will, doubtless, soon apply to his new invention improvements of detail that will insure its success and extensive employment. The peculiar merit of the lusol lamp is the elimination of all mechanism. As we have seen, capillarity and the heat of combustion suffice to raise the liquid, vaporize it, and mix the vapor with the quantity of air that is required to accelerate its combustion and cause the mantle to glow with dazzling brilliancy. Finally, the lusol light needs no costly and inconvenient system of factories, tanks, and pipes, or wires.

How Rats Disseminate Plague.

That the rodent is an active agent in the propagation of plague has been a steadfastly maintained theory among scientists for many years past, but exactly how an epidemic is disseminated among the rats and also communicated therefrom to human beings it has been left to the special plague commission appointed by the Indian government to determine. This scientific commission is still engaged in its undertaking, but the discoveries that have already been made are of such paramount importance, that a short and interim report upon the subject has been published. In the course of this proceeding the commissioners definitely state that the disease is conveyed from one rat to another and also to human beings by the parasite commonly known as the "rat flea." This hypothesis has been confirmed as the result of several experiments. When plague-infested and healthy rats were incarcerated separately in wire cages, thereby preventing them coming into contact with one another, the healthy rodents became infected, and it was also ascertained that guinea pigs could also become contaminated in the same manner. But on the other hand, if the plague-stricken rats, immune, however, from the flea, were confined and permitted to come into free physical contact with healthy animals, no such signs of infection were observed. Directly the fleas were introduced, the animals in a short time were all similarly affected, the progress of the epidemic varying in direct proportion to the number of fleas present. These tests conclusively proved that the parasite was the active agent in propagating the disease, since every precaution was adopted to prevent the possibility of infection being spread atmospherically. Moreover, similar tests were repeated in plague-infected houses. For instance, guinea pigs were permitted to run freely in a house, which though it had been disinfected still harbored parasites, with the result that the animals were found to be soon attacked by the fleas and contracted plague, and the parasites caught on their bodies were found to be capable of spreading the epidemic. When, however, under the same conditions, the guinea pigs were immured in cages of wire gauze, thereby preventing the infesting of fleas, no ill results attended the animals. There is one important theory advanced in the preface to this report—that the plague itself may in reality be a disease of fleas.

Light Paint for Machinery.

There is a very marked tendency at the present time on the part of manufacturers of machinery to make a departure from the use of black or dark paint in finishing their product. It has been the custom for a long time to cover the heavier parts of machinery of all kinds with paint or enamel of somber hue and the only variation which seemed permissible was an occasional striping of gilt or some bright color. During recent years a revolution has been going on in the matter of the construction and design of workshops and with it has come the demand for machinery painted some bright color. Not infrequently there is a demand for white, while light gray, buff, and cream color are favorites. The recommendation for this change is that the machine shop presents a much more attractive appearance and that the light surfaces of the machinery are responsible for the reflection of a great deal of light while the black absorbs the rays. The power plants of some of the new office buildings, hotels, and theaters are now regarded as show features of the establishment and one up-town hotel in New York has special accommodations for visitors. The engine room is in a very accessible place and it is fitted with a gallery for the convenience of spectators. Hardly a night passes but that a theater party with men and women in evening dress is to be seen viewing the installation with interest. This plant is finished in white with stripings of gold. The New York, New Haven and Hartford Railroad Company, in ordering machinery for the new power plant at Readville, Mass., reserved the right to name the color of the paint to be applied to the machinery.

A SIMPLE EXPERIMENTAL DYNAMO.

BY PAUL H. WOODRUFF.

A generator giving from 30 to 40 watts of electrical energy is a very convenient piece of apparatus for experimental purposes, as it requires little power to drive it yet may be made to take the place of several cells of battery. Of course, with a given number of watts we have our choice of voltage; thus, allowing 40 watts as the output of our generator, it is practicable to wind the machine so as to give 1 volt and 40 amperes, or 40 volts and 1 ampere, or anything between these figures, always remembering that whatever voltage we get, we must divide 40 by that number to find the amperes. The machine we are about to consider is so arranged as to deliver current at either of two voltages, according to adjustment; that is, if we wind for 8 volts 5 amperes, we can also obtain 16 volts 2½ amperes if we wish, by merely changing two connections. It will also deliver either direct or alternating current at both voltages. At any store handling electrical goods, a telephone magneto generator, either new or second-hand, may be bought for a small sum. The kind known as "bridging generator" should be selected; but before buying, the magnets should be tested as to strength, especially in a second-hand machine, as they will lose some of their magnetism if roughly handled. Another test is the shock. In most of these machines the current is collected by a spring resting on a pin in the end of the armature shaft. By placing a finger and thumb, one on this spring, the other on the metal body of the machine, considerable current should be felt when the handle is turned at a very moderate speed.

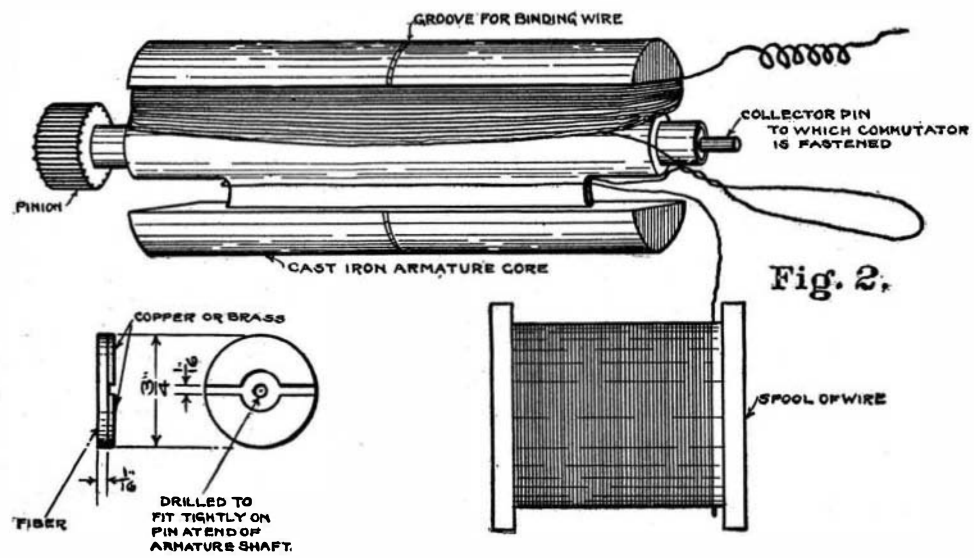

Fig. 1.

Constructional Details of the Dynamo.

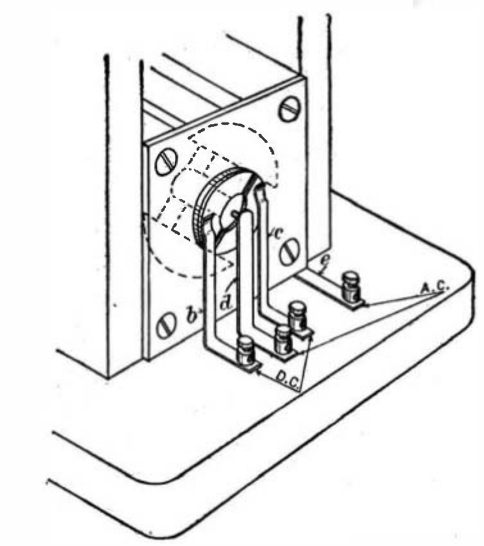

Fig. 3.—The Commutator.

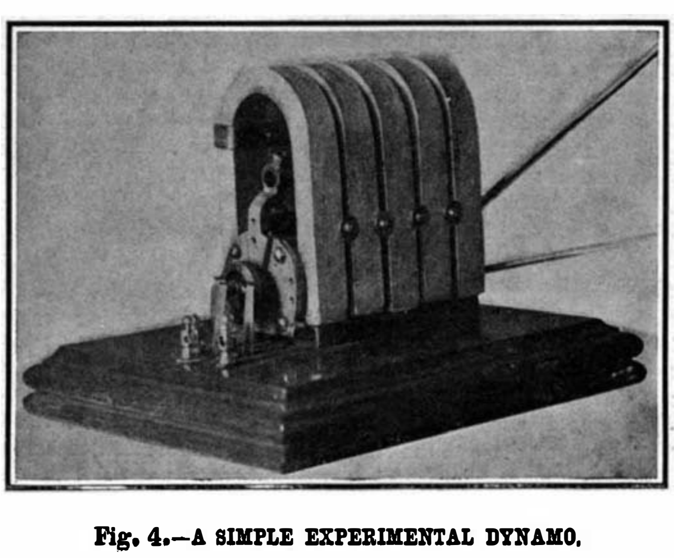

Fig. 4.—A SIMPLE EXPERIMENTAL DYNAMO.

Having made our purchase, we proceed to dismantle it. Take out the screws in the brass end plates or bearings, and remove the armature. The contact spring previously spoken of would best be removed now, as we shall not need it. The armature in most of these machines is 1½ inches in diameter, of the H or shuttle form, and wound with No. 31 wire. This should all be unwound with care, as it may come in handy for making other apparatus.

Now, while the armature is bare, we will make a commutator. This consists of a ¾-inch disk of red fiber, 1-16 inch thick, with a center hole that is a drive fit on the pin in the rear end of the armature shaft. On one side of this disk are fastened the two halves of a ¾-inch copper or brass washer, which has been sawed or filed into two equal parts. These may be drilled and tapped for small machine screws put through the fiber, or they may be cemented to the disk, exactly as Fig. 1 shows them. But before fixing the commutator on the shaft, we would better rewind the armature. As we have decided on the 8 and 16-volt arrangement, we will use No. 23 wire. Before starting, be sure that the iron is well insulated; it is usually covered with paper or cloth shellacked on. Leave two or three inches free at the end of the wire, and see that the covering on the wire is not torn or loose. Wind the channel at one side of the shaft full first, and in going over to start the other side leave a loop of several inches of wire, as in Fig. 2; then fill the other side. Always wind tightly and get as much on as possible. There is almost always a groove cut around the armature used for binding the bundle of wire. Wrap a turn of wire tightly in this groove, and solder it, or at least, twist it as tight as possible, or when the machine is running at a high speed, centrifugal force will throw the wires out against the pole pieces, spoiling the winding.

When the loop left in the center of the coil is cut, there are practically two separate coils on the armature. If the starting end of the whole winding is connected to the shaft or body of the armature, and the finishing end to the pin by soldering, while the remaining ends are connected together, the higher voltage will result. For the low voltage the coils are separated, and both starting ends connected to the shaft, with both finishing ends to the pin. The machine may now be put together again, that is, the armature and bearings assembled with the pole pieces, and the shaft given a whirl to see that it runs all right. Now, drive the communtator onto the pin at the end of the shaft. The metal pieces are insulated from each other by a 1-16-inch or less air gap; but one must be connected to the shaft, the other to the pin in the end. Probably this can best be done with a bit of No. 23 copper wire and a speck of solder. Be very careful to remove every trace of soldering fluid after the operation. The slot in the commutator should be parallel with the iron of the armature, as shown in Fig. 3. A little cement will make it solid in this position, but should not be used until the machine is tested, as described later.

It is now time to make a base of some kind for the machine. This is, of course, a matter for individual choice, but do not make it too light; about one inch thick, of hard wood, and say 3 inches larger each way than the extreme dimensions of the machine, ought to be satisfactory. Drill and counterbore from the bottom of the base for screws to hold the machine; you will find tapped holes already in the bottom of the pole pieces; screw the machine down solid, and we are ready for the final operation—the fitting of the collector springs, or brushes. Spring brass 3-16 inch wide and 1-32 inch thick is about right. Four pieces, made according to Fig. 3, are fastened to the base by binding posts in the locations shown; *b* and *c* rest against the commutator, not too heavily (these serve to collect direct current); *d* against the flattened end of the pin in the center, and *e*, which is simply a straight strip clamped under the machine, and making good connection with it, collect alternating current. These brushes should not press hard enough to interfere with the smooth and easy running of the armature.

In testing, have an assistant turn the handle while you connect the direct-current posts to some piece of apparatus—a small lamp, for instance. The commutator slot is now at right angles with the armature winding; but it may be found that a slight variation one way or the other from this position will increase the output. When the correct point has been found, the commutator may be connected to the shaft. In a sense the machine is complete, and may be driven quite satisfactorily with the small crank and gear supplied with it. But in the author's opinion, it is far preferable to discard the large gear altogether. Get a grooved wooden pulley (a V-groove is the best) 1½ inches in diameter, with a center hole a shade smaller than the pinion or small gear on the armature shaft, and drive the pulley right onto the pinion. Driven with a ⅛-inch round leather belt from a hand wheel or sewing machine flywheel, a speed of 2,400 revolutions per minute can easily be attained, at which speed the machine will be found very efficient and useful.

The following table gives windings for various approximate voltages at 2,400 revolutions, although nothing very definite can be given, as much depends upon the make and condition of the machine. The voltage varies directly as the speed.

Wire No.	Volts.	Amperes.	Volts.	Amperes.
31	100	0.4	50	0.8
28	50	0.8	25	1.6
25	25	1.6	125	3.2
24	20	2.0	10	4.0
23	16	2.5	8	5.0
22	12	3.25	6	6.5
20	8	5.0	4	10.0
19	6	6.5	3	13.0
17	4	10.0	2	20.0
14	2	20.0	1	40.0

THE SOLUTION OF NEW YORK'S TRANSPORTATION PROBLEM.

Less than a decade ago the Scientific American was urging upon the authorities of New York city the immediate construction of the first Rapid Transit Subway, pointing out that the objections to underground travel were mainly founded on prejudice. We pointed to the fact that the increase in the traffic on the surface and elevated railroads, which even then was beginning to be very marked, was but the beginning of a tide which would rise with increasing rapidity, and unless speedy measures were taken to meet the contingency, would, before many years had passed, entirely swamp the existing means of transportation. After many disappointments and protracted delays the Subway was authorized and built. Its completely successful operation, and the fact that its trains were speedily filled to their maximum capacity, proved the truth of our contention that it was only by going underneath the surface, that New York could hope to grapple sucessfully with the tremendous problem of providing adequate rapid transit. It has frequently been remarked, perhaps not altogether without some truth, that while New York city is apt to be somewhat late in adopting new improvements, when she once has done so, she develops them with a zeal and on a scale of magnitude, for which no parallel can be found. Certainly this has been the case in the matter of providing means for underground travel. The first rapid transit subway with its four-track road, its eight-car express trains, and its high running speed both in local and express service, ranks easily as the finest complete system of city underground railways to be found anywhere in the world; and to the 21 miles which are now in operation in this city, there will be added within four or five years' time an additional mileage of rapid transit tunnels, which will bring the total to over 100 miles.

The enterprise of the city itself is being ably seconded by the efforts of the great railway corporations. The New York Central Company is about to place its freight tracks which parallel the western water front of Manhattan, entirely below ground, and the company is also proposing to build a connecting tunnel from this new subway to connect with its existing main lines, running to the Grand Central terminal. The Pennsylvania Railroad Company has already completed its two tubes below the Hudson River, and is rapidly excavating its way across Manhattan Island, at a depth of 50 to 60 feet below street level, to a junction with the four tunnel tubes which are being driven below the East River to connect with the Long Island Railroad system.

Another enterprise whose magnitude is little understood is that of the Hudson Companies, whose project includes the construction of no less than four tunnels below the Hudson River, two crossing at Morton Street and two at Cortlandt Street, and a connecting tunnel running parallel with the Jersey shore and underneath all the big terminal stations of the roads which run into Jersey City. Moreover, the two tunnels which cross at Morton Street are being rapidly extended below Manhattan Island, one branch running from Sixth Avenue below Ninth Street to Astor Place, and the other extending below Sixth Avenue to Thirty-third Street, where there will be a terminal station. In addition to the four East River tunnels of the Pennsylvania Railroad Company, the Belmont interests are building what is known as the old Steinway tunnel, which passes below the East River and extends under Forty-second Street to the Grand Central Station. Finally, there is the Rapid Transit tunnel from the Battery to Joralemon Street, Brooklyn, which will connect the subway lines of Manhattan and Brooklyn.

The whole of the extensive and exceedingly costly work which we have outlined above is being built entirely below the street and river surface; and to this must be added the vast network of street railways which was formerly operated by the Manhattan Street Railway Company, and the equally extensive lines of the old Manhattan Elevated Railway Company, all of which—elevated, surface, and subway—are now amalgamated and operated by a single corporation known as the Interborough Company.

It will readily be understood that the planning and construction of so many underground railways, crossing and recrossing the island and each other, has necessitated careful consideration of the depths at which they must be built in order to avoid interference. As a matter of fact, when the work which is at present under way or proposed has been completed, there will be presented, in at least one part of Manhattan Island, the curious condition of five separate railway systems running, one above the other, at five different levels. The particular spot referred to is the intersection of Sixth Avenue and Thirty-second Street, where, in addition to the three superimposed underground roads, there will be two distinct railway systems above ground; first the trolley street railway, and above that the elevated railway. The arrangement of the tracks and stations, and their relation to the adjoining buildings, is shown in the sectional view on the front page of this issue.

We doubt if it would be possible to find in any city in the world a center of transportation which will compare in importance with that which is herewith represented. Far down below the street surface, at a depth of 55 feet, will be the tunnels which lead from the new terminal station of the Pennsylvania Railroad, across Manhattan Island and below the East River to Long Island. These tracks will be used both for the local service and for such of the main line express trains as will be run through to the extensive yards of the company on Long Island. The local trains will be operated on the multiple-unit system, with motor cars and trailers alternating, while the express trains will be hauled by powerful electric locomotives of the general type shown in our engraving. Immediately above the roof of this tunnel, and separated therefrom by the depth of its steel floor, will ultimately be built a three-track subway, the two outer tracks to be used for local trains and the center track for express service. Above this, again, will be the two tracks of the Sixth Avenue branch of the Hudson Companies' system, and at this point will be located their terminal station. At the street surface are the two tracks of the street railway; and above them are shown the elevated railway and its Thirty-third Street station. Above the elevated tracks is yet another means of travel in the shape of the footway bridge, connecting the two platforms. Finally, as if to render this epitome of modern transportation complete, we have, on the left hand, or westerly side of the station, one of the modern, electrically-driven escalators. In this connection it is interesting to note that not only the escalator, but the five railway systems, are operated electrically.

Fully to appreciate the significance of this junction, we must remember that from this point it is possible to take a car which, directly or by its connections, will not only take one to any point in Greater New York, or Jersey City and its suburbs, but to any city of the whole United States, and that this, moreover, can be accomplished very largely without having to make any change in the open.

The Discovery of Nubian Manuscripts.

While examining some sheets of parchment bought at Cairo for Coptic manuscripts, Carl Schmidt made a discovery of much importance to philology and history. The repetition of the word "Uru," which among modern Nubians means king, convinced the German savant, who is an authority on Coptic and the early Christian archæology of Upper Egypt, that the text was Nubian, a language which, although still spoken, is no longer written. The manuscripts date from the eighth century A. D., and are translations of Christian works in which frequent references to St. Paul are made. One manuscript is a collection of extracts from the New Testament, and the other a hymn of the cross. The Greek original of the hymn is not known. When the documents are deciphered philological science will be enriched by the knowledge of the language spoken by the people of Nubia before the invasion of Semitic tribes, and the mysterious inscriptions on many of the Egyptian monuments may be read.

The Horseless Age says the United Kingdom remains the best customer for American motor cars, its purchases growing practically in the same proportion as the total exports. The most remarkable development has taken place in the Mexican, West Indian, and South American markets, and it will probably not be long before American manufacturers will control these markets, as they now control that of Canada.

Engineering Notes.

The commission of engineering experts which was appointed by the municipality of Turin to investigate the project for a new international railroad passing through Mont Blanc, and thus providing communication between the Rhone and Dora Baltea valleys, has now issued its report. The commission selects Aosta, at an elevation of 1,600 feet above sea level, as the starting point of the railroad, which, after climbing 1,700 feet, should pass through a tunnel under Mont Blanc at a height of 3,100 feet and emerge upon the village of Les Houches in the Chamounix Valley and Pre St. Didier. By this route the distance between Turin and Chamounix would be reduced to 116 miles, and from the former city to Geneva 166 miles. It is suggested that as the railroad and tunnel would extend through three different countries, the cost of construction should be borne by the respective governments, while furthermore the municipalities of Turin, Geneva, and Chamounix, which have the most to gain from the enterprise, should also participate in the outlay.

Owing to the great crush that always prevails at certain of the great railroad stations in London in the early morning to procure workmen's tickets, automatic machines for the issuing of the same have been installed, thereby avoiding the long queues at the booking offices, and expediting the delivery of the tickets. In Great Britain this class of ticket, which enables the workmen to travel at purely nominal fares over considerable distances—in one case 28 miles can be traveled for four cents—is issued up to about 7:30 every morning, and accordingly there is a vast section of the public which avails itself of these facilities. The automatic machines have proved highly efficient, and expedite the delivery of the tickets to a considerable degree, since no time is lost in tending change, the passengers being required to insert the correct amount into the machine. At Farringdon Street the machine installed issued 2,500 two-cent tickets per day, and proved so reliable in operation, no serious delays occurring through the mechanism breaking down, that the system has since been considerably extended, and now machines for the issuing of three and four-cent tickets are being widely adopted. A further boon possible with these automatic machines is the issuing after 4 o'clock in the afternoon of tickets dated for the following day, thereby relieving the pressure upon the device in the morning, when a considerable rush sets in during the later hours in which the machine is in operation.

The Applied Science Reference Room of the Pratt Institute Free Library (Ryerson Street near DeKalb Avenue, Brooklyn) exists for the purpose of aiding those engaged in any trade or industry. Hundreds of questions arise every day, in the factories and shops of a city, which could be answered from some printed page. It is the intention of the Applied Science Reference Room to supply as many of these printed pages as possible. Sometimes they are in books, very often in periodicals or transactions, and again may be found only in a trade catalogue. In the room set aside for this work in the Free Library of Pratt Institute are taken nearly a hundred trade and scientific papers, giving the latest news of the industrial world. There are besides over fifty of the labor union papers, of which a file is preserved. The most important of the periodicals are bound, and these bound files contain much material that can be found nowhere else. The publications of the United States Patent Office are kept here also, and are used daily. The collection of books here includes up-to-date publications in various industries, such as electrical engineering in all its branches, plumbing, manufacture of textiles, industrial chemistry, gas engines, the making of cement, and so forth. The books in this room are not allowed to go out, so that anyone coming is sure to find the book he wishes to refer to, if it is a part of this collection. The library has, however, a good collection of books in these subjects for circulation, often duplicates of the books in the Applied Science Reference Room. The room is in charge of Mr. Edwin M. Jenks, whose work is to help those who are looking up any question that lies within the province of this room. A large collection of trade catalogues furnishes the very latest information in many lines, and is being enlarged constantly. The library will get any trade catalogue in print, at the request of any user of the library. One new feature of the room is a collection of mounted cuts of machines and mechanical devices. These may be used in the room or taken away to work with, if desired. A man looking up a new form of chuck, for example, will find a score of cuts showing different chucks, and among these may well find some that will be of service to him. Men studying in the evening schools, those preparing for civil service or other examinations, lawyers, and men of various interests will find this department of use. It is open every day except Sunday, from 12:30 P. M. to 9:30 P. M., and can be used between 9 A. M. and 12:30 through the library office. Come in when you have a question, or want to see a trade paper.