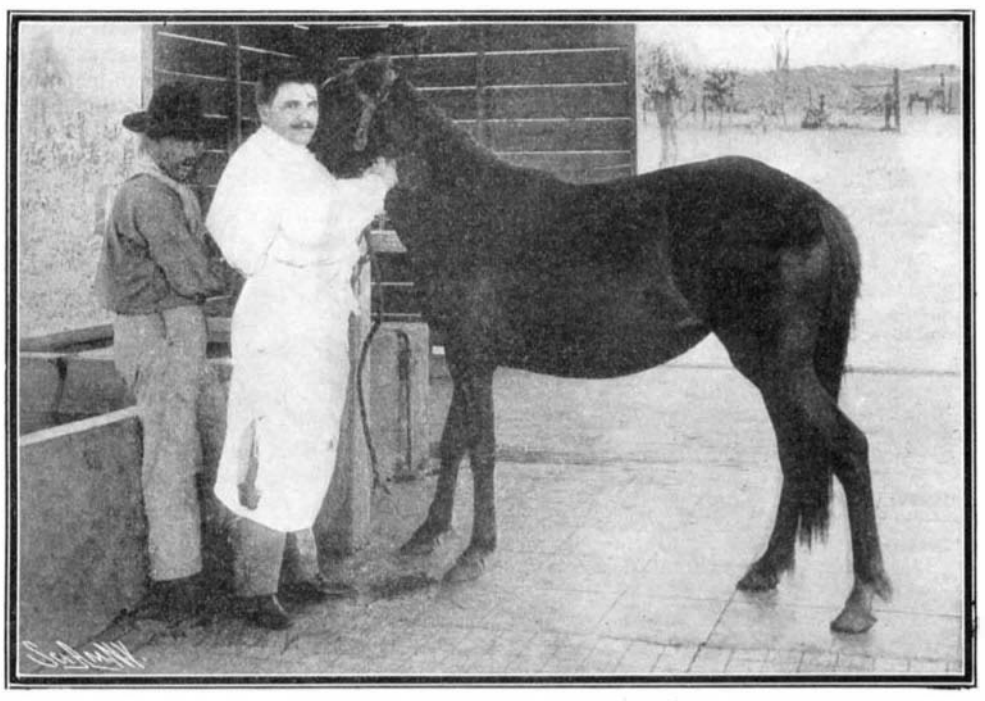
Two years ago, when the bubonic plague was making many victims here in the city, the supply of anti-bubonic serum in Rio de Janeiro being insufficient to meet the needs of both cities, the "Instituto Serumtherapico" was opened for its manufacture. Dr. Vital Brazil, educated in the American school of this city and the medical school of Rio, a man who had shown his fearlessness of the disease by fighting it at Santos when it was at its worst, was put in charge. The wisdom of the choice is clearly manifest now, not only because of the results obtained along the lines laid down at the beginning, but along others which will soon be mentioned.



EXTERIOR OF MOSQUITO-PROOF BARN.



TEMPORARY HOSPITAL WHERE SERUM IS PREPARED.



INJECTING THE POISON INTO THE VEINS OF A HORSE.

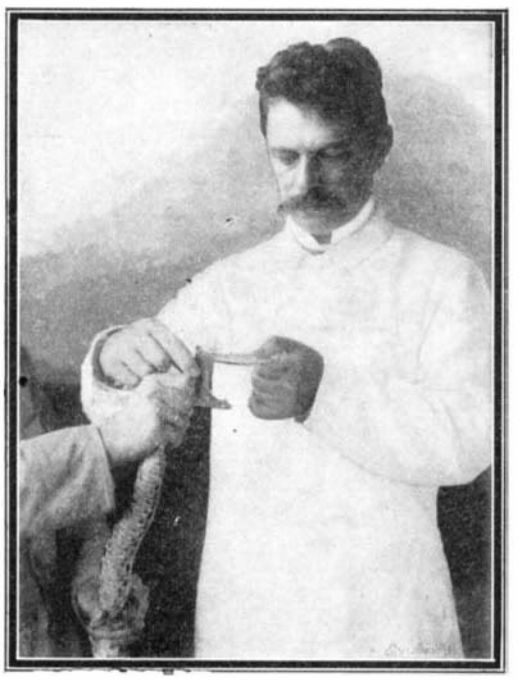
The Institute is about four miles away from the city, on a hill, with commanding view and plenty of pure air. The residence of Dr. Vital, the laboratory, the barns where the horses and mules are kept which furnish the serum, and numerous cages for rabbits and snakes, form the plant. The laboratory is as yet temporary. One of the barns is completely mosquito-proof and here are kept the animals which furnish the antibubonic serum. The second barn is for animals immune against snake bites.

This brings us to the second class of results obtained. Dr. Vital has been studying for years the snakes of Brazil, and influenced not only by scientific reasons but by humanitarian motives, has made a special study of snake bites and their antidotes. From two to three thousand people, it is estimated, die annually in Brazil from snake bites. This enormous mortality is due to the fact that, in the interior, the laborers work without shoes or stockings. Dr. Vital has proved conclusively by a long series of experiments that the ordinary antidotes used in the case of snake bites are not always sure nor safe. Permanganate of potassium is effective if injected in the exact place of the bite and immediately; cauterization destroys the tissues and with them the poison, but if not done immediately is useless. He has also experimented with the numerous herbs, concoctions of which are used, but the results have been negative in every case. Many of these remedies have been used with apparent success simply because only 25 per cent of snake bites are fatal.

In order to carry on these experiments a number of snakes were necessary. To catch them Dr. Vital chose a lasso invented by Dr. Lutz, of this city, which consists in a strap which passes around the end of a stick and under a metal bridge to which a cord, a little longer than the stick, is attached. The strap when loose furnishes a noose which can be slipped over the head of the snake, and on being tightened, secures the head of the snake against the stick. This is the method used both to catch wild snakes and those in captivity when their poison is to be extracted. Having caught the snake the assistant grasps it behind the head, and the doctor, with small pincers, pries open its mouth, pushes the membrane from the fang, and seizing its head, with thumb and forefinger on the poison-producing glands, presses out the clear liquid in drops. This liquid is then evaporated at 38 deg. C. or in the sun and is ready for solution when necessary.

"The poisonous snakes of Brazil," says Dr. Vital, "belong to about twenty species and these to two families, Crotalidæ and Elapidæ. The family of the Crotalidæ is without doubt the more important, because it includes almost all the species the bites of which are either serious or fatal. The Crotalidæ belong to the sub-order of Solenoglyphs. In the anterior part of the upper maxillary there is, on each side, a tooth much larger than the others, curved and capable of movement, which is the poison fang. It is jointed to the upper maxillary in such a way that it lies against the roof of the mouth when the snake is in repose, but when in the act of biting it assumes a vertical position. The tooth has a canal which leads from the poison gland to an oval opening near the end of the tooth.

The learned naturalist George Albert Boulencer, of the British Museum, classifies the Brazilian Crotalidæ in two genera, the genus *lachesis* and the genus *crotalus*, and the only species of *crotalus* is the *Crotalus horridus* or rattlesnake. This is abundant both in the northern and southern parts of Brazil." The poison extracted from rattlesnakes is a dense and milky liquid, slightly acid and white when dry, while the poison from lachesis is yellow. "The quantity furnished (to make a somewhat free translation from articles published by Dr. Vital in the Revista Medica de Sao Paulo) depends, among other circumstances, on these three principally—the size of the snake, its physiological condition, and the period of inertia or the time elapsed since it last bit. As to the first, we find what we would expect, that the larger the snake the better developed are its poison glands; as to the second, when the serpent is sick, the quantity of poison diminishes or disappears entirely, and as to the third point, experience has shown that at least ten or fifteen days are necessary for the production of a normal quantity of poison. The amount of poison varies, moreover, from time to time, but the average has been found to be about 0.04 grammes of dry poison or nearly four times that weight of liquid.



FORCING OUT THE SNAKE POISON ON A WATCH CRYSTAL BY PRESSING ON THE POISON-SECRETING GLANDS.

GRIPPING THE SNAKE.

Dr. Vital says that the poison from rattlesnakes is much more virulent than that of other species that he studied, but that the manner of introducing the poison has great influence on the rapidity with which it takes effect. Introduced in the veins, all poisons take effect much more quickly than when injected hypodermically.

Various other scientists have studied not only means of cure, but means of rendering animals and persons immune. Sewall in 1887, Kaufman in 1889, Calmette, Physalix and Bertrand in 1894 succeeded in making small animals immune by repeated injections of very small doses of poison. The brilliant study of Behring, Kitasato, and Roux of the preventive and curative properties of the serum from animals immune to diphtheretic toxine opened new horizons to experiment.

As a matter of fact, the verification **of identical properties** in the serum of animals immune against snake poison was made almost at the same time by Calmette, Physalix, and Berthand, these experimenters arriving at the conclusion that it was possible to obtain **a** serum sufficiently active against snake poisoning by following a process analogous in the preparation of the animals which furnished the serum. Calmette makes the animals immune by injecting continually increasing doses of poison with continually decreasing doses of hypochlorite of calcium. Dr. Vital does not use hypochlorite nor any substance which neutralizes the effect of the poison, but commencing with infinitely small doses of the poison in a salt solution of 7 to 1,000 succeeds, in the course of a year, in rendering animals not only immune, but capable of receiving, at one time, doses of poison that would kill one hundred animals of equal weight. One of the illustrations shows a horse that has been made immune in this way and is now receiving 100 milligrammes a day.

While repeating the experiments of Calmette and while using his serum, Dr. Vital found it to be ineffective, much to his surprise, and on further experiment, made the important discovery that there are two classes of snake poison, the bothropic and the crotalic, the first belonging to the genus *lachesis* and the second to the genus *crotalus*. With these he made two types of serum, the antibothropic and the anticrotalic, each of which is effective only in bites of snakes of the same class as that which produced the serum. This important discovery explained, therefore, the ineffectiveness of the serum of Calmette which is taken from animals made immune by poison from snakes of India. In order to produce a serum of universal efficacy, Dr. Vital mixes equal parts of the other two serums and calls it anti-ophidic. The animals which furnish the serum receive injections of poison every other day in the manner shown by the illustration, and the extraction of the serum is made twice a month, 3,600 grammes of blood being drawn each time. The horses and mules, of which there are eighteen for pest and twelve for snake serum, are kept solely for this purpose and are not used otherwise. The serum is separated from the coagulum by a process invented by Dr. Vital, a process by which the quantity is much larger than in the ordinary processes of separation.

The efficiency of the serum has been proved repeatedly on animals in experiments, some of which the writer has witnessed. Side by side with a rabbit that died in forty-five seconds was another that received a mixture of a quantity of poison equal to that used in the first instance and the proper amount of serum. This rabbit showed no effects. One dove received enough poison to kill it in about an hour and another an equal amount, but soon after the proper amount of serum. The first died and the second lived. An infinite number of similar experiments have been made, always with results almost mathematical in their accuracy. Besides these experiments, Dr. Vital has now a history of persons bitten in which the serum has been successfully applied.

A great figure in the press world of Paris has passed away, according to the Westminster Gazette, in the person of M. Hippolyte Marinoni. He was the inventor of the printing presses which bear his name. As a lad, he was of a mechanical turn. His parents apprenticed him to an engineer in the Rue d'Assas. He brought out the first flat-bed four-cylinder printing machine, and later, in 1872, his celebrated rotary. Meanwhile he had become manager of the Petit Journal, of which the editor at that time was the distinguished publicist Emile de Girardin. The great success of the Petit Journal was due to the "Marinonis," which printed, folded, and cut the papers at the rate of forty thousand an hour. Then a color printing machine was invented by M. Marinoni and thus the well-known illustrated supplement of the Petit Journal became possible. M. Marinoni was of the thorough type of self-made man—a little rough externally, but with a heart of steel.

THE MOUNT PILATUS RAILWAY, SWITZERLAND.

BY EMILE GUARINI.

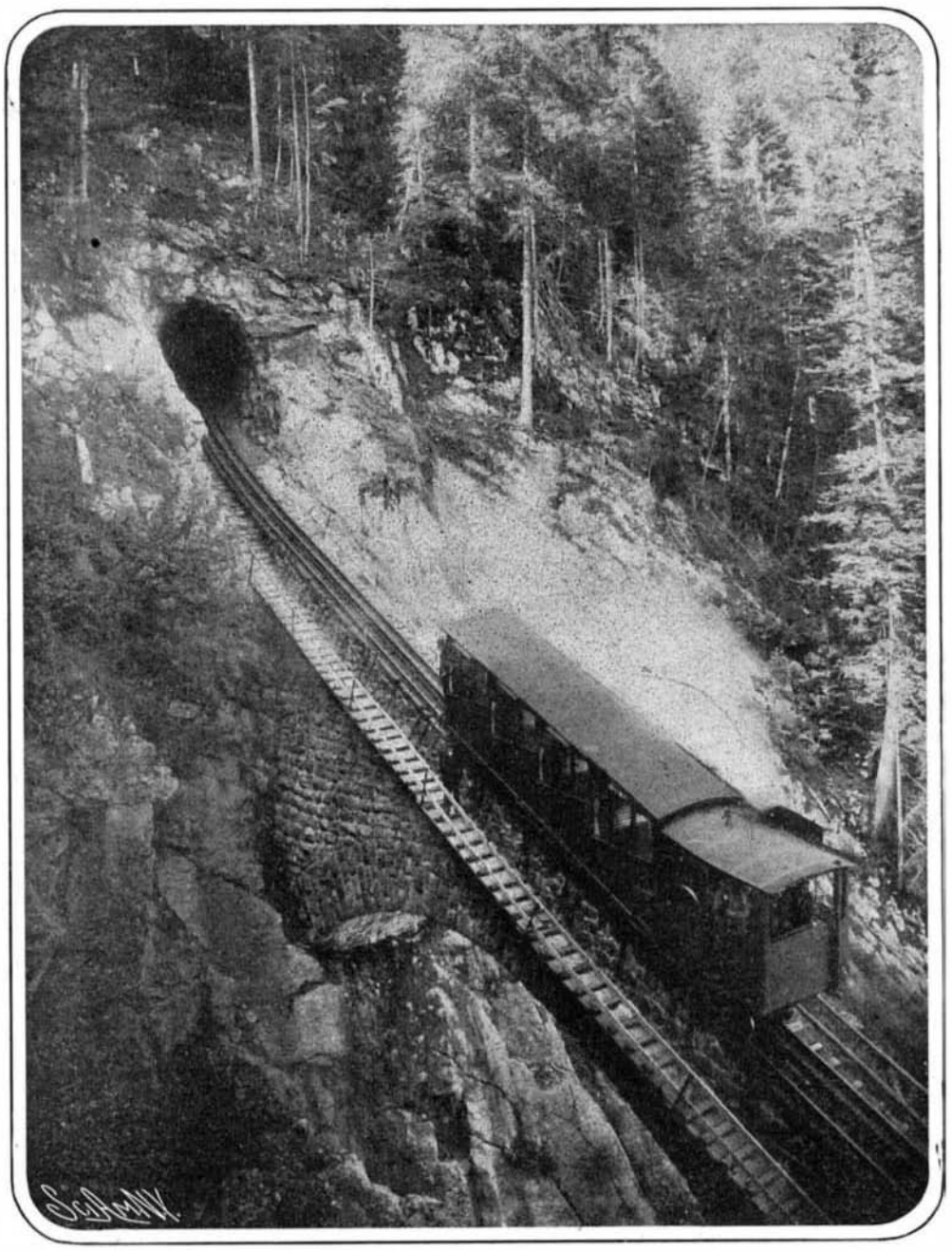
Notwithstanding that there are few assertions that can be made without fear of contradiction, there is one nevertheless that is undeniable and undenied, although the beautiful may be what pleases and its conception may consequently vary with taste, and that is that Switzerland is a beautiful and picturesque country. This is not the opinion of the Swiss alone, who are proud of their lakes and mountains, but of the tourists who come annually from all parts of the world to visit the country. Every one finds it beautiful because every one finds in it what pleases and interests him, and this includes the technical man, as well as the artist, the geologist, the botanist, the man of active life who comes to obtain rest, and the person of leisure who comes because it is the fashion.

Among the innumerable sites that are annually visited by the tourists who travel in Switzerland, Lucerne, that classical resort of foreigners, is, with its lake and remarkable surroundings, assuredly the most picturesque. But, just as one cannot claim to have seen Switzerland without having made the ascent of some one or other of its mountains, just so he cannot say that he has seen Lucerne unless he has ascended Pilatus, which, of all the mountains of Switzerland, is the most celebrated by the writings of which it has been the object, by the splendid panorama there unfolded to view, by the sea of fog that is sometimes seen forming there, by the magnificent spectacle presented to the spectator when he is on the top of the mountain, by the terrible legend of the damnation of Pontius Pilate, and, finally, by its meteorological legend, which has it that when clouds occupy the summit it is a sign of fine weather, and, when they are situated half way up, it is a sign of rain, a fact expressed in the country by the following archaic stanza:

"Quand Pilate a son chapeau,
Dans le pays il fait beau;
Mais quand il ceint son epé,
Gare l'ondée."

Formerly, when the ascent of Pilatus was made (an event that for centuries could not take place without a special permit for fear that the visitor might disturb the soul of Pilate and let loose a scourge upon the country, but in reality because certain lakes had for a long time been the refuge of a pagan cult), it was made by following a steep footpath that started from Alpnach-Staad and ended at the summit. It is this footpath that the Mount Pilatus railway follows for quite a long distance. But, while the modest footpath accomodates itself to all the capricious meanderings of the slope, the railway goes straight to the top, boldly crossing narrow passes and ravines, and traversing walls of rock that seem to bar its passage.

When the tourist leaves his conveyance at Alpnach-Staad, he finds himself at the lower station of the rack railway that runs to the summit. He is then at about 1,450 feet above the level of the sea. The car is there, inclined upon the track, the gradient of which is already 36 per cent. The locomotive and the car form a single vehicle. The car is divided into four compartments, placed one above another, and each accommodating 8 passengers. Its lower part is occupied by a water tank having a capacity of 100 gallons. The axles are arranged in such a way that curves of very small radius may be taken despite the distance apart of the axles, viz., 20 feet. Four pairs of cog wheels, two in front and two behind, serve for the propulsion, running, and braking of the vehicle. Rings that embrace the head of the rails prevent the car from being blown from the track in a gale or from running off because of ice or snow that may exist upon the roadbed. The boiler, which is of the tubular type, is 6 feet in length, has a heating surface of 225 square feet, and employs a working pressure of 12 atmospheres. It is placed at right angles with the axis of the track, in order to prevent the various gradients from producing fluctuations in the level of the water. The average gradient is 38.1 per cent; the minimum, 19.2 per cent; and the maximum 48 per cent. The engine cylinders are 8.75 inches in diameter, and the piston stroke is 12 inches. The normal speed of the trip is a little over three feet a second. The dead weight is 9.6 tons, and the load with 32 passengers, 2.4 tons. The locomotive is of about 70 horse-power. The braking arrangement has naturally been very carefully looked after. It consists of a compressed-air brake, an automatic brake, and two friction brakes. The suspension of the vehicle is assured by a system of four pairs of elliptic springs combined with spiral ones. The play of the car is prevented by safety stops, so that the vibrations are no greater than they are in an ordinary well-suspended train.



The Car on its Journey Through Wolfort Gorge.

Such, then, is the singular, but powerful engine, constructed by the Winterthour locomotive works of Switzerland, that daily traverses the 5,400 feet which separate the Alpnach-Staad station from that of Pilatus-Kulm, which is at an altitude of 6,800 feet. This altitude is reached by means of a track of 15,150 feet in length, constructed by MM. Lacher and Guyer-Freuber, of Zurich. From the edge of the lake to the top of the mountain, the substructure consists of solid masonry covered with large granite flagstones. The track itself, which is all of iron and steel, is solidly riveted, once in every three feet, to the underlying masonry. The bed for the rack is placed between the two rails, which it slightly exceeds in height. Attached to each side of it is a steel rack with which engage horizontally, on the right and left, the four cog wheels of the vehicle. Numerous bridges had to be constructed under most difficult conditions, and yet, in spite of that, the Pilatus railway, its rolling stock, stations, and shops, cost but $380,000 and took but four hundred days to finish. The track in the first place traverses plains bestrewed with wooden buildings, and then reaches the gorge of Wolfort, at an elevation of 2,950 feet, which it crosses by means of a bridge constructed with surprising boldness. This bridge, which is entirely of dressed stone, is within the radius of 260 feet uniformly adopted for the curves of the track. Its span is 75 feet. The railway afterward enters Wolfort tunnel, 145 feet in length, and then climbs the Risleten, the gradient of which is 48 per cent. In order to cross this critical place, it became necessary to employ a number of hurdles and piles, and to construct subterranean vaults, as well as huge sustaining walls. Continuing the ascent, the tourist reaches a wild region intersected by the two Spycher tunnels, 167 and 318 feet in length. Upon leaving the upper tunnel after a magnificent view of