than has already been done. It might be thought that it could pursue its investigations in some other place in Egypt where the cholera prevails, but there are insuperable objections to such a plan. The cholera has disappeared from all the large cities of the country, and only holds its own in the villages of upper Egypt; and an attempt to carry on our experiments in that part of the country would meet with the strong disapproval of the Egyptian government on account of the disagreeable complications in which the condition of affairs there might involve us. Moreover, I have been assured by responsible persons well acquainted with the Egyptians, that it would be impossible to obtain material for dissection in Egyptian villages; and for these reasons I must renounce all hope of following the course of the cholera up the Nile. The disease also, contrary to all expectation, appears to have gained no foothold in Syria. Since the investigations now in progress will occupy only about two weeks, the work will soon have to be temporarily suspended. The commission, however, entertains a strong desire to prosecute its researches further, and satisfy the object for which it was created. It would be a great disappointment if the results it has already reached should prove fruitless from want of further experiments. The only opportunity which is afforded us at present for continuing our researches is in India, where the cholera is still prevalent in several large cities, particularly in Bombay, and is not expected to subside immediately. It is also probable that we could gain access to some hospital there, and repeat the work which proved so valuable in Alexandria. In case, in your excellency's opinion, it should be deemed advisable to continue the researches of the commission, and extend the field of its labors to India, I am ready to continue in charge of its management.

I must also say a few words about the additional labors which the commission has found time to prosecute in connection with its researches on cholera. Egypt is full of parasitic and contagious diseases, and it was not difficult to obtain suitable material for the examinations we wished to make in order to control the results obtained in studying the cholera, and also to settle some general questions bearing on infectious diseases. For example: I dissected the bodies of two persons who had died of dysentery. In one case, where the patient had died of an acute attack, there were parasites in the mucous coat of the intestine which did not belong to the bacteria group, and were unknown. I also dissected the body of an Arab who had died in the Arabian hospital of malignant disease. The disease in this case was probably taken from sheep, which are imported into Egypt from Syria in great numbers, and die of anthrax *en masse.* I was also afforded an opportunity to observe six cases of bilious typhus in the Greek hospital. This disease closely resembles yellow-fever, with which it is often confounded, and presents much interest to the student. Three of these patients died, and were dissected.

Besides this work, repeated examinations were made of the micro-organisms in the air, and the drinking-water of Alexandria. If time allows, I intend to study the Egyptian ophthalmia.

The labors of the commission, which from their nature were very trying and fatiguing, and for the most part of a disagreeable character, were rendered doubly irksome by the high temperature prevailing in the city. It has been impossible to interrupt the work a single day until now. Nevertheless, the members of the commission are in good health, and have only suffered from some slight complaints, due to a change of climate, which soon disappeared. However, as soon as the condition of the work will allow, I consider it advisable for the commission to rest a few days. I intend, therefore, to go with it to Cairo for a short time, partly for the sake of recreation, and partly in order to visit the principal seat of the cholera in Egypt, and make further observations there.

THE PHYSIOLOGICAL STATION OF PARIS.[1] — I.

WE have seen in the last few years all kinds of establishments erected to provide for the new needs of science. Laboratories, although great discoveries have been made in them, have become in certain respects insufficient. In the study of organized bodies, as in that of the physical forces of the earth, one is soon brought to a standstill if he cannot study nature in her own domain.

Special establishments for certain sciences, astronomy for instance, are a necessity; and lately naturalists have perceived the insufficiency of the means placed at their disposal. Maritime stations, gardens for acclimation, experiment stations, agricultural stations, stations for vegetable chemistry or experimental medicine, — all these have responded to the development of certain branches of science.

Physiology, almost the only exception, has been, up to the present time, dependent upon laboratories. These are, in France at least, wretched places, poor and unhealthy, where the investigators are obliged to live in the hope of discovering the properties of the tissues, and the functions of the living organs. There is discovered the action of medicines upon the living organism, of poisons, and the various chemical and physical agents; there, by means of vivisection, or by the use of the proper and delicate instruments, the inner mechanism of the vital functions is analyzed.

This condition of destitution could not continue. It is evident, that with the means at its disposal, within narrow limits, and compelled to operate upon a few lower animals, physiology could not but remain behind the other sciences. In any case, it could not hope to attain its full development: it must abandon, without practical application, the knowledge that it had obtained at the cost of so great efforts.

In the last half-century physiologists have written a large number of works on the nervous and muscular systems. We have learned to distinguish the nerves

[1] By E. J. MAREY of the French institute. Translated from *La Nature.*

of sensibility and those of movement; to determine the courses of the two kinds of nerves in the various parts of the body. We know how excitations, according to their intensity or nature, act on these organs. We have measured the rapidity with which that still mysterious agent, which bears to the muscles the order for motion, travels in the nerves and in the spinal marrow. We have separated the action of the muscles in their elements, — undulatory vibrations which traverse the length of the muscular fibre. Finally, we have studied the nature of contractions, and know how fatigue, heat, cold, and poisons affect these movements.

On the other hand, while considering the mechanical conditions of animal locomotion, we have determined, from a kinematic stand-point, the characters of the various movements of man and animals. We have classified according to their kind the different bony levers of the skeleton, have determined the centres and radii of curvature of the joints, and have estimated the momentum of the opposing forces which represent the power and the resistance in the animal machinery.

It appears now that every thing is ready, and that physiologists have only to apply these studies to the various problems of practical life. They will teach us, doubtless, how best to utilize the muscular work of man and of the domestic animals; they will lay down rules which shall control the physical exercises of the young, the work of the artisan, the drill of the soldier.

Unfortunately it is not so. Limited as they are, physiologists are scarcely able to study the vital functions in man and the more important animals; besides, the usual method, vivisection, which has disclosed so much in regard to the properties of the tissues and the functions of separate organs, cannot discover the regular action of normal life.

The writer of this article has spent long years in his search for methods and an apparatus capable of faithfully interpreting the external signs of the functions of life. The pulsations of the heart or the arteries, the respiratory movements, the contractions of the muscles, record themselves with this apparatus, and obtain, for analysis, curves in which the least details of the movements are represented. The object of other instruments is to trace the course traversed by a man or by an animal, or to express the efforts developed as functions of the time. Recently, instantaneous photography has completed the knowledge of physiological movements, so that to-day we can easily solve most of the problems of the animal mechanism.

But if the methods were perfected, if new apparatus were invented, all the difficulties would not be removed; for it is not in the ordinary physiological laboratories that one can study the motions of a bird on the wing, of a galloping horse, or of a man walking, running, or performing some other muscular exercise. It was to promote these researches on the physiology of man and animals, that the physiological station, of which we will give a description, was erected.

Only the municipal council of Paris could grant land adequate for this kind of experiments. There was a very convenient place on the Avenue des Princes, near the Porte d'Auteuil. With the generosity always shown when science is concerned, the council granted these lands, and even voted a subsidy to cover a part of the expense of experiments. On the other side, Mr. Jules Ferry, the minister of public instruction, pleaded warmly before the chambers in favor of the contemplated establishment. A law, passed in August, 1882, granted the sums for the construction of the necessary buildings. The work was pushed actively forward during the last autumn and winter, and in March experiments were begun at the physiological station.

The practical applications of physiology are infinite; but in this vast number there are certain questions whose solution is near at hand, certain others for which nothing is prepared. The management of the physiological station, although the subsequent needs are foreseen, is, for the present, arranged for the study of the animal mechanism; and the experiments under progress relate to human locomotion.

The problems which present themselves first of all are the following: 1°. To determine the series of motions which are produced in human locomotion of various kinds, — walking, running, leaping; 2°. To search for the external conditions which influence these motions; those, for instance, which increase the rapidity of pace or the length of step, and which thus exercise a favorable or an unfavorable influence upon the locomotion of man; 3°. To measure the energy expended each instant, in the various acts of locomotion, in order to discover the most favorable conditions for the utilization of this energy. Instantaneous photography, and various other appliances of the graphic method, help to solve these problems, which are impossible to direct observation.

Before entering into the details of the experiments, we will describe the general arrangement of the physiological station. Fig 1. shows the land and the building as a whole. A circular and perfectly level course is laid out in a piece of ground used by the city of Paris as a nursery. This course has two concentric tracks: the inner one, four metres wide, is for horses; the outer one, for men. Around these tracks runs a telegraph-line, whose poles are fifty metres apart. Every time a walker passes a post, he causes a telegraphic signal; and this is recorded in one of the rooms of the principal building. We shall refer later to this kind of automatic record, by means of which, for every minute, the rapidity of the walk, the accelerations and diminutions, and even the number of steps, may be known. In the centre of the course is an elevated platform, on which a mechanical drum beats the time for the step. This drum is worked by a special telegraph-line, coming from a room in the large building where the rhythm is maintained by a mechanical interrupter.

From the centre of the course runs an iron track, on which rolls a little carriage forming a photographic studio. From within this apartment a set of instantaneous pictures of the men and horses whose gaits are to be studied, may be taken. These photographs are taken as the walker passes before a black screen. Finally, the dynamographic studies, to measure the energy exerted in the various muscular motions, are possible by means of apparatus which will be described later.

Our readers are already familiar with the history, in detail, of the applications of instantaneous photography to the analysis of the locomotion of man and animals. Many have seen the beautiful pictures obtained by Mr. Muybridge, who has succeeded in photographing a horse running at full speed. For the requirements of the physiological analysis of movements, we have substituted for the complex apparatus of Mr. Muybridge a simple contrivance, giving on the same plate the successive positions of a man or an animal at various instants of his passage before the black screen. We shall refer to these experiments in order to describe certain improvements which make the figures more clear, the time-measurements more exact, and which, by multiplying almost indefinitely the number of images, give a complete analysis of all kinds of movements.

The apparatus employed at the physiological station for the instantaneous photography of movements comprises two distinct parts, — first, the photographic apparatus, with the room on wheels, which holds it; and, secondly, the black screen, on which appear in white the men and animals whose pictures are being taken, as well as the instruments for measuring the distance run, and the time consumed between two successive photographs.

Fig. 2 represents the photographic chamber where the experimenter is. This room is on wheels, and is arranged on an iron track, so that it may approach or move from the screen, according to the objectives which are employed, and the desired size of the photograph. Generally it is convenient to place the photographic apparatus about forty metres from the screen. At this distance, the angle at which the subject to be photographed is presented, changes little during his passage before the black screen. From the outside of this building may be seen the red glass through which the operator can follow the various motions which he is studying. A speaking-trumpet enables him to direct the different movements which ought to be made. The front wall of the building is raised in the figure, in order to show a revolving-disk, provided with a little window, across which the light passes intermittently into the objective. This disk is of large size (1.30 m. in diameter), and its window represents only a hundredth of its circumference: hence, if the disk revolve ten times a second, the duration of the lighting is only one-millionth of a second. The movemement is recorded on the disk by wheel-work, which is wound

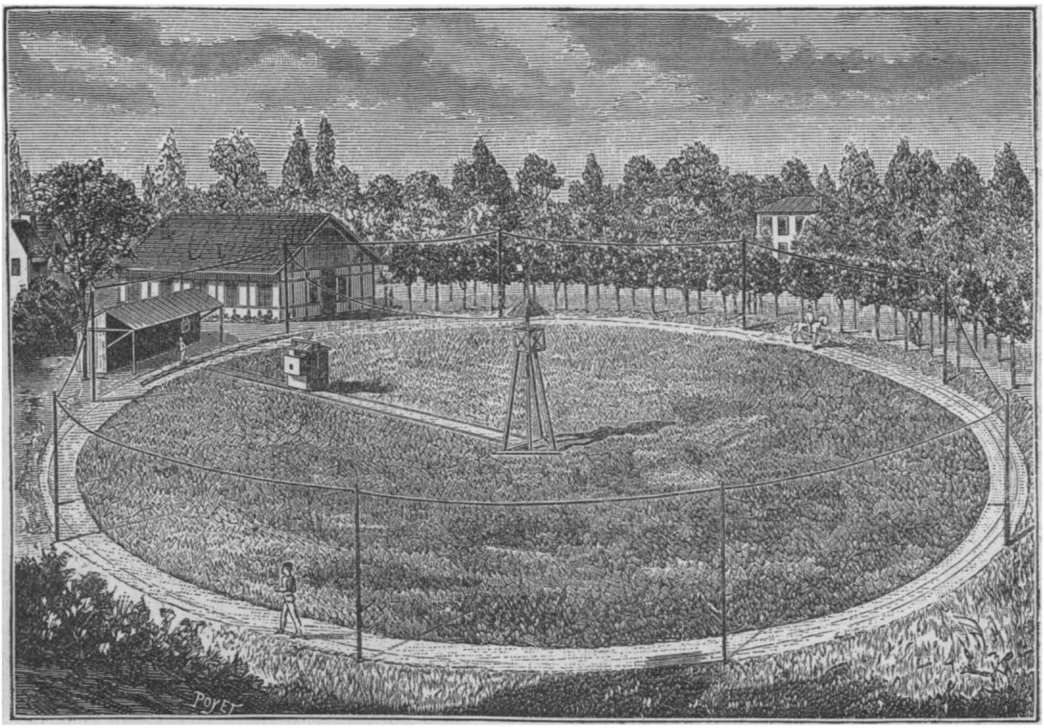

FIG. 1.—PHYSIOLOGICAL STATION AT PARIS.

by a crank, and set in motion by a weight of a hundred and fifty kilograms placed behind the building. A brake checks the disk. A clock-bell, regulated from within, notifies an assistant either to set in motion or to stop the disk.

Fig. 3 shows the interior arrangement of the chamber. The removal of one of the side-walls discloses the photographic apparatus, *A*, placed on a bracket, and directed toward the screen. This instrument receives the long and narrow sensitive plates, which just admit the image of the whole screen. The plates which give the best results for the shortest exposures are those of Van Monckhowen of Ghent, and that of Melazzo of Naples. At *B* is the revolving-disk, which produces the intermittent light; at *D*, a shutter, which is raised vertically at the beginning of the experiment, and falls at the end in order that the light may enter the apparatus only during the time absolutely necessary. *E* is a long slit which unmasks before the objective the field in which the movements to be studied are taking place. The darkness of the chamber permits one to handle at his ease the sensitive plates, and to change them for each experiment.

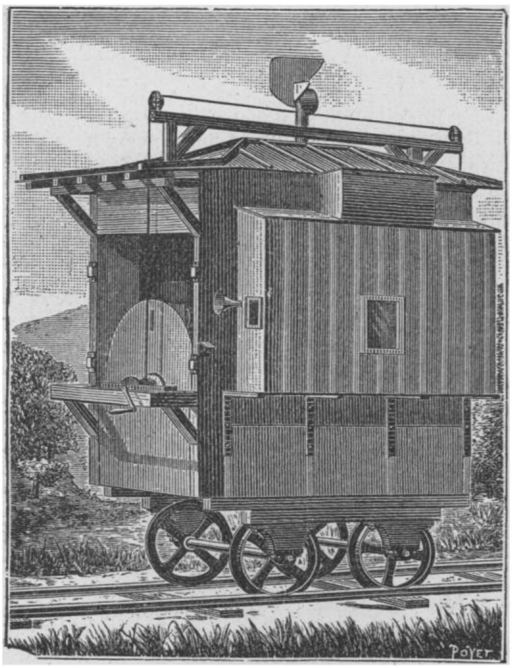

FIG. 2. — ROLLING PHOTOGRAPHIC CHAMBER.

(*To be continued.*)

SEPTEMBER REPORTS OF STATE WEATHER-SERVICES.

THESE reports emphasize the general lack of rain, which, without exception, was characteristic of the weather prevailing in every state issuing reports. The low mean temperature is also made a subject of note.

Georgia. — In this state there has been no general rain since April 23, and the crop reports are in consequence unfavorable. Cotton averages sixty-two per cent, and corn seventy-six per cent, of the usual yield. The temperatures ranged between 45°, the minimum in the northern portion, and 95°, the maximum in the southern section. The average rainfall was 1.57 inches.

Indiana. — The temperature averaged 3.5° below the normal for September; and frosts occurred on the 6th, 10th, and 26th, damaging late corn and other vegetation. The prevailing wind was north-east. The rainfall ranged from 0.15 inch to 5.98 inches, averaging 1.99 inches for the state.

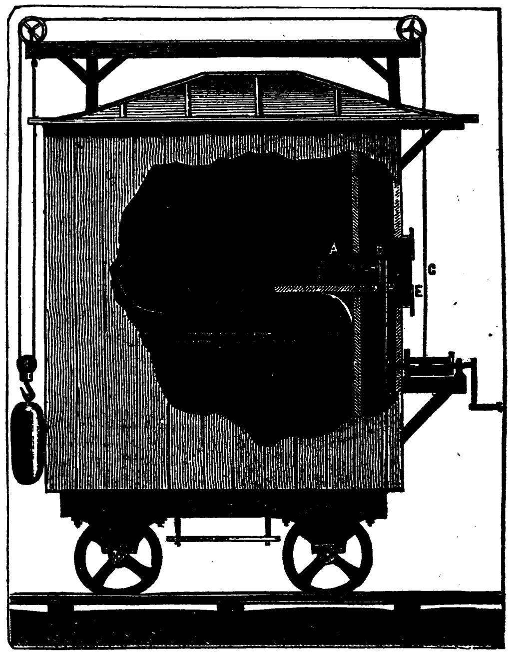

FIG. 3. — INTERIOR OF PHOTOGRAPHIC CHAMBER.

Kansas. — At Lawrence the rainfall was smaller and the temperature lower, with one exception, than any other September for sixteen years. Rain fell on seven days, and there was but one thunder-shower. The mean cloudiness was 40.33 per cent, the month being 0.31 per cent clearer than usual.

Missouri. — At St. Louis the rainfall was less than a hundredth of an inch, which has not happened before since Dr. Engelmann began his observations in 1839. The normal rainfall at St. Louis is three inches. Several other stations report no rainfall. Light frosts occurred, but without material damage to the corn-crop, except over limited areas on low ground.

Ohio. — The barometric conditions were normal; but the temperature was about four degrees below the