

theoretical and practical investigation. The value of b , in van der Waals's equation, was assumed to be 0.0005 with a negligible a (Onnes and Keeson), and this is in agreement with the value of 0.000432 calculated from the isotherms at and above -217° C. (Onnes). From the observations on the liquid, however, it would seem that the value of b should be 0.0007 there, and that a must have a positive value of 0.00005 (Onnes). Lastly, the lowest steady temperature known was obtained by boiling helium at a pressure of not more than 1 cm., at which the temperature could not have been much above 3° K. The liquid was mobile and perfectly clear, and no trace of solid was visible, so that a still lower steady temperature is clearly attainable (Onnes). FRANCIS HYNDMAN.

THE INTERNATIONAL CONGRESS ON ROADS.

THE first International Road Congress was held in Paris during the week which ended on Saturday last, October 17. On the whole the congress may be pronounced a success, chiefly on account of the large number of interested visitors present, and from the fact that on certain points there was a strong consensus of opinion that roads can now be constructed to stand modern automobile traffic at slight additional cost, and that the two nuisances dust in summer and mud in winter can be greatly minimised in their extent.

The congress, though not wholly official, received the support of the French Government. The letters of invitation and explanatory circulars were sent out from the general secretary of the Ministère de Travaux publics; consequently the invitations were not confined to delegates sent by the Governments of the various countries represented, but were sent to representative public bodies, road authorities, automobile clubs, and to engineers and other members of the public who are likely to have knowledge and be interested in the great question of road communications.

The attendance at the meetings was generally very good; the rooms were crowded. As is usual, the hospitality shown by the French in the way of *fêtes* and excursions made the week very enjoyable to the French provincial visitors as well as to the foreign visitors. The first reception was at the Sorbonne, afterwards a grand evening reception at the Hôtel des Invalides, a gala performance at the Comédie Française, and a final sitting at the Sorbonne on Saturday morning announcing the results obtained.

The general procedure was as follows. Early in the year requests were sent to all the interested countries that contributions should be submitted in the form of short papers, which would be printed and circulated previous to the congress, the substance of which would be collected by a reporter of each of the groups, and on which discussions would take place. The subjects on which these memoirs were invited were the following:—General reports on the construction and maintenance of existing roads, special reports on the cost of road-bed and methods of construction of roads; special reports on maintenance questions—on this group of construction and maintenance of roads thirty-two papers were received, of which seven were by English contributors.

The second group of questions related to that part of road construction and maintenance which was rightly named at the congress "the present struggle against the wear and the dust." These included methods of cleaning and washing, and questions were specially put asking for experience in the use of tar or similar insoluble binding materials. Twenty-two papers were received in this group, five of them by English authors. Another group was on the roads of

the future. On this question fifteen papers were received, none of them by English authors.

The remaining questions were those relating to traffic, damage caused to the roads by speed or by the weight of the vehicles, by pneumatic tyres, anti-skidding devices and similar matters. To this question sixteen papers were specially addressed, half of them by Englishmen. Then came seven papers, all by Frenchmen, on road signalling and milestones; and finally six papers on public vehicles used on the roadway, including tramway services. Five of these were by Frenchmen and one by a Spanish engineer.

Altogether ninety-eight papers were contributed, printed and circulated previous to the congress to all the subscribing members. This part of the work was splendidly done. The papers were sent in in their original language; in many cases they were completely translated; in some cases summaries were made in more than one language. It will be seen that about one-fifth of the whole of the papers came from England.

The discussions were divided into two sections, first those chiefly relating to road construction, and second those relating to the use of the roads and the vehicles running on them. They were held in the old tennis court at the corner of the Tuileries Gardens next to the Place de la Concorde, and on the plateau immediately surrounding this building were grouped a large number of modern appliances used on the roads, such as road rollers, road repairing machines, machinery for brushing and watering by horse-power and by automobile power, and, lastly, a long array of machines for distributing tar or other bituminous compounds on the road to render it waterproof and dustless. Inside the building a number of smaller exhibits were shown of various road materials and specimens cut out of existing roads, the latter being chiefly found on a collective English exhibit.

As stated at the commencement of this article, the success of the congress laid chiefly in the interest which it excited, and in the fact that for the first time a large number of road engineers and of those interested in the use of roads were brought together in a very pleasant manner, and, as is usual at these meetings, a great many useful friendships were formed which will undoubtedly lead to the better circulation of new ideas on road construction.

The number of English professional visitors was very large. Among the English visitors were found chairmen of the county councils, many of the most prominent county engineers, with a large sprinkling of municipal men and of surveyors of the various rural districts. As might be expected, a very considerable number of these gentlemen were not sufficiently familiar with French to follow the debates, which for the most part were conducted in French.

At an early stage it became evident that the knowledge possessed by some of the English visitors was very valuable to the congress, but that there was a great risk of their experience being lost, so that it was decided to hold supplementary meetings of the English-speaking, *i.e.* the English and American, visitors, previous to the regular meetings, and this course, although at first sight it might have seemed as if the English-speaking races wished to be exclusive, turned out to be of use. The results of the discussions by the English-speaking sections were delegated to one or two speakers, who afterwards communicated them during the main debates. In this way some useful resolutions were carried which cannot now be given, as they were not printed or agreed to in detail when the writer left Paris immediately after the final sitting on Saturday; but, speaking generally, it may be said that a great many of

these resolutions are of but small importance to us in England, as they relate to such well understood and generally agreed to subjects as the necessity of providing substantial concrete foundations underneath paved roadways, a form of construction which has been generally adopted in England for the last quarter of a century, and to methods of drainage and similar matters equally understood by us.

On a matter, however, of common interest, that is, the substitution of tar or bituminous binding material in place of the water hitherto used to consolidate and hold together the road material, and which is conveniently dealt with under the French name "*Goudronnage*," the congress practically gave a unanimous answer. This was to the effect that if *goudronnage* be properly carried out; if the tar or similar material be chosen with reasonable care to avoid matter soluble in water, such as ammoniacal liquor remaining mixed in the tar so that it can be subsequently washed out by the rain or dried out in the form of crystals which might afterwards form an irritating dust; if the tar be put on in the correct quantity, and this quantity the smallest required to hold the individual stones of the road metal firmly in position, so that they never roll or move in relation to one another, and their upper surfaces are allowed to wear themselves bare of tar, it is not a difficult matter to obtain, at quite a moderate expense, a waterproof road which will not do any damage to vegetation, which will be practically dustless if it be swept at reasonable intervals from horse droppings or dust blown upon it from the adjoining land, and which need not be slippery, either to horse or to automobile traffic, whether the surface be wet or dry.

It appears certain also that by so dealing with the roadways their wear can be so greatly reduced that the annual cost of upkeep of roads so treated will be considerably less than the cost of the existing water-bound roads, of which so much of the material is lost by being blown away as dust in summer or washed away as mud in winter.

There can be no doubt that all engineers, English and Continental, are at one on this important question, and this in spite of the fact that many paragraphs, obviously inspired by those who wish to recommend other binding materials, were widely circulated in the journals during the progress of the congress. It had been roundly asserted that tar was a palliative, but that on the whole its defects were greater than its advantages. Those who were present at the congress know that this is an incorrect statement; that such damage as has occurred to trees and vegetation, or inconvenience to passengers, such as irritation of the eyes and throat, which followed on the early applications of tar to the French roads during the Grand Prix race, was due to well understood causes, that is to say, to the use of crude tar and its application to a road surface which had already broken up, both of which faults the congress unanimously condemned.

It may be here remarked that owing to the cautiousness, and hence the reticence, of some of the most important of our road authorities, the true position of England, which now possesses the greatest lengths of carefully waterproofed roads of any country in the world, was not put forward so much as might have been the case.

It was interesting to converse with American engineers, who, on account of the importance of road development in America, are studying this question very closely, and to hear from them how much more they could learn by visiting our English roads than anywhere in France, at any rate near the capital. French engineers, although they have practised

goudronnage to a considerable extent, have not been careful enough in excluding the ammoniacal liquor, and in many cases have put on the tar irregularly and in far too great a quantity; wherever this is the case softening in hot weather and slipping in wet weather is likely to follow.

Before the congress of last week closed the question of the next congress was talked of, and it appears likely to be held in Brussels in about two years' time.

As regards that section of the congress relating to the influence of the vehicles themselves on the road, some of the papers were very valuable; but curiously enough the French, who above all other nations were the first to appreciate the great advantages of large wheel diameter, in their draft resolutions fixing the maximum weights to be carried per unit width of wheel left out the important factor of the influence of wheel diameter, though, luckily, owing to the influence of the English-speaking delegates, it is probable this factor will be reinstated in the form in which it exists in our own very well-considered regulations issued by the Local Government Board.

SCIENCE AT THE UNIVERSITIES.

THE proceedings at the academic ceremonies held in Oxford on October 8 to celebrate the fiftieth anniversary of the opening of the University Museum, described in our issue of last week, and especially the address delivered by the Vice-Chancellor, Dr. Warren, President of Magdalen College, may well serve as an encouragement to the older men of science who have for many years been unwearied in their insistence that science should occupy a high place of honour among the branches of learning cultivated at the universities. The statement of progress at Oxford during the last fifty years, which the Vice-Chancellor and Dr. Vernon Harcourt presented, should act as an inspiration to the present distinguished staff of scientific teachers to whom the world is looking to develop in connection with their university a centre of scientific activity unsurpassed at any ancient or modern seat of learning.

How complete the change of attitude towards science has been at Oxford may be gathered from the description of the state of things immediately preceding the building of the museum which the Vice-Chancellor gave at the beginning of his address:—

Science was not a stranger to Oxford before the first stone of the museum was laid, but her existence was somewhat precarious and her progress intermittent. The period just before the establishment of the museum was, like the night before the dawn, a somewhat dark age. It is, I believe, recognised in physiological science that the history of the embryo repeats the history of the race. It appeared to be so with science at that time. She was then in the condition of the cave dwellers among primitive men. At any rate, she lived underground. Her teachers, like those of the early Church, wandered about in "caves and dens of the earth." There was a cellar under the Ashmolean where science was taught. If I remember right, my old friend, whom I much wish we could have seen here to-day, Prof. Story-Maskelyne, was both taught, and instructed himself, in that underground chamber. There was another cellar, or series of cellars, in Balliol College, where my wife's father, Prof. Brodie, used to pursue chemistry; but it would not be fair to represent this as the whole history of science in Oxford even at that time. Dr. Daubeny at my own college, Magdalen, and Dean Buckland, as he afterwards was, at Christ Church, had already done pioneer work. To-day things are very different. Natural science has now, as you will see this afternoon, a palace with many chambers and apartments, well and, it may be said in some instances, beautifully equipped. That is not everything, and will not alone