should undertake the improvement of the tidal portions of the rivers; that above this limit the local authorities should improve the rivers by canalisation up to a town conveniently situated to form an inland port, up to which sea-going vessels of 400 or 500 tons could come, and which would serve as a distributing or receiving centre for waterways of suitable dimensions penetrating into the interior; and that in some cases, for surmounting high summit-levels, inclined planes worked by locomotives should be substituted for canals. Another engineer proposes that the Government should undertake through routes for vessels of 350 tons from Birmingham to Liverpool, Hull, the Severn, and London, and between Liverpool and Hull, and from London to Bristol, and considers that these main routes would be certain to yield a profit on the purchase of the existing waterways involved in the schemes and on the expenses of construction, which could then be utilised in acquiring and improving other waterways. A third engineer desires to make each river-basin a separate system; he considers that a barge of 150 tons is the largest barge that would pay; and instead of bringing sea-going vessels inland, he would bring these inland barges down to the tideway, where transhipment into sea-going craft would take place most conveniently. A fourth engineer considers that 100-ton barges are the largest size expedient for English inland navigation, and that in certain cases the improvement of canals to accommodate them would not pay; whilst a fifth engineer thinks that any improvements of inland waterways would prove an unprofitable and useless expenditure.

It is evident from this summary of the views expressed by some of the most experienced engineers with reference to inland navigation, that the commissioners, after having collected all the evidence available, will require some time to formulate their recommendations, and to decide how far Continental practice with regard to inland waterways is applicable to the special conditions of the United Kingdom.

THE SCIENTIFIC STUDY OF INFECTIOUS DISEASES.[1]

THE wider recognition of medical science as a rewarding object of endowment is a result of discoveries made during the last quarter of a century, and it is of interest to inquire why this increased knowledge should have borne such abundant fruit. The result is not due to any change in the ultimate aims of medicine, which have always been what they are to-day and will remain—the prevention and the cure of disease—nor to the application to the solution of medical problems of any higher intellectual ability and skill than were possessed by physicians of past generations, nor to the growth of the scientific spirit, nor to the mere fact of a great scientific advance in medicine, for the most important contribution ever made to our understanding of the processes of disease was the discovery by Virchow in the middle of the last century of the principles and facts of cellular pathology, the foundation of modern pathology.

The awakening of this wider public interest in scientific medicine is attributable mainly to the opening of new paths of investigation which have led to a deeper and more helpful insight into the nature and the modes of prevention of a group of diseases—the infectious diseases—which stand in a more definite and intimate relation to the social, moral, and physical well-being of mankind than any other class of diseases. The problems of infection which have been solved and kindred ones which give promise of solution are among the most important relating to human society. The dangers arising from the spread of contagious and other infectious diseases threaten, not the individual only, but industrial life and the whole fabric of modern society. Not medicine only, but all the forces of society are needed to combat these dangers, and the agencies which furnish the knowledge and the weapons for this warfare are among the most powerful for the improvement of human society.

[1] Abridged from an address delivered by Dr. W. H. Welch at the formal opening of the Laboratories of the Rockefeller Institute for Medical Research on May 11.

Great as was the material, intellectual and social progress of the world during the past century, there is no advance which compares in its influence upon the happiness of mankind with the increased power to lessen physical suffering from disease and accident, and to control the spread of pestilential diseases.

Before some accurate knowledge of the causation of infectious diseases was secured preventive medicine was a blundering science, not, however, without its one great victory of vaccination against small-pox, whereby one of the greatest scourges of mankind can be controlled and could be eradicated, if the measure were universally and efficiently applied. The establishment upon a firm foundation of the germ doctrine of infectious diseases, the discovery of the parasitic organisms of many of these diseases, the determination by experiment of the mode of spread of certain others, and the experimental studies of infection and immunity have transformed the face of modern medicine.

The recognition, the forecasting, the comprehension of the symptoms and lesions, the treatment of a large number of infectious diseases have all been illuminated and furthered, but the boon of supreme import to the human race has been the lesson that these diseases are preventable.

Typhus fever, once widespread, and of all diseases the most dependent upon filth and overcrowding, has fled to obscure, unsanitary corners of the world before the face of modern sanitation.

In consequence of the knowledge gained by Robert Koch and his co-workers Asiatic cholera, to the modern world the great representative of a devastating epidemic, will never again pursue its periodical, pandemic journeys around the world, even should it make the start.

Of bubonic plague, the most dreaded of all pestilences, which disappeared mysteriously from the civilised world more than two centuries ago, we know the germ and the manner of propagation, and, although it has ravaged India for the last ten years with appalling severity, it can be, and has been, arrested in its spread when suitable measures of prevention are promptly applied.

Typhoid fever, the most important index of the general sanitary conditions of towns and cities, has been made practically to disappear from a number of cities where it formerly prevailed. That this disease is still so prevalent in many rural and urban districts of the United States is due to a disgraceful neglect of well-known measures of sanitation.

To Major Walter Reed and his colleagues of the United States Army Commission an inestimable debt of gratitude is due for the discovery of the mode of conveyance of yellow fever by a species of mosquito On the basis of this knowledge the disease, which had been long such a menace to lives and commercial interests in the Southern States, has been eradicated from Cuba, and can be controlled elsewhere.

Another army surgeon, Major Ross, acting upon the suggestion of Sir Patrick Manson, had previously demonstrated a similar mode of incubation and transportation of the parasite of malaria, discovered by Laveran, and it is now possible to attack intelligently and in many localities, with good promise of success, the serious problem of checking or even eradicating a disease which renders many parts of the world almost uninhabitable by the Caucasian race, and, even where less severe, hinders, as does no other disease, intellectual and industrial activities of the inhabitants.

The deepest impress which has been made upon the average death-rate of cities has been in the reduction of infant mortality through a better understanding of its causes. The Rockefeller Institute, by the investigations which it has supported of the question of clean milk and of the causes of the summer diarrhœas of infants, has already made important contributions to this subject which have borne good fruit.

No outcome of the modern science of bacteriology has made a more profound impression upon the medical profession and the public, or comes into closer relation to medical practice, than Behring's discovery of the treatment of diphtheria by antitoxic serum, whereby in the last twelve

years the mortality from this disease has been reduced to nearly one-fifth the former rate.

The most stupendous task to which the medical profession has ever put its hands is the crusade against tuberculosis, the preeminence of which as the leading cause of death in all communities is already threatened. Sufficient knowledge of the causation and mode of spread of this disease has been gained within the last quarter of a century to bring within the possible bounds of realisation the hopes of even the most enthusiastic, but it will require a long time, much patience, and a combination of all the forces of society, medical, legislative, educational, philanthropic, sociological, to attain this goal.

But great and rapid as the progress has been, it is small in comparison with what remains to be done. The new fields which have been opened have been explored only in relatively small part. There still remain important infectious diseases the secrets of which have not been unlocked. Even with some the causative agents of which are known, notably pneumonia and other acute respiratory affections and epidemic meningitis, very little has yet been achieved by way of prevention. The domain of artificial immunity and of the treatment of infections by specific sera and vaccines, so auspiciously opened by Pasteur and by Behring, is still full of difficult problems the solution of which may be of immense service in the warfare against disease. Of the cause of cancer and other malignant tumours nothing is known, although many workers with considerable resources at their disposal are engaged in its study. With the change in the incidence of disease, due at least in large part to the repression of the infections of early life, increased importance attaches to the study of the circulatory, renal, and nervous diseases of later life, of the underlying causes of which we are very imperfectly informed. There are and will arise medical problems enough of supreme importance to inspire workers for generations to come and to make demands upon all available resources.

In full recognition of the dependence of success in the warfare with disease upon increase of knowledge, the Rockefeller Institute for Medical Research was founded by the enlightened munificence of Mr. John D. Rockefeller, to whom grateful acknowledgment is made. Likewise to the broad sympathies and active interest of his son, Mr. John D. Rockefeller, jun., the origin and development of this institute are largely indebted.

May the hopes of the founder and of those who have planned this institute be abundantly fulfilled! May it contribute largely to the advancement of knowledge, and may the streams of knowledge which flow from it be "for the healing of the nations."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A RECENT report of President Butler, of Columbia University, refers to the salaries paid to the professors and adjunct professors of the University. This part of the report was reprinted in *Science* for November 23. President Butler says that these salaries are inadequate, and that the effects of this inadequacy are deplorable. The report shows that the present average salary paid to a Columbia University professor is but one-half of the sum fixed as necessary thirty years ago, and that the cost of living has meanwhile increased between 10 per cent. and 20 per cent. The purchasing power of the average salary of 1906 is, therefore, hardly more than 40 per cent. of the purchasing power of the salary established in 1876. In other words, the great expansion of the University, which has been brought about by the labours of the university teachers, has also been brought about at their expense. In President Butler's judgment the most important need of Columbia University at the present time is an addition to the endowment fund sufficient to enable the establishment and maintenance of a proper standard of compensation to members of the teaching staff. There are 119 professors and thirty-nine adjunct professors, 158 in all. To increase the salary of each by only 200*l*. on an average—not at all an adequate amount—would absorb the interest at 5 per cent. on a capital sum of more than 600,000*l*. The need is so imperative and the public interests affected by it are so important, the report states, that the mere statement of it ought to bring the needed sum, great though it is, from the American men and women who are the large-minded possessors of wealth.

THE scheme for the establishment at Bristol of a university for the west of England is now taking definite shape. The sum of 40,000*l*. has already been promised, and with the buildings of University College, which are worth about another 50,000*l*., the scheme may be said to have made a good start. There was a difficulty in arriving at an arrangement between the Merchant Venturers' work in higher education and that of University College, but we understand that the Merchant Venturers have practically accepted the principle of the proposed university, and though details remain to be settled, there is good reason to believe that the movement will now go forward with every promise of success. Speaking at the Merchant Venturers' Technical College, Bristol, on December 20, Prof. M. E. Sadler referred to the energy with which the Merchant Venturers had furthered the work of technical instruction, and expressed the hope that it would be found possible to unite the Technical College with the University College, and thus to form the nucleus of a great University of Bristol. Under modern conditions universities should combine opportunities for advanced technological, commercial, and professional training with the highest tradition of literary and philosophical culture. There is still room, in spite of other recent foundations, for a new university in England with its seat at Bristol; but the nation will not gain by the establishment of a university weak because ill-endowed and insufficiently equipped with teachers, laboratories, libraries, and the buildings indispensable to the social side of university life. The rapid growth of Bristol in recent years encourages the hope that its citizens will emulate the example of Manchester, Liverpool, Birmingham, Leeds, and Sheffield in the building up of a great modern university.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 8.—"On the Occurrence of Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of Infection in Trypanosomes Generally." By Prof. E. A. **Minchin**. Communicated by Prof. Ray Lankester.

In a former communication to NATURE (November 15, p. 56) an account was given of the results obtained by the Sleeping Sickness Commission at Entebbe, Uganda, with regard to the transmission of the *Trypanosoma gambiense* of sleeping sickness, and other trypanosomes, by *Glossina palpalis*, the dusky tsetse-fly.[1] It was shown (1) that the infection was a "direct mechanical" transmission by the proboscis, and that no "cyclical" infection, comparable to that of malaria, could be discovered; (2) that *T. gambiense* appeared to die out in the intestine of the fly after ninety-six hours; (3) that besides *T. gambiense*, the fly carried two other species of trypanosomes, named *T. grayi* and *T. tullochii* respectively.

Since the article referred to was written, it has been found that *T. grayi* becomes encysted in the hind-gut of the fly, and all analogies with other Protozoa suggest that the cysts are destined to be cast out and infect fresh hosts, probably, in this case, the vertebrate hosts from which the fly obtains the trypanosomes. This suggests the occurrence of a hitherto unsuspected mode of infection by trypanosomes, in which the parasites, when taken up from the blood of the vertebrate by the blood-sucking invertebrate, pass, in the gut of the latter, through a developmental cycle, which ends in the parasites becoming encysted. In this condition they are cast out and re-infect the vertebrate host by contaminating its food or drink. Such a mode of infection is termed "contaminative," as contrasted with the "inoculative" method seen in malaria, and hitherto vainly sought for in these trypanosomes.

[1] Mr. E. E. Austen, of the Natural History Museum, has suggested to the author that *Glossina palpalis* should be distinguished in this way from the other seven known species of tsetse-flies.