HIGH AND LOW TENSION ELECTRIC CIRCUITS.

T. O'CONNOR SLOANE, PH.D.

An error in scientific nomenclature does not always imply ignorance. The chemist invariably calls carbonous oxide carbonic oxide, and calls the higher oxide of carbon either carbonic acid or carbonic acid gas. Several such inaccuracies have become so engrafted upon the science that they are accepted and used universally. Electricity has been defined as the science of measurements. It might with more propriety have been termed the science of nomenclature and definition. Any tendency to error in its terminology is to be avoided. Every day an inaccuracy is perpetrated by electricians as well as by the laity which should be stopped, especially as no end is served by its continuance. It is the use of the term high and low tension current or high and low potential current. Neither tension nor potential can be attributes of an electric current. The use of such an expression may conduce to convenience; but if for the word "current" either "system" or "circuit" be substituted, an improvement at least is effected. The worst of the matter is that this application of the term tension has given a false conception of the true nature of a current.

A current passing through a circuit is urged by electromotive force, or by a difference of potential, which, in a certain sense, forces the current through the wire. The term tension is correct if used to denote this difference of potential; but it no more expresses an attribute of the current than the elevation of Lake Glazier expresses an attribute of the flow of the Mississippi. It influences its flow, but is not a function of it.

The error is worse when a current of so many volts is spoken of. A current is rated by amperes, not by

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volts. A wire carries current at the rate of so many amperes, a current cannot be measured in or be designated by volts.

Some diagrams are given to show when a current is produced how a high and low potential difference may produce absolutely identical currents. For convenience simple numbers will be used throughout the description.

Three dynamos with their circuits are shown. The first dynamo is supposed to maintain a difference of potential of one volt at its terminals. The terminals are supposed to be connected with a wire ten feet long of one ohm resistance. A current of one ampere will pass through the wire.

The second dynamo is supposed to maintain a difference of potential of ten volts, and to have its terminals connected by one hundred feet of the same wire. This will give a current of one ampere, just as before. Finally the third dynamo is supposed to give a difference of potential of one thousand volts, its current passing through ten thousand feet of the same wire. As before, the current will be of one ampere intensity. Under the popular terminology, the first two cases would be called low tension currents and the last a high tension current. Yet the currents in the three cases are absolutely identical.

To illustrate this still further, equal lengths of the different circuits can be compared. Suppose a section of five feet is taken and its electrical data determined. It will in all three cases be found to be passing a current of one ampere intensity. The difference of potential from end to end of the section will in all three cases be one-half a volt. Thus, if equal portions are compared, the three currents, high and low tension "currents" so-called, are found to be identical. In like manner if ten foot sections of the different wires be compared, the same current of one ampere, with a difference

of potential of one volt, will be found in all three. The popular term indicates the original difference of potential, but is very incorrectly used. It would be far better to consider the whole circuit with its generator and apply the adjective to it—speaking of a high or low tension circuit or of a 1,000 volt circuit, alluding in all cases to the maximum difference of potential that is maintained in the circuit when in operation.

Copper Guns.

It is matter of very recent history that the alloy of copper, zinc, and tin, known as gun metal, was employed in the construction of guns with great success. There are still in existence scores of so-called "brass" field pieces, and very powerful and excellent weapons they were. They have long since been superseded by guns of longer range and greater accuracy. It is noteworthy, however, that brass guns seldom burst. Their great defect was a tendency to droop at the muzzle when fired rapidly. The enormous steel guns of H. M. S. Victoria have developed a similar defect, and are being returned to Elswick to be straightened and stiffened by carrying a breech hoop further forward. We have spoken of brass guns to show that there is nothing new in the idea of employing copper to some extent in the manufacture of guns, but the purpose we have in view at present is to suggest its use in a way which we believe to be novel. It is generally known that modern guns, both heavy and light, are rapidly destroyed, as far as the chase is concerned, by what is technically known as "scoring." The projectile does not fit the bore dead tight. The powder gases—charged, no doubt, with unburned powder in the condition of sharp dust, and intensely heated—rush through the insignificant crannies between the shot and bore, and cut channels in the latter. The mischief, once begun, goes on rapidly, and in a very short space of time the whole inner surface of the gun is plowed up and roughened and furrowed to a disastrous extent. Nothing remains but to cut the steel lining tube out, and replace it with a new one.

We suggest, as a subject for a not very costly experiment, the substitution for steel of some copper alloy wherewith to line our guns. In the smaller natures, the present lining tube is a plain steel barrel a couple of inches thick, over which are shrunk hoops or rings of steel. The innermost tube is not supposed to impart any strength. It is intended to receive the rifle grooves, and endure wear and tear. In the larger natures of guns, the inner tube plays a far more important part. It is an extremely costly article, bored out of a solid forging. To the difficulties met with in making these tubes may be attributed most of the delay experienced in obtaining heavy guns for our ships.

It may be urged that to adopt a comparatively soft material in lieu of tempered steel as a lining for guns would be a mistake, but we think not. It is well known that it is next to impossible to score copper with powder gases. Touch holes, for example, are bushed with copper. Vents made directly in the iron or steel are scored up a great size by comparatively few discharges. Soft tough metals resist abrasion exceedingly well. Thus, for instance, it is very difficult to cut copper on a fine emery wheel. Lead cannot be so cut at all. The end of a copper bolt may be held for an hour against an emery wheel almost without effect, but the same wheel will cut up a file at the rate of two inches a minute. All experience goes to show, then, that it would be quite possible to use a gun with a copper-lined bore, which would be practically exempt from scoring. But such a gun could not be rifled, at least we fail to see how sufficient stubbornness could be imparted to the grooves. But although copper would itself be too soft, it does not follow that its alloys would be, and our proposal is simply that a steel gun should be made and fitted with a liner of phosphor bronze, manganese bronze, or Delta metal, and the results ascertained. The cost of the experiment would be very small. It would only be necessary to take some gun which needed retubing, and, instead of lining it with steel, line it, as we have suggested, with a copper alloy, and then go on firing it to destruction.

If we can substitute copper alloy for steel as a liner, the construction of big guns would be enormously facilitated. The tubes could be cast and bored out. They could be rolled to toughen and consolidate them. As the metals we have named have enormous ductility, they could be put into a gun comparatively loose, and expanded to fit the bore by a couple of rounds, as proposed years ago, and carried into effect by the late Major Palliser, when he converted cast iron smoothbores into rifled guns, by fitting them each with a steel lining tube. There need be no apprehension that the gun would be weakened, for any of the alloys we have named could be made to bear as much as forty tons on the square inch, while remaining exceedingly tough, whereas a steel of the same strength would be extremely brittle. It is not easy to see what the objections are to the system of construction which we suggest, and a steel gun with a manganese bronze liner may yet prove to be the gun of the

future. Be this as it may, it seems that the experiment would be worth carrying out, but care should be taken not to spoil the experiment by using a badly selected alloy or an unsuitable system of rifling.—*The Engineer*.

PARIS SEWER, ELECTRIC WIRES, AND PNEUMATIC TUBES.

In Paris the city station Bergere has aerial cables, and these are used by the Faubourg St. Martin station. But the new companies that have just received grants will be able to establish subways only. The sewers have been reserved for the cables of the municipal service. If we consider that the cables, although protected by mouldings or otherwise, are at the mercy of the force of workmen who traverse the sewer, and are exposed to humidity and several other causes of damage, this is perhaps not an advantage. It must, moreover, be remarked that the sewers are greatly encumbered by telephone and telegraph cables, and by pipes for distributing compressed air.

In the illustration we show a section of a sewer in Opera Avenue. At A there is a water main, $3\frac{1}{4}$ feet in diameter; at B and C, two 4 inch water pipes; at D, an 8 inch pipe for the distribution of compressed air; at E, several large bundles of telegraph and telephone wires; and at F, a pipe for the passage of compressed air for setting pneumatic clocks. To these still should be added the pipes that serve for the pneumatic post of Paris. The large number of conductors already established will be especially remarked. Under such conditions for the placing of wires, especially for alternating currents, it is indispensable to take precautions against the phenomena of induction. It might seem as if the most advantageous means for this purpose would consist in the adoption of concentric cables.

SECTION OF A PARIS SEWER.

Now, such cables, which are already employed in several distributions, present great inconveniences, both as regards making connections and the security of the service, and, despite experiments, the use of them has not as yet entered thoroughly into practice. It is probable that the sewers will not be used for this purpose. The various electric lighting companies are taxing their wits to find models of subways for the laying of their cables as advantageously as possible.

We shall not fail, when the occasion occurs, to describe the principal methods employed, and which will finally settle us as to the practical establishment of subways—a question which is certainly the most important one in distributions.—*La Nature*.

A Novel Project.

When it was stated some weeks since in the newspapers that the building of a milk pipe line from a point in New York State to New York City was projected there was a rather general smile, and the matter was treated as a joke. The projectors were, however, it seems, in sober earnest. A company with a capital of \$500,000 has, it is announced, been formed at Middletown, N. Y., for the purpose of constructing such a line. The proposed method of forwarding the milk is in cylindrical tin cans surrounded and propelled by water, and the promoters of the scheme assert that the time of transportation for a distance of 100 miles will not exceed an hour, while the profit will be about one cent a gallon. *Fire and Water* thinks if this sort of thing goes on, we need not be surprised ere long to find New York the converging point not only of oil, natural gas, and milk pipe lines, but of whisky ducts from the blue grass regions, and beer ducts from Cincinnati, St. Louis, and Milwaukee. The pipe manufacturers may well feel cheerful at the prospect before them.