Fig. 1.—Electric substation where 44,000 volts transmission potential is reduced to 13,200 or 6,600 volts and supplied to farmers on lateral branch circuits.

Fig. 2.—Alternating current motor driving irrigation pump fed by 2,200 volt farmer service through transformers which reduce the potential to 200 volts at the motor terminals.

Fig. 3.—Thrifty crops on irrigated lands. Electric pump equipment lifts the water from the water service trench nearby and from the low meadow adjoining.

Fig. 4.—An excellent hay crop on a low meadow land drained by the electric pump equipment shown in Fig. 3.

Central Station Current for Farms

Advantages of Introducing Electricity into Rural Districts

By T. Commerford Martin and Putnam A. Bates

UP to the present time, with 6,000 central station companies in the United States, there has never been a company or plant established to supply electricity to a farming region. Perhaps there never will be. Conditions in the central station industry have changed so rapidly in thirty years that electrical supply, once the peculiar enjoyment of residents in a limited city area is now available, from the one source, over hundreds of square miles. The Boston Edison company, which began twenty-five years ago with a little area of perhaps half a mile around Faneuil Hall, now covers a large part of Massachusetts with its circuits, and has many farm supply problems on its hands. Around Chicago, the North Shore Electric Company furnishes 24-hour current to a population of 250,000, in an area of 1,200 square miles, reaching 71 cities and towns, and some hamlets with barely 100 people. It has already many farmers on its books, and will soon have many more on its lines. The Public Service Company of New Jersey covers with its circuits the whole of the northern part of the State. Out in California, from the Sierras, electrical energy is fed to San Francisco over 200 miles away, and the circuits of the one system embracing more than half the counties in the State, are availed of already by many a farmer who never expects to have a railway track laid in front of his barn yard. It has been proposed to throw into 25 or 30 plants, the generating capacity of all the 400 existing central stations of New York State, because it is so easy now to distribute electricity that is made economically in great quantity. In England, the idea has boldly been put forward by Ferranti of using in about 100 central stations 60 million tons of coal, to supply the whole country, farmers included, with electricity at as low a price as $\frac{1}{4}$ cent per kilowatt hour— $11\frac{1}{3}$ horse-power for an hour for half a farthing. Here in varying instances we have reality and dream, but all emphasizing the immense fact that electricity has ceased to be the servant merely of the city population, and now regards as within its reach any populated district where poles can be set and wires strung.

It is needless to go into the technical details of the process of engineering and invention to which this expansion must be attributed. Three main factors are involved, namely, the adoption of the alternating current, the utilization of water powers, and the resort to higher pressures of current. Of all these changes the farmer is especially the beneficiary at present, and destined to be even more so in the near future. The

methods of supply have been tried out and firmly established. The questions now confronting the central station manager, and already being dealt with by him in a great many instances are those of specific local distribution and service. Sometimes the farmer has still to consider the problem merely for himself. The farmer may install his own private electric generating plant, or several neighbors might band together and construct a power station of their own, each being served on the co-operative plan. The most extensive use of electricity, however, in the rural or farming districts will, unquestionably, come as a development of present central station systems or the organization of companies having as their prime object, the serving of farmers' needs, through well planned electric plants located in the heart of the agricultural sections.

During 1910-11 a canvass was made by a committee, specially appointed by the National Electric Light Association, to investigate the work of the various central stations in its membership in developing and caring for the electric power and lighting service to farms and in rural districts. The result of this canvass was embodied in a report prepared by this rural electric service committee, of which Mr. J. G. Learned was chairman, and presented before the National Electric Light Association's annual convention, May 29th, 1911. The evidence brought out in the report is most interesting and encouraging.

Interesting data and valuable suggestions are, therefore, now before us on this new problem of extending central station electric service to the farmer. In mapping out territory, the central station can no longer regard the outlying sections as of no immediate concern. They are to be reckoned with, and preparations should be under way to develop this business along lines that would insure handling it on such a basis as will give satisfaction to the farmer, and be profitable to the service company.

It is clear, from the reports of several electric plants, where the rural business has been developed along good engineering lines and the farmer assisted in the solution of his somewhat complex mechanical farm problems, that this service is profitable. Other central station companies are now making elaborate plans for carrying out methods of farm supply.

The uses to which electricity can be advantageously applied in rural districts are many, and far more in fact than one would at first suppose. For reasons of safety and labor saving, the need for electricity is

really greater in farming districts than in the more densely populated sections, owing to the comparative isolation and consequent difficulty in obtaining labor. In the agricultural sections where stock farming is carried on, or where there is considerable water to be pumped for irrigation purposes, the use of electric power is well recognized as a decided betterment and it is in such districts, largely, that one will find the greatest opportunity for immediate progress.

Broadly stated, the stock breeding and stock feeding districts require more power than truck gardening districts. A stock farm requires to have conveniently within its reach at least 25 horse-power for feed grinding, ensilage cutting, threshing, pumping and a variety of similar uses. The operation of dairies and creameries also requires considerable power and is an inviting field for the use of electricity.

Naturally, the farmer is not compelled to use electricity, for there are several types of agricultural power apparatus utilizing steam, oil, heated air or other source of energy, which may usually be employed at a somewhat less first cost, but the convenience, absence of risk and cleanliness of electric service are features which he values. It is not necessary, therefore, to exert much effort in explaining the advantage of electricity, but the question is on what basis shall the service be supplied?

The conditions incident to the supply of electricity in the rural or farming districts differ so materially from those in the towns and cities that when the "farm" is considered, one is in the habit of regarding the proposition as undesirable, because one does not clearly see the manner in which such service may be economically rendered nor the extensive uses to which electricity may be applied in agriculture. This ignorance is not a universal condition by any means, but it is illustrative of the atmosphere surrounding many central stations, located adjacent to good farming sections.

In northern Colorado, we find a progressive company that apparently has attacked the problem in the right manner, and some of the characteristic features of the service supplied are illustrated in the accompanying photographs. In the center of the more thickly settled sections, sub or distributing stations of the type shown in Fig. 1 are erected, the object being to locate points to which to build heavy distribution feeder lines and from these substations as centers to feed out lateral branches.

This system embodies good engineering methods

and makes the current transmission costs such that for farmer business the same rates are charged as those asked within the towns, the only difference being that a minimum charge is made to insure a reasonable return for the extra investment in the pole lines, the first cost of which this central station company finds it agreeable to bear.

The planning of this system has been carefully done and the company's policy is to encourage the utilization of its current. The soliciting agents are trained in the uses to which electricity may be efficiently applied in farming and their success in securing results and business rests solely on their power to convince the farmers of the merit of each idea suggested.

It is quite natural that the rural consumers will require more individual attention from electrical solicitors, owing to the entire reliance of the farmer on this source for information. This makes farmers somewhat more expensive to care for as customers, but in the period of development it is money well spent, as friendship is created or cemented and new uses are found for current.

An especially desirable feature of the farmers' service is the fact that the power or principal portion of their current requirement is entirely during the daytime, which makes a tendency to balance up the load on the power station without adding to the "peak" load conditions. It is, therefore, obvious that many plants in smaller cities can supply farms during the day and their urban customers at night, from the same generators.

Figs. 2, 3, and 4 illustrate water electrically pumped, for irrigation purposes, which is an important field for the use of power in any agricultural section.

Fig. 2 shows a small inexpensive housing for the electric pumping plant, which elevates the water from a reservoir, a corner of which is shown in the background. The water is delivered from the pump through a system of trenches upon an acreage of sugar beets. In nearly all western States it is impossible to raise fruit, grain or garden crops without the aid of irrigation. Everywhere crops would gain if irrigation were more general.

Gravity irrigation is not always possible, due to the level of the land, with respect to the water source. To irrigate these high lands, which are often more

valuable than the lower lands, it is necessary to raise the water by pumping.

A general view of one of these electric pumping equipments is illustrated in Fig. 3, while Fig. 4 shows quite another condition, in that the land of this particular field is so low that water would naturally collect in places, forming marshes. The pumping equipment seen in Fig. 3 is utilized to keep this field drained during the season of irrigation; and the large field of potatoes—the foreground of the illustration—receives the benefit of this water.

The central station system above referred to, and of which these illustrations are photographs, would be entirely appropriate as a means for mastering the farmers' electric service problem in any locality, and while the uses to which electricity may be applied differ in the various localities, these illustrations are especially significant. The more extensive use of irrigating methods and power applications for general purposes must be adopted in successful farming systems of the future. This fact at once suggests a new field for the central station service that will no longer be neglected.

It was the introduction of electric motors that enabled manufacturers of all classes to determine definitely their power costs. The results thus obtained, through the elimination of belting and shafting losses and by measuring directly effective power used, were surprising.

On the farm, the advantages of such a change lie in another direction. The saving in power is not so important, for the amount of energy needed for this purpose is never so great as in the manufacturing establishment. The "ever ready" feature of the electric motor is here its chief advantage. Moreover oils and other combustible fuels, useful as they are, always introduce a decided additional fire risk wherever used, and of necessity farms are isolated in outlying districts away from organized fire protection. Small power engines, using gas or oil fuel, may be placed at a distance from buildings when in operation, which of course is safer, but not so convenient. The danger, however, cannot be so readily lessened in the use of oil lamps, matches and lanterns, nor is it very convenient to have to go outside to a point distant from the central buildings whenever power work is done.

It is the inconvenience of things that often spells failure for farmers. With a minimum of labor at command and a maximum of work to do throughout most seasons of the year, a direct saving in time of getting ready on each operation is all important.

From this point of view, therefore, the utilization of central station electricity for farming sections within striking distance of established power houses is ideal.

The central station manager and the farmer have different "angles of attack," but in reality their interests are the same. It takes time, however, to size up correctly a new situation of this kind, and this fact accounts for the tardy development of electrical matters in rural districts.

The successful farmer of to-day is vastly different from the farmer of a generation ago. He operates, maintains and develops his farm with the care and shrewdness of a business man. He analyzes his soil with the sole purpose of determining or of adapting to it the kind of crops best adapted to its characteristics and conditions.

He realizes that his stock must no longer trample tons of fodder under foot during the feeding season. Instead, he must cut the roughage and feed it in such manner that there will be little waste. The result of adopting such an obviously better method is success.

All this, however, takes power, and the old time tread mill is too awkward to harmonize with the situation under the improved conditions. Power machinery, therefore, becomes a necessity, and the electric motor is ever the dream of the man who wishes to be abreast of the times.

The matter of finance has yet to be mastered by most farmers, and central station men must remember this when arranging for the farmer's initial investment. It will be policy to find a way to provide the line wires, transformers and meters, but cutting and hauling poles is a farmer's work and one can well leave this to him. He is often a skillful mechanic, familiar with the technique of a trade, and he or his sons take just as kindly to the handling of a dynamo or motor as they do to the operation of an automobile. The main thing to do in introducing electrical applications on the farm is to utilize—not in the city but on the spot—all these latent possibilities.

A New System of Bunkering Steamships

The "Herald" and Her Performances

By F. C. Coleman

ONE of the latest developments in the bunkering of steamers is represented in the "Herald," a twin-screw coaling vessel shown in the photographs. The "Herald" is fitted on the Holland-Johnston system with two elevators, and has a speed through the water of 6 knots. The capacity of the vessel is 400 tons of coal, and the output 100 tons per hour per elevator, i. e., 200 tons per hour for the vessel. Our frontispiece shows the "Herald" bunkering the London & North-Western Railway Company's mail steamer "Anglia," and gives a clear idea of the construction of the vessel. The coal is carried in pockets or compartments on each side of the vessel. Between the compartments and extending nearly from one end of the coaler to the other, is a longitudinal passage up and down which the movable elevators are free to travel. The system is novel and differs from other coaling methods, inasmuch as though the "Herald" has only two elevators, larger vessels fitted in the same way might have three, four or five elevators; and with each of these elevators, having an output of 100 tons per hour, it would be possible for a vessel so fitted to discharge herself at the rate of 500 tons per hour. Large ocean liners served by large vessels of the "Herald" type, one on either side of the liner, such as the "Mauretania" or "Lusitania" and the big vessels of the White Star Line, could thus be coaled at the rate of 1,000 tons per hour.

A thousand tons per hour may appear a very large quantity of coal to transfer from barge to steamer, and it can only be done by a system such as that on which the "Herald" is constructed, because to attempt to pass that quantity of coal down one shoot, or even two shoots, would mean that the discharge would have to be so rapid that the delivery of it could not properly be taken. In the "Herald" system, however, different shoots are put through the side bunker doors in different parts of the vessel and coaling is thus going on simultaneously in practically all parts of the vessel's bunkers, consequently, the only delay with

this method will be at the final trimming in the top of the bunkers, which must always be a slow operation.

The elevators may be moved from any one point in the trunk to another, being carried by the trucks on rails, which are shown in the photographs. In addition to this flexibility of the positions of the elevators, the barge itself can, of course, be moved, consequently there is no doubt that any vessel with side bunker doors may be coaled by this design of plant.

When supplying coal to vessels provided with center bunker hatches instead of shoots, conveyors are put into operation for the purpose. With other systems of coaling a great drawback is experienced with the fine coal dust or dirt which gets blown about by the wind and covers the vessel being coaled from end to end with dirt. Compare these systems with the method of loading the London & North-Western Railway Company's mail steamer "Anglia," by the "Herald," and it will be seen that the complete absence of dust in the case is remarkable. Coaling by means of the "Herald" is a very clean operation. No dust whatever gets on board the vessel being coaled.

The elevators are driven by a very ingenious multiple gear in the top pentagon drum; the small engine necessary for the purpose being contained at the head of the elevator between the top and the bottom trunks. The exhaust steam from this engine is admitted into the head of the elevator in a suitable position, and is directed along the shoots into the vessel's bunker doors. The illustration shows the steam. It was found by experience that coal dust is carried straight into the vessel's bunkers with the steam, thus insuring an extremely clean method of coaling steamers. It is stated that the steam does not in any way wet the coal.

With two elevators, the crew of the "Herald" consists of the master, the engineer, the assistant engineer, a fireman and three deck hands. This crew is sufficient to navigate her and do all that is neces-

sary in connection with the bunkering of steamers. The salient features claimed for this bunkering system are: Flexibility as regards the shoots, cleanliness, rapidity and economy.

The Brooks Comet

By Prof. W. R. Brooks

THE new comet discovered in July by Dr. William R. Brooks, director of the Smith Observatory, Geneva, N. Y., is now visible to the naked eye, and in a very favorable position for observation on the western side of Pegasus. The comet has moved up through the northern part of Cygnus, and on September 10th was about 20 degrees northwest of Vega, the brilliant star in the constellation Lyra, and now overhead in the early evening. This was its greatest north declination, about 57 degrees. From this place the comet is moving first westerly, then southwesterly as it speeds toward the sun.

The following ephemeris will show the comet's track through the northwestern heavens. Those not having telescopes with graduated circles, can plot these positions upon a good star atlas, and thus get the comet's relative place to the well marked stars in its course:

September.	R. A.	N. Declination.
13	17 hrs. 10 min.	+57 deg. 9 min.
17	16 " 18 "	55 " 42 "
21	15 " 31 "	53 " 00 "
25	14 " 51 "	49 " 21 "
29	14 " 17 "	44 " 58 "
October.		
3	13 " 49 "	40 " 6 "
7	13 " 26 "	34 " 51 "

The comet was nearest the earth on September 17th, when its distance was 45,000,000 miles. While the comet is visible to the naked eye, an opera or field glass will add to the pleasure of the observation.