THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH.

BY HERBERT T. WADE.

Physicians are now forced in large part to look to various scientific institutions and laboratories, where medical research can be carried on most effectively, for new methods of curing and preventing disease. In Europe there are a number of such institutions, but in the United States the Rockefeller Institute for Medical Research in New York city stands as the most important example of the few organizations of this kind which private munificence has made possible. It is a home for medical research of the most special character, and differs from other American medical laboratories in that it is independent of any medical faculty or general hospital, so that from beginning to end there is nothing to interfere with purely scientific investigation.

Provided with an adequate endowment, the Rockefeller Institute is housed in a commodious building on a bluff overlooking the East River. There is in course of erection a small hospital, where the staff may apply and test under careful observation such new methods or discoveries as have proved worthy of a thorough trial on human beings afflicted with diseases not yielding to present modes of treatment. Such a hospital promises to be of the greatest value to the medical profession, for the treatment will be entirely at first hand. With the highest medical and nursing skill used in caring for patients suffering from such specific diseases as are accepted for treatment, there will be the most intimate knowledge of the remedial agents employed. In this way the establishment will be made more effective than existing hospitals for the successful demonstration of any new form of treatment, though otherwise its methods will be the same.

General laboratory for physiological and pathological chemistry.

The Rockefeller Institute for Medical Research.

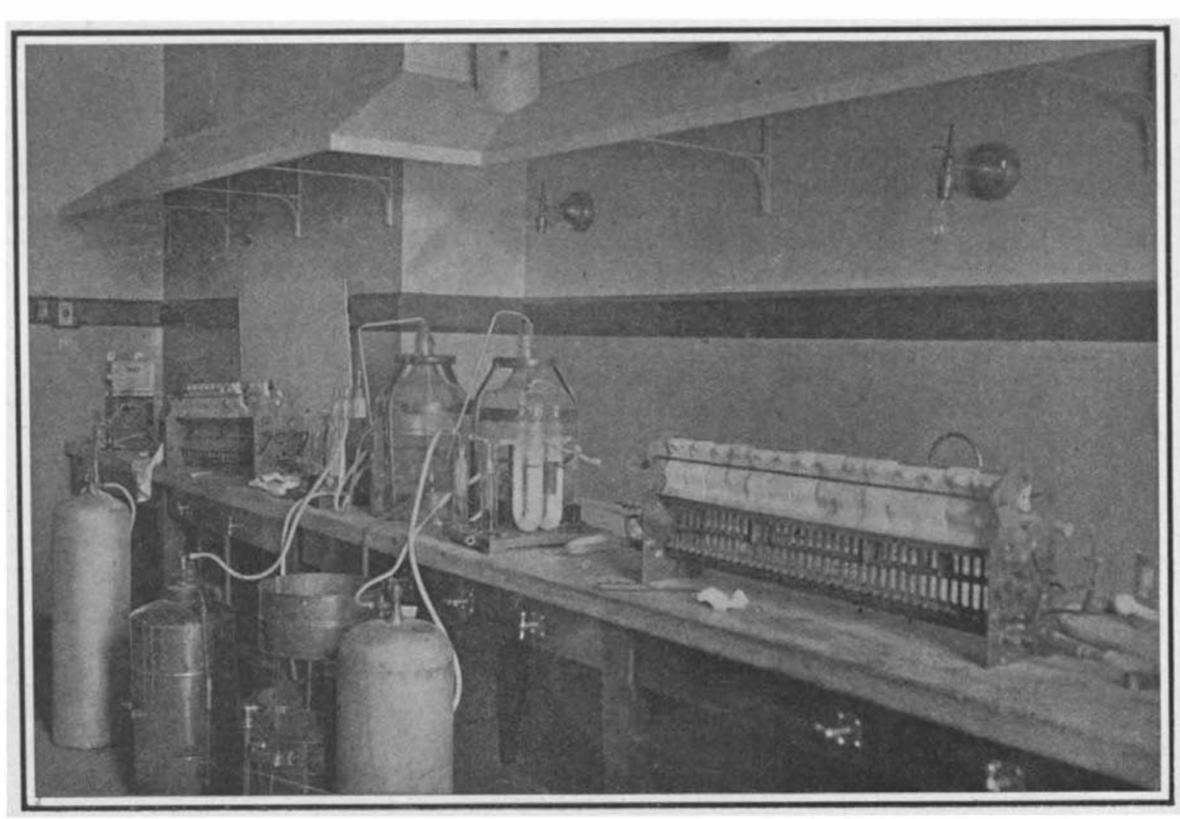
The laboratory building shown above overlooks the East River. The new hospital of the Institute is now being erected to the right of the laboratory.

There are diseases that confessedly are not understood by physicians, and will not yield readily to any treatment, and therefore must continue indefinitely or terminate fatally. On such diseases the inventive and investigating genius of many scientific medical men in every part of the world is centered. When any new method of treatment is discovered, haste is made to test it in numerous hospitals, not only with the object of saving the lives of afflicted patients and curing the disease, but to prove the efficiency of the treatment or remedy for future and broader application. The attending physician or surgeon usually is more than willing to apply any new treatment suggested by workers in European or American laboratories and hospitals. It is evident, however, that a method can be much more successfully developed and tested by the close co-operation of the investigator and the physician in charge, who may be one and the same individual.

The Rockefeller Institute stands for the development of experimental medicine, so that new and original studies and researches can be prosecuted, and their results tested on a systematic and effective basis through careful experimentation on animals, and finally by application to human patients. In medicine, as in other branches of modern science, discoveries and improved methods are not the result of a sudden inspiration, but of systematic and patient experimentation and research, in which negative results are only too frequent.

As it is as impossible as unjustifiable to test on a human patient any treatment or remedy until its effect on animals is understood thoroughly, animal experimentation necessarily form a large part of all progressive medical research. The animals used are supplied essentially with the same organs as human beings, the functions of which in many cases are identical, and can be studied thoroughly in health and disease. Especially is this advantageous in the case of diseases which are communicable to animals, for then their progress and cures can be studied directly in the laboratory. The animal under such conditions receives the best of food and care; for it is necessary that there be no complications of any kind to obscure the effects of a treatment that may involve the administration of some drug, inoculation, antitoxin obtained from another animal, or surgical treatment requiring the removal of an organ or some portion of it, or possibly the substitution or transplanting of bone, nerve, blood vessel, or tissue. From the animal is learned in the first place the normal action of the various organs, their precise functions, and their connection and interdependence, or in short what is termed physiology. Therefore a constant and ever more special study of the nature of the healthy organism is an important part of the work of the Rockefeller Institute, and the results of such investigations are of inestimable value to students and teachers of physiology as well as to the intelligent practitioner.

But it is naturally to morbid or diseased conditions that active medical attention is directed, and in this field of pathology there is an almost infinite range of conditions, to whose study the methods of physiology



Combustion apparatus in special combustion room of the chemical department.

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and biological chemistry and microscopy are applied. By the use of colored stains micro-organisms can be rendered visible under the microscope. Many forms of bacteria not otherwise to be observed will respond to different dyes with different effects. By various culture processes the bacteria themselves can be propagated for further study and experiment. After the bacterium of a disease is discovered and isolated, it can be propagated as desired, often in an attenuated form, so that a culture can be prepared and used for inoculation in order to render a person or an animal immune from the disease. Or from the blood of an animal thus inoculated a serum can be obtained, containing antitoxin or substances capable of neutralizing the toxins or poisonous substances produced in the blood by the bacteria. In this way the important science of serum therapy has developed. The antitoxin thus produced for diphtheria, for example, has greatly diminished the mortality from a disease once dreaded. A serum treatment for cerebro-spinal meningitis developed at the Rockefeller Institute promises likewise to be of the greatest usefulness in the cure of that malady.

The starting points in these researches are specimens from diseased patients. A culture of the bacteria is made, and then by inoculation the disease is communicated to some animal such as a mouse, guinea pig, or rabbit. The disease is then studied, it being possible of course to kill the animal at any stage and subject it to post-mortem examination and study, so that the exact progress of the disease may be learned and material obtained for further culture. A horse may be inoculated, and from its blood a serum rich in antitoxin obtained. The serum thus obtained is then tried on diseased animals. If a number of experiments are consistently successful through their entire range, the serum may be tried with human beings. Not every animal is suitable for every investigation. While certain are immune to some diseases, to others they will respond readily, so that an extensive number and variety must be maintained by the Institute. While under observation the animals receive as watchful care as human patients, and their weight, temperature, and other indications of their symptoms are duly observed and recorded.

Without taking up a specific investigation, it is of course impossible to refer in detail to methods or technique. From a large number of researches covering a wide field, it is somewhat difficult to select those whose importance would appear at once to the non-medical person. One of the earliest efforts of the Institute made in co-operation with the New York city Board of Health and various infant hospitals was a report on the results of milk feeding, in which the most wholesome condition of milk, and especially its freedom from injurious organisms, was determined. In fact, this was an important part of a general study which has put the New York Board of Health in a position thoroughly to safeguard the milk supply of the city, and the medical profession at large to understand most fully the proper condition of milk used in infant feeding, so that the infant mortality of the city is diminishing in a most gratifying manner. Another early study of the Institute dealt with dysentery and the conditions under which the disease is spread. Again, there has been the serum for meningitis, with which encouraging results already have been obtained, and the progress made on the study of the growth of cancer, a disease which has baffled efforts for its cure and relief.

An important work in biological chemistry has been undertaken with reference to the essential composition of albumen as a foundation for our knowledge of the physical basis of life. The production of spinal anæsthesia by magnesium sulphate injections has received practical application at the hands of surgeons for certain classes of operations, and has also been used to mitigate the spasms of lockjaw, and of contributing to the recovery of the patient. More recently, success has attended experiments dealing with the transplanting of various organs in different animals, which already has suggested the possibility of its wide human application.

For carrying on the work of the Institute, an efficient organization under the direction of Dr. Simon Flexner, formerly professor of pathology in the University of Pennsylvania, has been assembled. There are specially organized departments of pathology, bacteriology, physiological and pathological chemistry, physiology, pharmacology, comparative zoology, and experimental therapeutics each in charge of responsible heads aided by a number of assistants.

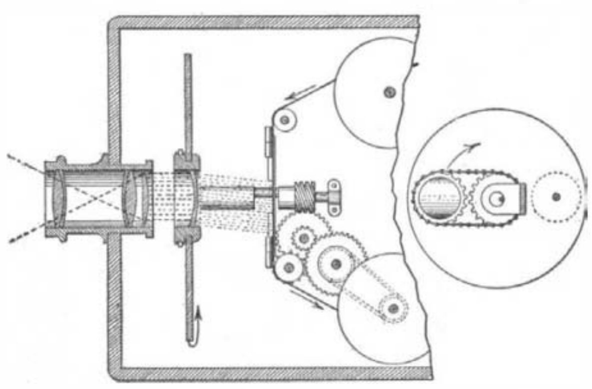
Taken all in all, the Rockefeller Institute, with its thorough organization and equipment, is a striking illustration of what an adequate endowment judiciously administered can accomplish for scientific research and the benefit of man.

Scientific investigation to-day must be productive of results which a discriminating but utilitarian public can appreciate. From medical laboratories have come such means for combating such diseases as diphtheria, cholera, yellow fever, and bubonic plague, to mention but a few whose consequences have been most appalling, so that it is not unreasonable to look for a career of constantly increasing usefulness for the Rockefeller Institute, whose work has been inaugurated so auspiciously.

A NOVEL CAMERA FOR MAKING MOVING PICTURES.

Numerous cameras have been invented for producing photographs of objects in motion upon an intermittent moving sensitized film, but none so far, we believe, have come into public notice wherein the film has a continuous movement from one spool to another behind a lens. The camera in the accompanying illustration has this latter feature, which renders it much more easy to operate and more simple in construction than is usual, and the basis of the exposure of the image on the moving film in an optical manner is quite novel and interesting. A single crank on one side of the box operates through suitable gears and belting the lower winding spool, which in turn draws the sensitized film from the upper roll over a guide roll downward through a feed tube in a constant continuous movement, while another gear meshing in a spiral spur rotates a longitudinal shaft, on the extreme left end of which is supported a revolving exposure disk.

On the flat side of this disk near its periphery is a transparent circular window, the axis of which coincides with the axis of the camera lens, the latter being rigidly secured to the front wall of the camera, and also is in line with the moving film behind. Within the circular aperture of the disk is a rotatable ring having sprocket teeth on the portion of its circumference extending laterally beyond the flat surface of the disk. Within this rotatable ring is secured a concavo-convex or negative cylindrical lens termed a refractor. At the rear of the camera lens combination is fixed a plano-convex or positive lens. Referring to the small illustration on the right, it will be noticed a stationary sprocket is fixed to the shaft bearing. A sprocket chain connects



A SHUTTERLESS MOVING PICTURE CAMERA.

this sprocket with the movable ring sprocket on the rotating disk. The effect of this arrangement is to keep the transverse horizontal axis of the cylindrical lens in a horizontal position as the disk revolves. In the larger illustration the course of the rays of light from the object through the lens is shown. From the camera lens they are directed in a parallel direction by the single plano-convex lens and upon impinging on the movable cylindrical lens in the disk, while its direction is upward, are refracted downward with the same rapidity that the constantly moving film moves also downward, thereby impressing the image upon the film perfectly sharp and clear and always in register and line. The arrows show the lens in the disk moving upward while the film passes downward. At the same time by means of an eccentric pin on the main shaft a reciprocating frame adjacent to and in front of the film moves downward with the refractor rays as they strike the film and makes a distinct division line between each picture. Another device is provided at the top of the camera for indicating the number of feet of film that are used. The inventor, Mr. Joseph Bianchi, of Toronto, Canada, in explaining the operations of the camera, stated that he was able to secure good motion effects with eight impressions to the second on the moving film in place of sixteen, as usually required on cameras of the intermittent character. Positive strips made from the negative films are passed through any usual moving picture lantern with the stop interval between the pictures, and are more steady with less lateral displacement than is generally noticeable in films of the ordinary type. The camera is also very light to carry and is convenient to operate. It is a distinct advance in avoiding the usual delicate intermittent mechanism of cameras of this type.

The Current Supplement.

Prof. Reginald A. Fessenden opens the current SUPPLEMENT, No. 1723, with a brief history of wireless telegraphy. Each year there are millions of cords of wood wasted in the forest and on the farm. F. B. Veitch explains how this waste wood may be practically utilized by destructive distillation, and by recovering the turpentine and other products with which it is charged. Sir William Ramsay places himself on record as having observed a phenomenon that indicates how radium's decay may be stopped. Dugald Clerk, the well-known authority on gas engines, discusses the problems of the motor car. The Brusio-Campocologna hydro-electric power plant is one of the largest and most up-to-date electric power generating and transmission systems of the world, a pressure of 50,000 volts being utilized to send the current to its destination. This electric installation is described by F. C. Perkins, and its chief features are illustrated. L. Delaunay contributes an article on "Matter and Ether," which explains the meaning of the terms. Dr. C. W. Michaelis writes on hardening hydraulic cements.

A TUNNEL-BORING MACHINE.

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attached a yoke casting mounted adjustably on the rear truck. By means of two screws, one horizontal and the other vertical, this yoke is moved vertically or laterally, for the purpose of varying the adjustment of the frame in any direction of alignment or gradient. Above the frame, mounted in bearings at the front and rear ends of the I-beam, is a hollow, longitudinal driving shaft, which carries at its forward end the large circular head in which the drills are mounted. This drill head consists of a central hub, a casing, four connecting arms, and four bars to which the pneumatic hammers are fastened. The hammers are seated in a plane parallel to the axis. Upon three of the bars six hammers are mounted, and upon the fourth seven hammers, and they are so composed that as the head rotates, they cut along different overlapping circles and cover the face of the excavation. Steel plates fixed between the four groups of hammers are arranged to form pockets to catch and carry away the fragments of the rock as they are broken from the face of the wall. They discharge into a hopper at the rear of the rotating head, from which they are carried away by a conveyer leading to the rear end of the machine.

Air is led to the drills through the hollow driving shaft. At its rear end the shaft rotates in a stuffing box fitted in an air chamber carried on the rear truck of the machine.

The head is rotated by a compressed-air engine, carried on the forward part of the frame, the motion being communicated by a worm-wheel drive, which rotates a longitudinal shaft provided at its front end with a pinion. The pinion engages a gear, which is bolted to the rear case of the rotating head. The forward motion of the machine is secured by an air engine on the rear truck which, by means of a friction wheel and gear train, turns the feed gear, before mentioned as meshing with the rack laid between the rails on which the machine travels.

The machine which we illustrate is designed with a drill head 8 feet in diameter. If a full-sized tunnel of say 15 or 20 feet diameter were being driven to rock, the method adopted would be to drive an 8-foot heading with the boring machine, and then break down the rock, until the full sections were secured, by the usual process of drilling and blasting.

As to the capacity of the machine and the cost of operation, the designers estimate that it will be capable of removing 5,000 cubic feet of rock per day, and that $300 per day will be sufficient to meet all the expenses incident to the operation of an 8-foot machine. While testing the cutting elements in the shops, one of them cut a strip across the face of a granite rock 4 inches wide, 4 feet 4 inches long, and 1 inch deep, in one minute. This is equivalent to driving an 8-foot tunnel 72 linear feet in 20 hours, by the use of twenty-five of the pneumatic cutting hammers, which is the number mounted in the machine which we illustrate.

A rock tunneling machine has been the dream of many inventors for a long time, and many and various have been the mechanisms devised. When it is considered that the ordinary compressed-air drill, which represents a survival of the fittest in rock-drilling methods, at least as regards endurance, requires 5 to 10 horse-power and an average of six changes of the drill bit in cutting a hole six feet long of an average diameter of two inches, not to mention rapid wear and frequent breakage in the machine itself, and that in many kinds of rock one such hole per hour is considered good work, the nature of the problem of building a machine to cut away roughly a thousand times as much rock nearly half as fast (which is what the manufacturers claim for their machine) will be appreciated.

Taking into consideration the time lost in adjusting an air drill for each hole drilled and in making a new "set up" of column, tripod, or stretcher bar for every few holes, all of which the tunneling machine will eliminate, the work done by this machine will be something like two hundred times that of an ordinary air drill; and if it will really "stand up" in practice and do that work with about one-tenth of the proportionate power of the air drill and no greater delay due to wear and breakage, the economies effected will be obviously immense, and the achievement is indeed a great one.