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THE DIFFICULTIES AND PROBLEMS OF THE ELECTRIC ENGINEER.

One of Germany's greatest philosophers, now many years dead, affirmed that electricity was destined to serve the minor uses of life. Up to a recent period this observation was wonderfully just. In spite of the work of Page and others the electric motor remained for years little better than a toy. In metallurgy the deposition of thin coatings of metals was all that electricity effected; in the production of light and heat its work was nothing; and the electric telegraph was the most impressive exhibition of its power. Now all is changed. In all technical departments the work of electricity appears—often on the greatest scale. In welding metals and in the arc light the larger class of heating and lighting operations are effected; in the Cowles and other electric furnaces, metallurgy and heating find their exponent, while in the transmission of energy electricity is without a rival in the magnitude of its operations and in the number of horse powers of energy conveyed to points distant from the place where the energy is generated. The effect of the new *regime* and of the unprecedented developments upon the public has had its effect, and electricity is believed to be almost omnipotent.

Yet the German philosopher's observations have even to-day a glimmer of truth in them, because of the limitations of electricity. None of the phases of energy has drawn for it more provoking limits. Repeatedly experiments in the larger class of operations have been tried only to fail, because the limitations of the subject were poorly understood. By a survival of the fittest, and by gradual improvement in detail, the present appliances of what may be termed electric engineering have been produced and have found their place in the world's work.

In the transmission of energy one of these limits is found. Ordinarily a mechanical transmission system works more economically, as it does more work. Thus a cable traction plant kept in motion and propelling no cars works at a total waste; every car put upon the line increases its efficiency, and the efficiency keeps approaching the hundred per cent limit as car after car is added. In the electric transmission of power, as usually conducted; the case is exactly the reverse. Every increase in energy transmitted involves a greater waste upon the line. The only way to bring about economy is to have the resistance of the line low as compared to that of the lamps and motors absorbing the energy transmitted. Of course, this may be counteracted to some extent by the greater economy in generation of large quantities of energy at the station, but the limits to the economy of transmission proper remain. A line supplying lamps or motors in parallel with each other will work to constantly increasing disadvantage as greater draughts are made upon the line. The case is comparable to the "wire drawing" of steam, where a large engine is fed by too small a pipe. For a given steam pipe, the larger the engine supplied by it, the greater will be the waste.

Recently many attempts have been made and carried out to use the current as a heating agent. Again the question of economy appears, and for the present seems to preclude the extensive use or any except special applications of the current for heating purposes. The generating plant is usually run by steam. Coal is burned and its energy is employed to drive a steam engine which drives a dynamo. The dynamo may have an efficiency of ninety-eight per cent; the boiler may have an efficiency almost as great; but the steam engine, subject to the second law of thermo-dynamics, at one fell swoop reduces the efficiency of the system to perhaps only two or three per cent. Burning coal under a boiler and using the steam power to generate electricity, and using the current as a heat producer, is comparable to running a hot air furnace on such principles as to send nearly all the heat up the chimney.

It would seem as if the thought that a horse power of energy is required to keep a few feet of fine carbon filament white hot would be a subject almost of mortification to the electric engineer. This is the case with incandescent lighting. That it is a subject of thought with him, that he does hope for improvement in the future, is evidenced by the eagerness with which researches on the direct production of light are watched. The electric world, in a sense, is waiting for the inventor or scientist who will produce the Hertz waves of frequency sufficient to affect the eye. The inefficiency of the incandescent lamp is so fully recognized that the glow-worm, firefly and curculio are looked upon as models of efficiency in light production—examples too near perfection perhaps for man to aspire to follow—yet as examples which may show the way to better results in the future.

The want of suitable refractory material for the incandescent lamp filament, the high capitalization required for electric generating plants, the poor economy of the steam engine as a prime motor for driving dynamos, are a sample of the difficulties which the electric engineer has to contend with. It is to be hoped that the inventor will dispose of enough of them to make electricity take the place it is fairly entitled to.

BAUXITE MINING IN ALABAMA.

The growing importance of aluminum gives interest to the ore from which it is obtained. This ore derives its name, beauxite or bauxite, as it is more commonly called, from the town of Beaux, or Baux, near Arles, in southern France, where it has been found in large quantities.

Within recent years it has been discovered in Tennessee, Virginia, both the Carolinas, Georgia, Alabama and Arkansas.

An article by Henry McCalley, in *Science*, is our authority for the following statements concerning the present status of the mining of the ore in the South.

Of the four companies which have been engaged in the industry, only two are now operating. They are known as the Republic Mining and Manufacturing Company and the Southern Bauxite Mining and Manufacturing Company.

But three mines are being worked at present; they are all near Rock Run, Alabama. An average sample of the ore from one of these mines shows on analysis about this composition:

Alumina	61·00
Ferric oxide	2·20
Silica	2·10
Titanic acid	3·12
Water	31·58

Samples from the other mines differ a little from this; they yield from three to five per cent less of alumina. The mining is easy, as the ore is soft and can generally be taken out with a pick; it is, however, rather expensive, as the ore varies so much in quality that it must be carefully sorted by hand and with the screen.

The diggings are on side hills, and are drained by open ditches. The ore whose analysis has been given is about 35 feet thick in the mine. It is concretionary; the best of it is found in a middle seam four or five feet thick.

Owing to its hydroscopic property all the ore has to be dried before it is shipped.

This is done by spreading it out in the open air, for the action of sun and wind.

When favorable tariff legislation makes it safe to increase the working capacity of these mines, artificial means of drying and better drainage facilities will be adopted.

At present only the best grade of ore is shipped. It is used for the manufacture of alum, which could as well be made from the inferior ore now lying in heaps about the mines, but to compete with the cheap imported ores, sent over by men who had the entire business in their hands, before these mines were open, only the best product can be put upon the market.

EXPERIMENTS WITH TELEPHONES.

The telephone invention now being public property, no impediment is offered to the free use of the instrument for business, social and scientific purposes. This, together with the fact that the very best telephone can be bought for less money than is required for the materials or parts from which it is made, places everybody on an equal footing as regards the use of this interesting instrument.

The telephone is incapable of producing any very striking physical results beyond transmitting speech, as the current generated by the telephone used as a transmitter is almost infinitesimal. Still there are many interesting experiments which may be performed by means of two telephones with suitable line connections.

To use the telephone to advantage, a call of some kind is required for signaling. The simplest device for this purpose known to the writer consists of a battery at each end of the line, a ratchet bar mounted so as to act as a switch for cutting out the telephone, and a battery having one pole grounded while the other is furnished with a blade of spring metal which may be drawn quickly along the ratchet bar, making a series of rapid interruptions of the current, producing a rattling sound in the distant telephone, which can be readily heard at a distance of from 25 to 40 feet from the instrument, especially if a trumpet-shaped resonator be placed in such relation to the telephone as to allow the mouthpiece of the telephone to rest upon the smaller end of the resonator. A toy tin horn cut off at the proper diameter answers well for this purpose. A screw-threaded rod serves very well indeed for the ratchet bar.

An interesting experiment is transmission by telephone of the vibrations of a tuning fork at one end of the line to a tuning fork at the other end of the line. The mouthpieces and diaphragms are removed. At one end of the telephone line a tuning fork is supported on a resonator with one of its prongs very near, but not in contact with, the pole of the telephone magnet. A tuning fork of the same pitch is vibrated in front of the telephone magnet at the opposite end of the telephone line. The fixed tuning fork is made to vibrate by the variations of magnetism produced by the current induced in the transmitting telephone by variations of magnetism produced by the vibration of the fork at the transmitting end of the line.

By means of two telephones, one with a diaphragm,