

former days. In other words, we have to meet much keener competition in every department of life. And I hope, though perhaps not with much confidence, that all our educational institutions are recognising that fact and preparing to furbish up their somewhat antiquated methods to meet the demands of modern civilisation and modern competition." And at the same meeting the Vice-Chancellor, Sir Henry Roscoe, said, "If we are to meet successfully the constant changes of thought and manner of life to which a highly-organised society is increasingly liable, our Universities must not be content with giving instruction or testing attainment, however high, but must make real contribution to the knowledge which alone, in some form or other, will be a guarantee of the stability of that society."

I shall only add that the endowment and teaching of history as a science, the most complex of the sciences of evolution, should renew and vivify the teaching of all other sciences. For as the sciences of evolution, the metamorphic sciences as I would call them, are founded on the physical sciences, the ethical sciences are founded on the metamorphic sciences, and especially on that highest and most complex of all these sciences, the science of history, or science of anthropological evolution. More particularly within the scope of the more general or anthropological professorships of history it would come to set forth in their due connection, and in the inferences to be drawn from them, the great, yet hitherto, in this country, hardly known and wholly unappreciated, results of modern research with respect to the origin and history of civilisation. From such chairs also the keynote would be struck which would give a cooperating harmony to the work of every minor chair in the great faculty of history. For a general theory of civilisation, a theory aiming at setting forth the laws of man's history, would touch the whole circle of historical studies. Every special chair, therefore, of the faculty of history would be a centre of fruitful scientific criticism of whatever theory might be put forth from the chair of general history or sociology (if such should be its title). Imagine the result in new knowledge of such an interworking of generalising theory and verifying research! Were the faculties of our Universities, or even of one of them, reorganised as the contemporary development of the idea of evolution demands, what a school of cooperating workers would thus be created! From standing lowest among the great Powers in organisation and encouragement of intellectual work, Great Britain would take her place as highest! "Lords and Gentlemen of England! consider what nation it is whereof ye are, and whereof ye are the governors, a nation not slow and dull, but of a quick, ingenious and piercing spirit; acute to invent, subtle and sinewy to discourse, not beneath the reach of any point the highest that human capacity can soar to." And what lacks there in order to our showing ourselves worthy of this noble adoration of Milton's but such institutions as our Universities might be if organised, not as I suggest, but as the idea of evolution demands? J. S. STUART-GLENNIE.

THE CONGRESS ON TUBERCULOSIS.

THE most sanguine expectations of those who have been responsible for the organisation of the British Congress on Tuberculosis could scarcely have led them to anticipate that such a remarkable success would attend their efforts as that which has been achieved. The work of some of these congresses appeals almost entirely to experts, whilst that of others has its interest only for the popular mind. Where, however, such a question as tuberculosis is concerned, the interests involved are so great and far-reaching that the medical man, the dabbler in science and the man in the street are all alike interested and fascinated. From Prof. Koch's splendid address, delivered on the first working day of the Congress, to the practical closing resolutions submitted to the Congress on Friday, those who attended would be ill to please did they not consider themselves provided with subjects for most interesting discussion.

One of the most important items in the success of the Congress was Prof. Koch's address, in which, in masterly fashion, he enumerated the various steps to be taken for the gradual elimination of tubercular process. The very fact that he resiled from one of his original positions—

that bovine and human tubercle bacilli are practically identical—aroused such interest that, had no other single subject been discussed, the success of the congress would have been assured, and Prof. Koch is to be congratulated on raising a subject of such vital importance. It cannot but be felt, however, that the experimental evidence on which his opinion is founded is scarcely sufficient to warrant such a sweeping generalisation as that put forward; whilst the clinical evidence brought forward is even less convincing.

The experimental evidence can only be allowed to stand or be controverted on the production of positive evidence that bovine tuberculosis is communicable to man. Such evidence was at once forthcoming, Dr. Ravenel of Philadelphia bringing forward three cases of such infection that had come under his personal observation; one of the patients died, whilst in one more at least the bovine tubercle bacillus was recovered from the local lesion. These cases are, of course, of very great importance, and now that doubt has been thrown on the possibility of such infection, a most careful outlook will, in future, be kept for similar cases. From the clinical side, Prof. Koch's evidence is not convincing, especially as he maintains that no tubercular lesion can be accepted as arising in connection with the intestinal canal in which some effect is not produced on the mucous membrane. It appears to be the experience of pathologists who have examined a large number of cases of abdominal tuberculosis (tabes mesenterica) that a certain proportion, at any rate, whilst showing no local lesions such as ulceration or swelling of the mucous membrane itself, give abundant evidence of invasion of the mesenteric glands, and in a certain proportion of these cases the mesenteric glands only are affected, this proportion ranging from 14 per cent. (Woodhead) to 28 or 29 per cent. (Shennan and Still). Such affection of the lymphatic glands can scarcely be explained on any other assumption than that the infection has taken place from the alimentary canal, whilst there seems to be further collateral evidence that, in some of these cases at any rate, the infective material has been introduced through the agency of cow's milk. So strong is this evidence that most pathologists, on this ground alone, appear to have considerable hesitation in accepting Koch's statements without very careful corroboration, and it is to be hoped that in England, as in Germany and America, the matter will be put to the test as soon as possible. It should be mentioned that Prof. Virchow, one of the greatest authorities on tubercle, is by no means satisfied of the accuracy of Koch's conclusions on this matter. Whatever may be the result of future investigations, however, Prof. Koch may be most heartily congratulated on the courage and lucidity with which he expounded his views and on the interest that he has aroused in the question by the firing off of his bombshell, as it has been called.

The following remarks made by Lord Lister after Prof. Koch's address are of especial interest:—

Lord Lister said the discourse they had listened to was full of profound interest from the beginning to the end. But what had chiefly riveted their attention had been the startling thesis that bovine tubercle could not develop in the human body. This was a matter of enormous practical importance, because, if this conclusion were sound, it would greatly simplify their preventive measures; but it would be a very serious and grievous thing if the rules now in force for securing purity of milk supply should be relaxed and it should turn out after all that the conclusion was erroneous. For his own part he thought the evidence adduced by Dr. Koch to show that human tubercle could not be communicated to bovine animals very conclusive. At the same time he agreed with him that in a matter of such great importance further inquiry was desirable. But even if that were established it would by no means necessarily follow that bovine tubercle could not be communicated to man. He took in illustration the case of variola. Attempts to inoculate human

small-pox into the calf had been so very rarely successful that eminent pathologists had concluded that small-pox and cow-pox were two entirely different diseases. We now knew that this was an entire mistake; that cow-pox was small-pox modified by passing through the cow. He referred to some very instructive experiments by Dr. Monckton Copeman, who entirely failed to inoculate human small-pox into the calf, but invariably succeeded in inoculating it into the monkey, and was as invariably successful when he introduced matter from the pustules in the monkey into the calf, the result being ordinary cow-pox which could be used for vaccinating children. It may be that some species of animal may serve as an intermediary host for tubercle between man and the bovine species. Or it may turn out that, if a sufficient number of experiments are made, human tubercle may prove occasionally transmissible to the bovine animal, as small-pox is in rare instances to the calf, and that the bovine tubercle so produced may be transmissible to man, as is the virus of vaccine. The evidence, necessarily indirect, on which Koch relied as showing that bovine tubercle could not be transmitted to man did not seem at all conclusive. It consisted mainly in the alleged rarity of primary tubercular intestinal lesion in children, in spite of the multitudes of tubercle bacilli swallowed by them in milk. Even if it be admitted that primary tubercular intestinal lesions are as rare in children as Koch's statistics indicate, it is certainly true that tabes mesenterica exists in a considerable percentage of children that die of tubercular disease without tubercle being found in any other part of the body. When the mesenteric glands are thus affected without any discoverable intestinal lesion, the natural, and, indeed, inevitable, interpretation seemed to him to be that the tubercle bacilli had passed through the intestinal mucous membrane without causing obvious lesion in it, and had been arrested in the glands of the mesentery. It was known that even typhoid bacilli, whose essential place of development is the intestinal mucous membrane, occasionally pass through it without producing the characteristic lesion. And if this might occur with the typhoid bacilli, how much more likely was such an occurrence with tubercle bacilli! If this be so, Koch's main argument falls to the ground. As regards the experiments Koch had referred to of inoculating bovine animals with material from the glands of children affected with tabes mesenterica, the result being negative, these experiments had been but few; and even were they more numerous, they would not, to his mind, be quite conclusive. It might be that tubercle from milk in the intestines might be so modified by passing through the human subject that the bacilli in the mesenteric glands, though derived from a bovine animal, might be no longer those of true bovine tubercle, but bacilli having the characters of human tubercle little disposed to develop in cattle. The Congress would probably require a more searching inquiry into the subject before accepting this doctrine of the immunity of man to bovine tubercle.

In all other points Prof. Koch, Dr. Brouardel and Prof. McFadyean are thoroughly at one, and they carried with them, by the simplicity and earnestness of their statements, the whole of the members of the Congress, and the effects of their work and observations were plainly manifest in the resolutions that were submitted at the final meeting. These may be summed up in the statement that for the prevention of tuberculosis it is necessary to attend to the housing of the people, to the provision of a sufficient supply of fresh air, as good nutrition as possible, and to the prevention of the dissemination of the tubercle bacillus (for which purpose proper precautions should be taken to have it collected and destroyed as soon as it comes from the patient); for the cure of consumption fresh air, good food and well-regulated exercise; whilst in regard to bovine tuberculosis there seems to be no difference of opinion that, until the question raised by Prof. Koch is finally settled, no relaxation of the methods at our disposal for the examination and confiscation of tuberculous meat and milk should be allowed.

The work of the sections was, of course, somewhat more specialised in character. The report of the combined discussion on tuberculin will direct attention to the advantages and disadvantages claimed for and against the use of this therapeutic agent. Other methods of treatment also received full attention in Section I (Medicine).

In Section II. (Preventive Medicine) preventive measures were fully discussed, and the number of papers brought forward and dealt with give ample evidence of the interest taken in the work of this section.

In Section III. (Pathology and Bacteriology) some of the most useful work that came before the Congress was discussed. We would specially refer to Prof. Benda's paper on the channels of spread of tuberculosis and Dr. Ravenel's paper on the relation of bovine to human tuberculosis. This latter paper was exceedingly well-timed from the fact, already mentioned, that the author had to record three cases of infection of the human subject by bovine tuberculosis.

In Section IV. (Veterinary Section) an exceedingly interesting series of papers was discussed, especially one dealing with the application of tuberculin to cattle supplying milk. In connection with this, Prof. Bang pointed out that tuberculous animals might have non-tuberculous lesions of the udder; but, if there was any suspicion of tuberculosis of the udder and the animal was otherwise tuberculous, the benefit of the doubt should always be given in favour of the consumer, and the lesion should be looked upon, temporarily at any rate, as of a tubercular nature, and the necessary precautions should certainly be taken. Where, however, it could be proved that the lesion was non-tuberculous he thought that the milk might sometimes be used, if proper precautions were taken; though we should imagine that most people would consider the proper precautions in such a case would be absolute sterilisation of the milk.

As proof of the great interest taken by the King in the work of the Congress, His Majesty received a number of the foreign delegates in the Throne Room at Marlborough House. The delegates were accompanied by the Earl of Derby, Sir William Broadbent (chairman of the Organising Committee), Prof. Clifford Allbutt (regius professor at Cambridge and chairman of the General Purposes Committee), Mr. Malcolm Morris (honorary secretary-general of the Congress), and Dr. St. Clair Thompson (honorary financial secretary of the Congress). The following delegates were presented by the Earl of Derby, but Dr. Koch, who had promised to open a discussion at Eastbourne, and a few other foreign delegates were unable to be present:—Prof. Osler and Prof. Janeway, United States; Hofrath Prof. von Schrötter and Prof. Dvorak, Austria; M. le Sénateur Montefiore Lévi and Dr. van Ryn, Belgium; Dr. Mickailovsky, Bulgaria; Prof. Bang and Dr. Charles Gram, Denmark; Dr. Brouardel (Doyen de la Faculté de Médecine de Paris), Prof. Bouchard and Prof. Nocard, France; Geheimrat Prof. Gerhardt, Prof. Flügge, Geheimrat Prof. von Leyden, Prof. Fraükel, Dr. Werner and Dr. Dettweiler, Germany; Prof. Thomassen, Holland; Prof. Koranyi, Hungary; M. Malm, Norway; Prof. da Silva Amado, Portugal; Señor Don Antonio Espina y Capó, Spain; Hof-Marshal Printzjold, Sweden; and Dr. Neuman, Switzerland. His Majesty shook hands with each delegate as he was presented, and then said:—

"GENTLEMEN,—Let me express to you the great pleasure and satisfaction it has given me to ask you to come here to-day; I only regret that you should have arrived during such a severe thunderstorm. It has been a source of great concern to me that, owing to circumstances over which I had no control, I was prevented from presiding at the opening of your important Congress and attending its meetings; but I can assure you that, though not present, I take the deepest interest in its proceedings, and that I follow with much interest, through the medium of the daily Press, the papers which are read and the discussions on the subject. There is no more terrible disease than that known as consumption, and I only hope and trust that you may be the means of minimising its evil effects, and thereby receive the gratitude of the whole world. There is still one other terrible

disease which has up till now baffled the scientific and medical men of the world, and that is cancer. God grant that before long you may be able to find a cure for it, or check its course; and I think that to him who makes the discovery a statue should be erected in all the capitals of the world. In taking leave of you I trust that your stay in London and in England has been an enjoyable one, and that you will one and all carry away pleasant recollections of your visit to my country."

There can be no doubt that the King's desire will be gratified, for, if the foreign delegates have received the some amount of pleasure from the scientific and social work of the Congress as have their British *confrères*, they should go away amply satisfied and with very pleasant recollections indeed. That they were prepared to enjoy everything may be gathered from the fact that they cheerfully, and apparently even willingly, sat through twenty-seven speeches at the final banquet given on Friday night.

The other social features of the Congress were the receptions at the Mansion House by the Lord Mayor, at Apsley House by the Duke and Duchess of Wellington, at the Victoria and Albert Museum by the Earl and Countess of Derby, and at Sion House by the Duke and Duchess of Northumberland; whilst evening parties, private dinners, water parties and the like afforded ample entertainment for all who were able to attend such functions.

Altogether the Congress may be looked upon as one of the most interesting and successful ever held in London, and the results promise to be very far-reaching.

POSITION AND PROSPECTS OF ELECTRO-CHEMICAL INDUSTRIES.

THE presidential address delivered last week by Mr. J. W. Swan, F.R.S., to the Society of Chemical Industry, though it covers the same ground as the one he delivered three years ago as President of the Institution of Electrical Engineers, does so in a much more comprehensive and detailed manner. The paper is very valuable and instructive, though not always pleasant reading for the English electrochemist, who cannot help reflecting that his country is much behindhand in the development of those industries of which Davy and Faraday laid the foundations. It cannot be urged that our backwardness is wholly due to the lack of water power in the British Islands, though doubtless this has contributed in many instances to our failure to keep pace with our competitors. But there are many electrochemical industries in which, though cheap power is by no means essential, other nations have been the pioneers and are likely to reap the reward. Thus, to quote one striking example, there appears to be no English bullion refinery using electrochemical processes, although these are finding extensive employment in America and Germany. The value of the output for 1900 from two out of the three German refineries is given by Mr. Swan as 2,500,000*l.*, the source of power in all three cases being steam.

The fact remains, however, as Mr. Swan points out, that the greater number of electrochemical plants are operated by water power. For fifty European works the figures obtained show that there is 149,000 h.p. available from water, 16,700 h.p. from steam, and 250 h.p. from gas. The great bulk of the horse power generated from water is used in the production of aluminium and calcium carbide, industries in which cheap power is paramount. Is it to be feared, therefore, that the more extended use of electrochemical processes will cause chemical industries to leave this country for others more fortunately supplied with waterfalls? The question is one, as Mr. Swan says, "of national importance, for chemical manufactures occupy, and have always occupied, a leading place among the industries of our country." Something, perhaps much,

is to be hoped for from the reduction in the cost of power generated from coal, in which connection we may quote Mr. Swan's words:—

"Great advances have in recent years been made in the direction of reduction of cost, by improvements in the steam engine, the gas producer and the gas engine. In the best modern steam engines a heat efficiency of 15 per cent. is obtained. There is great reason for hope that help in the more economical generation of power for electrochemical work may come from the further development of the gas engine. Already much has been done, both in the improvement of the gas engine and also in providing it with cheap gas. Our honoured past president, Dr. Mond, has made a valuable contribution in this direction.

"One of the drawbacks to the employment of gas engines for large operations has been that they were not adapted for large units of power, but now engines of 500 h.p. and even 1000 h.p. are manufactured, and work with successful results."

It is to be feared, moreover, that we are not only hampered by unfavourable conditions, but that we do not make the most of the opportunities we possess. The position deserves the most careful consideration of all chemists and electricians, or the former will one day awake to find that his purely chemical manufacturing processes have been superseded in other countries by electrochemical methods, and the latter will find, as he has already found largely in electric traction, that, whilst he was sleeping, a new field of development has been fully exploited by American and continental engineers. We cannot help thinking that the fault is, to a considerable extent, due to our educational system and to the bias of the English manufacturer against college-trained men. Mr. Swan's remarks on this point are worthy of very careful attention:—

"In England and Ireland we are suffering acutely from dire educational neglect and destitution, and that worst kind of poverty, *insensibility to our deficiencies*.

"Our English system of scientific and technical education is not equal to the present needs of the country, seeing how severely we are pressed on every side by the most energetic and intelligent competition. We are giving to the classes at the bottom of the industrial ladder a disjointed smattering of miscellaneous science, of no great value, though probably good so far as it goes, while we are neglecting to educate thoroughly those upon whose shoulders will soon rest the weight of the management of our great manufacturing industries. In the present state of things a competent knowledge of the science of the business a man is engaged in, as well as an active interest in it, whether it be chemical industry or any other, are essential conditions of any large degree of success in meeting the emergencies of a highly competitive and progressive time. A scientific training of university standard, for our manufacturers and for our technical chiefs, is an absolute necessity. Surely public money cannot be better spent than in providing adequate facilities for the educational equipment of the men of the future, with this essential means of national defence. Our country possesses great stores of mineral wealth, a precious heritage that we are lavishly spending. That gift of nature will certainly not avert, and cannot go far to compensate for, the consequences of neglect of the scientific training necessary to turn our fast-diminishing mineral wealth to the best advantage.

"One of the most pressing requirements of the moment, demanded, not only in the interest of chemical industry, but in that of our manufacturing industries generally, is *adequate endowment and encouragement of research*. Original scientific research is the fountainhead of new knowledge, the vital stimulus of industrial growth, the originator of new industries and sustainer of old. Yet, nationally, in the organisation of our educational and industrial system, we give to scientific research no hospitality—we barely pay it the respect of recognition."

These arguments have been advanced again and again by educational enthusiasts, but they have as yet borne but little fruit. Perhaps now that they have been so strongly endorsed by one so well qualified to speak from the manufacturer's point of view as Mr. Swan, they may find their way into the minds of those in whose hands lies the future industrial prosperity of England.