DISCUSSION OF ELECTRICAL CONGRESS PROGRAMME.

MR. A. E. KENNELLY :—Mr. President and Gentlemen: The Chairman of the Sub-Committee on Provisional Programme for the congress work being unavoidably absent, I may be permitted to offer a few remarks on the subject. There will be, as we all know, a large amount of work before the Electrical Congress this year when it meets in Chicago. It will be work of an unusually important character, for the reason that units are in demand which must either follow or depart from the course of all the practical units hitherto created, and any departure will mean a certain variation in the methods of dealing with electrical units and electricity as compared with the methods of dealing with magnetic units or magnetism. It is, therefore, with very considerable interest that we approach the problem which the Electrical Congress at Chicago will have in hand, and it is important that we should clearly understand among ourselves what the leading questions at issue may be, and how far the results that may be attained by the Congress will interest us individually, as well as the INSTITUTE as a body. It is unnecessary for me to recapitulate the work that was done so excellently and faithfully by the Committee of the British Association for the Advancement of Science, commencing its labors in 1861 and terminating them practically with the endorsement of the Congress of 1889. There can be little doubt that if that Committee were to undertake now the work that it undertook in its day, it would introduce certain modifications which would have the result of making a better and more completely coherent system of units than that we now possess. But inasmuch as we cannot change the past, and the past is extremely creditable, it is useless to speculate upon what might have been, and it is desirable to give our attention to what actually is. We have difficulties in the magnetic circuit of two kinds. One kind is that we cannot use the ampere-turn directly as the practical unit of M. M. F. without a numerical coefficient. We ought to be able to use ampere-turns on dynamos as the units of magneto-motive force, if the purposes of convenience in that unit alone were considered. We cannot consider the convenience of one unit alone, because we have to consider the whole system of units, and the Sub-Committee of this INSTITUTE has submitted the view, one I think in very general commendation, that we cannot employ ampere-turns directly, but we have to employ the awkward numerical factor of $12.57 \cdot 4 \pi$ with it. There have been several schemes suggested, excellent ones in their way, for obviating this unfortunate necessity, and for giving us ampere-turns directly as the magneto-motive force and throwing this factor into some position in the system where it may, in the opinion of the parties promulgating the idea, be of less objection and disadvantage. Each of those questions must be considered impartially upon its own basis. But broadly, they all mean a depar-

ture from the existing system of practical units, the volt, ohm, ampere, etc.; and, therefore, if we are to have what may be for the magnetic circuit, what may be for dynamos and motors, a more convenient system of practical units than the one which is immediately suggested, it can only be at the expense of a departure from the old units, and that breach must necessarily be an awkward hiatus for all computations of a practical nature. The second difficulty is in the magnitude of the units. The practical system started out with a clear field before it and made the ohm a practical unit, a reasonable quantity and a very practical one, and I think it meets with universal commendation and has served its purpose remarkably well. The volt was next issued, which was another arbitrary multiple of the fundamental c. g. s. unit approximating to the E. M. F. of one Daniell cell. The volt also has served its purpose well although the immediate combination of the volt and ohm, the ampere, at one-tenth of the c. g. s. unit of current, is a disadvantage. However, I do not think that any of us have suffered great inconvenience from the employment of the practical system at the present time. The employment of a concrete and coherent system, forces upon us practical units in the magnetic circuit that are of very awkward magnitudes. The unit of flux becomes one hundred million c. g. s. lines, and that is a very large quantity, as we do not have dynamos with so much flux in them. Also an intensity such as the earth's field, for example, became extremely difficult to designate on the suggested practical system. However, we have to bear in mind that all amendments of the practical system involve—while they may give us a certain convenience perhaps—a departure from the existing fundamental rules that are part and parcel of the absolute system of measurement, and that for this advantage of local convenience we have to assume an expense in work of memory. The four units—gilbert, weber, oersted and gauss—have been suggested by the Committee of this INSTITUTE as those best fitted to concur with the original ampere-volt-ohm system, and it is in the hope of being able to obtain a thoroughly practical system of units that we can look for the advantages which the forthcoming Electrical Congress will have in store for us.

THE SECRETARY:—It was one of the objects in preparing this provisional programme that it should be published in advance and given wide circulation in order to elicit certain criticisms which it might give to rise to, and there have been criticisms in regard to it, more especially in Europe, and a few communications in our own journals. I noticed one in an electrical paper last week by Professor Rosebrugh of Canada, and I understood that this Committee had undertaken to prepare at some time a recapitulation of these suggestions for presentation. I would like to inquire of Mr. Kennelly, who represents the Committee, whether he has taken note of those suggestions and whether he has any remarks to bring forward at this time in regard to them.

MR. KENNELLY :—I beg to say that the members of this Sub-Committee have kept account of all comments, criticisms, and suggestions that have appeared in the scientific and technical press in relation to the question of congress work. None of the criticisms which have been made up to the present time call, it seems to us, for immediate consideration. In regard to units, they all rest upon that distinction, in regard to the magnetic system of units, between the convenience of dynamo work, and the convenience of having a system which shall be a coherent one. It has been the intention of the Sub-Committee to draw up at a sufficiently mature period all the criticisms and discussion that have appeared—a recapitulation of all the considerations that have been offered, and the Committee has felt that it is premature at this time so to present them.

MR. LOCKWOOD :—I understood Mr. Kennelly to say that several criticisms offered dealt largely with the points which he mentions. Now there are one or two very minor points in the form of definitions which were reported to the Committee, to which I took the liberty to make exception verbally to the Committee, and later I sent a short communication to one of the electrical papers. I called attention to what seemed to me to be rather an odd definition of the north pole of the magnet, the Committee having proposed to define it as that which seeks the geographic north pole; and the south as that which seeks the geographic south pole. My criticism is, that the poles of a magnet, assuming it to be one which is pivoted as a needle poised to swing freely in a horizontal plane, does not point to or seek the geographic north pole, and does not lie in the geographic meridian, but seeks the magnetic pole which circles in a small orbit around the geographic north pole. It seems to me if we are going to define the polarity of magnets at all we should define them correctly. To that end I offered the following words as a substitution :

“The north pole of a magnet to be defined as being that which in a magnet poised to swing freely in a horizontal plane seeks the magnetic pole in the direction of the terrestrial north, and the south pole that which seeks the magnetic pole, near the terrestrial south.”

I do not know whether the INSTITUTE considers that a material point, but whether it be material or immaterial, it seems to me we should seek correctness, just as carefully as the magnet seeks the pole that it wants to find.

On the same page there was a proposal to substitute the term “continuous current” for “direct current.” I took exception to that, for the reason that we may have continuous and discontinuous direct currents, and continuous and discontinuous alternating currents. I have known many currents which had one direction, but which were about as discontinuous as anything can well be. It seems to me, therefore, that the term would be decidedly misleading. We may say a current of one direction, or we may say a singly directed current, or we may say a direct

current, but when we should say or assume that a direct current is necessarily continuous, I certainly fail to see. I think perhaps that it might be possible to find a better term than "direct current," but I should say "direct current" was a better term to describe what it is intended to describe, than "continuous current."

I object also on my own personal account to that part of the programme which states, "the value of the practical unit of illumination to be a bougie decimale at the distance of one metre. The bougie decimale is the unit of light and power already established, and is practically equal to one English standard candle." And on page 5: "For the practical unit of illumination defined above, the name 'bougie-metre.'" Now that is a pretty long term, and it is a hyphenated term. As long as we can have words which are not hyphenated, I think we should use them. As we have honored nearly every great inventor and discoverer, it would seem to me, as I suggested when I wrote the letter to which I have referred, that the first part of this being already established, that is to say the definition of the practical unit of illumination, ought properly to stand; but for the second part, that copied from page 5, I would substitute the following: "For the practical unit of illumination defined above, the name 'Davy.'" That name is, I conceive, much more appropriate than "bougie-metre," which is very clumsy, and would be a good deal of a bogey in the way of general use.

MR. KENNELLY:—Mr. Chairman and Gentlemen, Mr. Lockwood's criticisms are three. The first deals with a matter of fact, and the last two deal with matters of opinion. I think we must all admit that his substitution of the term "terrestrial" north pole for "geographic" north pole is felicitous, and I think that would be accepted in preference. As regards the second criticism, it is a matter of great dispute as to whether a "straightforward" current should be called "direct" or should be called "continuous." "Many men, many minds," and I think that perhaps neither of those terms, "continuous" and "direct," may be employed; but if Mr. Lockwood will only suggest to us some third or fourth term he may be giving us a great benefit.

In regard to the unit of light, there are so many new names to be introduced and brought forward this year, and there is so much objection to the creation of standards which are themselves barely admissible as definitions, that however advisable it might be to have the well remembered and honored name of Davy placed on the list of the illustrious founders of the science, still I think there would be considerable difficulty in introducing it at the present time. However, that is a matter of opinion, and I should certainly hope that Mr. Lockwood's suggestion might receive all the consideration that it merits.

MR. LOCKWOOD:—I think the word the gentleman used just

now—straightforward—is about as good a name for the direct current as could well be devised, unless we should shorten it by simply using the word “straight,” and the gentleman’s suggestion appears to me a very appropriate one.

PROF. NICHOLS:—May I say a word as to the standard of illumination? It would seem to me unfortunate to assume that we are likely to have a standard, between now and the meeting of the Electrical Congress in Chicago, for illumination, that is worthy of the name of Davy or of the name of any one. I think the time is not probably very far distant when we shall be able to define illumination in terms of the c. g. s. system, in other words, to actually get within our grasp a candle-light equivalent which will express what we all desire, and which will be capable of interpretation in the sense that having defined it, we shall be able to make secondary standards which will produce the given amount of light, so that we may know what it is that we are measuring. That time has not yet come, but the indications are that it is not far distant. Would it not be better then, before establishing and fixing this matter, to simply regard it as tentative, to adopt temporarily whatever seems most desirable to the Congress, and to let the permanent naming of it wait until the time when we are able to define our light unit in a system which is a part of the great system which we are hoping to do something towards the completion of in Chicago this summer?

THE PRESIDENT:—I would like to ask Mr. Lockwood whether his suggestions of the north pole of a magnet would not bring about the very obscurity that I understood the Committee wished to avoid. If you define that to be the north pole of the magnet which points to the earth’s magnetic north pole, then you make this pole of the magnet to be the south magnetic pole, I would not know then whether you meant the end which points to the earth’s geographic north pole or its south pole. Whereas, if you say that the north pole of a magnet is that end which points to the terrestrial or nearly to the terrestrial north pole, as the Committee suggests; then it would be very simple. If the north pole of the magnet, out from which the assumed lines of force flow, points approximately to the earth’s geographic north pole, then that pole must be the south magnetic pole. Now, frankly I would not know from your definition which you meant. I would rather suppose, if it were without any explanation, that you meant the true south pole of the needle.

MR. LOCKWOOD:—I would like it to be known to you and to the other gentlemen present, that the definition is not mine. I am only responsible for that amendment. I imagine that the Committee of this INSTITUTE has really considered the point concerning which you inquire. I believe you asked me whether it would not be productive of much ambiguity. In answer to that, I would say, that I think it would, and I also think that an absolutely correct statement would be productive of the same

result, if we judge from the effect which our simple rules of election produced. I think no matter how we define anything, in very many minds it will tend to ambiguity. I admit very freely the force of your reasoning, and in my own mind I have gone through it all. The poles of the magnet which point to the terrestrial north or south, might be called—as attempts have been made to call them from almost time immemorial—the north seeking pole, or the south seeking pole, or the blue or red poles, or the austral and boreal poles, etc. I imagined that the Committee had taken those points into consideration, and had come to the conclusion that no matter what we officially name the magnet poles, we shall continue to call the north pole of the earth the north pole, no matter where the needle points, and although the majority of us know, or think we know, much better, we will persist in calling that point of the needle, which points northward, the north pole. My suggested amendment was simply to the Committee's definition, and in view of the fact that I supposed they had taken all these matters into consideration, I did not feel myself authorized to go any further into that, but simply to give one of the suggestions which had been called for.

THE PRESIDENT:—I may be wrong, but I think the general practice in this country is to call the end of the needle which points approximately to the earth's north, north, and to regard the magnetism of the Northern Hemisphere of the earth, as essentially south. That, I think, is the general idea that is held now.

MR. LOCKWOOD:—If that be the case, it is one of the instances where the smaller governs the greater. I do not suppose that any number of needles will govern the polarity of the earth. But I can imagine that the polarity of the earth will tend, in some degree at least, to direct the needle. I do not think that the terminology which we apply to the polarity of the earth should govern the terminology which we apply to the polarity of the needle. I should like to hear what the views of the Committee were, if any of the members of the Committee will kindly give them.

MR. KENNELLY:—The Committee endeavored to enunciate the very statement that the President has just given us, and the amendment that Mr. Lockwood has offered I take to be intended for the benefit of those unhappy creatures whose lot might be cast between the north geographic pole and the magnetic pole in its vicinity, and who, of course, contrary to the definition of the Institute's Committee, would find the magnetic pole geographically south, as they would live north of it. But if we eliminate that section of our planet, which is fortunately rather remote, the suggestion of the Committee will practically agree with the suggestion that I understood Mr. Lockwood's amendment to improve, namely, that the magnetic pole of the earth which is ter-

restrially north, or situated in the vicinity of the geographic north pole shall be the earth's south magnetic pole, and that the pole of a needle which points toward it when allowed to assume its natural direction, shall be the north pole of that needle.

THE SECRETARY:—In regard to this final closing up of the work of the Committee preparatory to the assembling of the Electrical Congress, it is probable that this will be the last meeting of the INSTITUTE before the convening of that Congress, and therefore it would be proper to suggest that this final summing up be published, either in the TRANSACTIONS or in the electrical journals or both, before the regular meetings of the INSTITUTE, in order to have it in general circulation before the Congress. As we are not prepared to close it up at present, and it appears to me that authority should be given for that to be done without further discussion of the matter before the INSTITUTE, I would make a motion to the effect that the Sub-Committee on Provisional Programme be authorized, at such time as they find convenient before the assembling of the Congress, to publish, through the electrical journals and the TRANSACTIONS, such a summing up as they may deem proper.

The motion was seconded by Mr. Hammer and carried.