BRITISH MEDICAL JOURNAL

LONDON: SATURDAY, DECEMBER 1st, 1934

INTERNATIONAL ACTION TO CONTROL THE SPREAD OF INFECTIOUS DISEASES*

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A conviction that international co-operation for the control of the spread of infectious diseases deserves to be better known among public health workers than it often is—or at least to be appreciated in better proportion—has led me to address you on this subject this afternoon. In effect I would invite you to inquire with me into the progress made by international methods in the post-war years, and what those methods are. It will not, I hope, be too dull or profitless an inquiry.

In recent years we have come almost imperceptibly to increase co-operation with fellow workers in foreign countries and in other parts of the British Empire on almost every technical subject. Whether it is economics, trade, air routes, water problems, athletics, or what you will, we cannot go far before asking ourselves how they manage the matter, say, in America, or in France, or in Italy, or in the Dominions: Do they do things our way? Have they a better or a worse? Are we cutting one another's throats? Are we pulling together or can we pull together to mutual advantage? Health questions are no exception in this respect. The cosmopolitan tradition has always been strong in medicine and in public health. It was long ago embodied in the Red Cross, and we know what that meant in terms of curative treatment for friend and foe alike during the war. Some of my audience will remember how closely mutual action for disease prevention brought the allied forces together at that time; nearly all will have personal knowledge since then of the advancement effected in some health subject or other by consultations in which nationality and race have hardly needed to be thought of.

To take a non-infectious disease, cancer: it was four months ago at Zurich, in German-speaking Switzerland, that I found myself at a busy and well-organized international congress at work on its radiotherapy. The physicists, radiologists, physicians, and surgeons one met there had come not only from Central Europe but from all parts of the earth to do common work and to make friendships. The cause was the thing, and for them put completely into the background the happenings in Austria and in Germany during that historic fortnight between July 20th and August 3rd. It was, in fact, a big cause and an enduring one. If radiotherapy offers our best method of curing many forms of cancer, and if the philanthropists and the health authorities everywhere are to provide it and spend vast sums of money in obtaining it, the proofs must be offered, the methods declared, and the results estimated. The last is no easy task for cancer, where it must be made a condition before expounding results that the treated cases have been followed up for at least five years to ascertain if the patients die or if the cancer has recurred, and it cannot be done at all without a close

understanding between the workers on the use of terms and on the practices followed.

None of this, as things are now, is within the compass or resources of the workers in a single nation. The big radiotherapeutic work is being done, in different ways, in a few institutes which are scattered all over the world. The Zurich congress had not met for combat between them, but to learn what each had done and is doing, and, as a preliminary, to secure that all successes and failures are observed and reported so that they can be understood and compared. It is a good topical example of voluntary co-operation on the international side, successful for the same reasons that national congresses like the present are successful—namely, the possession of an essential subject, thorough preparation, and meetings held at reasonable, not too frequent, intervals. A list I have of such voluntary international congresses on health and medical subjects in different countries during the past year exceeds a hundred. One does not want to exaggerate their significance, or to claim that no work is good until it has been talked about in a foreign capital. But the point to be made is that in these days in almost any expert work the element of international consultation is required sooner or later, and that we have come almost imperceptibly to accept its necessity and to welcome it.

International Health Organizations

What I have said so far relates to intercommunication—the international congress is only one method—arranged voluntarily between individual workers of different countries, helped, as they often are, by the authorities which they serve or by world health agencies, of which the Rockefeller Foundation is the chief. But the same tendency towards international consultations and understandings has in recent years been evident in the health work of national Governments, and it must be remembered that now in some countries, such as the U.S.S.R., every medical and every public health activity is State-organized and State-directed. This has largely been brought about, or at least facilitated, by the League of Nations, through its Health Organization. The Covenant of the League contains an article [Art. 23(f)] which states:

“Subject to and in accordance with the provisions of international conventions existing or hereafter to be agreed upon, the Members of the League . . .

“(f) Will endeavour to take steps in matter of international concern for the prevention and control of disease.”

This obligation of States members of the League has from the beginning been taken seriously. The Assembly votes a substantial annual health budget for its Health Organization, which consists of a medical director and a technical health section of the Secretariat, aided by a committee of health experts of different nationalities.

* Address to the Public Health Congress, November 19th, 1934.

During the last twelve years a great variety of public health and medical subjects has been taken up internationally by this Health Organization. This can be illustrated easily from the world map, which recalls in some places missions to countries asking for foreign experience in the organization of their health services (notably the Balkan States and the Republic of China); in other places meetings of experts on particular subjects such as malaria, leprosy, and sleeping sickness, or the "interchange" visits, with which British medical officers of health are especially familiar. To these must be added particular conferences, say, on cancer statistics, or on the standards and definitions to be adopted for serums, vaccines, and vitamins. The League work also includes the powerful aid to knowledge of epidemic diseases in the Far East provided by the Far Eastern Bureau, which it maintains, largely as a result of Japanese initiative, at Singapore, and to which I will allude again in a moment.

I cite this work of the Health Organization at Geneva not so much because of its bearing on my theme this afternoon, which is international control over the introduction of infectious diseases, as for the example it gives of the international collaboration going on in other fields. Most of the Geneva work has had the advantage of new ground to occupy. It is otherwise with international measures for the control of the introduction of infectious diseases, which have behind them some centuries of tradition, and have been the subject of active international or diplomatic interventions from time to time ever since the plague periods of the Middle Ages. Some of these traditions are strong, and in many places continue to govern the national practice. Some, it must be admitted, are, or until quite recently have been, quite out of date when modern knowledge of the causation of epidemics and modern methods of intercommunication are considered.

Here, therefore, progress in reform and rationalization is by no means easy. It cannot be rapid or be dealt with by short cuts. It has, however, been a notable and encouraging progress, which will bear comparison with the newer type of international work. Some of it has been effected through the new machinery of the League, but most is done through the earlier established International Office of Public Health, which was set up in Paris under the Rome Convention in 1907, and has since had various new duties added to it by subsequent international agreements. This body, often better known as the *Office International d'Hygiène Publique*, since its official language is French, has various ties with the Health Organization of the League to avoid overlap, and, if the League of Nations' spirit consists in working for and obtaining international understanding and camaraderie, it works, side by side with the League, fully in that spirit.

First Public Health Services

Sanitary organization for the defence of frontiers, which at ports meant quarantine services, was among the earliest, if not the first, of the services established in the name of public health. The largest organized State public health service in the world, that of the U.S.A., sprang from frontier defence, and still depends upon it. Our own State medical services were at the beginning deeply concerned with quarantine, and started with the cholera menace of last century. Only the other day a new Government, the National Republic of China, decided to set up an effective port sanitary service as a preliminary to the organization of its internal public health administration.

Owing to modern knowledge we need have far less apprehension than used to be the case of the results of the mere importation into a country of a disease to which we are strangers, and it is unfortunately true that many of the worst infections—influenza, for example—will defy

all frontier measures. Our recent tendency with many epidemic and endemic diseases is to rely more on immunization, on specific curative treatment, and on general measures of hygiene, such as the prevention of overcrowding, than upon mere defence against the introduction of, or exposure to, the infection itself. One can conceive, indeed, that by another generation or two frontier defence against infections may almost come to be disregarded in view of other available measures; a time when we could be content, and the public we serve would be content, to disregard even the importation of cases of major small-pox; to accept the arrival of the plague-infected rat, or the dog which may be incubating rabies; to chance the anthrax-infected shaving-brush or the psittacosis parrot—always in confidence that, if these or any other infections come into the country, local action will circumscribe and extinguish them, and local action will suffice.

But if this time is to come, it is not here yet, and I do not see local authorities asking for it. We may not place as much value as we did on protection against exposure to infection, but at least we expect to have that protection provided when it can effectively be exercised. For home administration this is a truism: at home we insist on maintaining disinfection, hospital isolation, and many other measures to keep people from exposure to infection, sometimes even at a greater cost and effort than a strict sense of proportion would warrant. In the case of importations from abroad parallel action must be maintained, and is expected. If defence against the introduction of infections is only one of the measures required, defence there must still be.

Now in the past, and indeed until quite lately, defence was usually the only measure thought of. If you are interested enough to study the literature of what was called the Levantine plague or of cholera diffusion—you will find much of it epitomized by Simon and in the Local Government Board Medical Reports, and more recently by Professor E. W. Hope in his book on *Health at the Gateway*—you will soon appreciate how ruthlessly, from the seventeenth century well into last century, these national self-protective measures were applied.

Early Port Sanitation

Leaving aside land frontiers, it was common practice at seaports for passengers and crews, sick and healthy together, to be kept in isolation for weeks in the cramped space of the ship at a quarantine anchorage or be herded into lazarets on shore, or for the ship to be incontinentally repulsed to any other port in which it could find refuge; or for merchandise to be destroyed wholesale and ship-owners ruined because the ship had come from a port where pestilential disease was suspected to exist. It was from this aspect, inhumanity and restraint of commerce, that international agreements about infectious diseases came to be made. The formal International Sanitary Conventions on the subject, which started in 1892, were directed far less towards joint action for controlling the spread of disease than to getting rid of the intolerable administrative position created by the working of the individual national defences. Enormous diplomatic energy was for this purpose expended in the successive pre-war International Sanitary Conventions, up to and including that of 1911, and they were not unsuccessful. They limited the detention of ships and passengers and freed the cargoes. They gave port sanitary authorities a defensible code of action to work upon with medical authority behind it, and helped to make them, at least in this country, the practical bodies they are. But to understand these international agreements you must think of them as being essentially of the nature of armament conventions which limit the range and calibre of the guns per-

mitted, rather than the occasions on which the guns need to be let off.

It has not been an easy task to intrude into this elaborate defence-regulating system new methods of international co-operation directed against the diseases themselves. When dealing with infections every administration has a traditional, as well as a natural, prejudice to rely solely on those measures which are wholly in its own control, while in many countries age-long legislation and practice have been based on the conception of this being the only line that a responsible authority can accept when it has to protect its own nationals.

We have, nevertheless, gone some way on the new lines and found them profitable, using as the chief instruments, first, the remodelling of the International Sanitary Convention effected in 1926, and secondly, the International Health Office at Paris, which has a permanent committee of technical officers representing nearly all the nations of the world, and includes a quarantine commission that regularly keeps the practical application of this important Convention under review.

Rat-plague Infection After the War

Let me take, as a good example of the change over, the spread of plague by the carriage of plague-infected rats on ships. When port sanitary authorities, old and new, got to normal work after the war they found that the spread of rat-plague infection from port to port by means of shipping had become a rather formidable affair in many parts of the world. When a rat-plague infection was introduced it could, in some circumstances, cause a considerable prevalence of human plague; even if it did not, the continued presence of epizootic plague among rats in the port had definite dangers and inconveniences, and its existence was naturally considered a reproach to the local sanitary authority and the health administration of the country. Many ports had attacked the position energetically, and they were encouraged to do so by the efficiency with which rats on shipboard could be destroyed by new fumigation processes—notably, by hydrocyanic gas in one form or another. It came about, therefore, that on the basis of individual port defence ships had only to go from, or to have touched at, ports in plague-infected countries for the authorities of the port visited to require them to be submitted to fumigation processes which, besides being costly to the shipowner, were as often as not unjustified by any evidence of the existence of plague-infected rats on the ship.

Now so long as this extreme measure of defence was only adopted in a few ports and on a few sea routes, it was accepted without much protest by shipowners, but when the ship, from the mere fact of having at some time or other during the voyage been at a plague-infected port, had to be fumigated again and again at many subsequent ports, the position became intolerable for the shipping trade, and, once the possibility of international co-operation was admitted, it was impossible to justify it.

Successful Measures for Its Control

The system which is now adopted is a really co-operative one. If there is actual plague infection on the ship it must, of course, be dealt with at once. But what we have now done is simultaneously to go for the root of the trouble—namely, the ship rat itself. Every six months, according to present international practice, a ship has to be properly overhauled at one of the recognized ports (there are now over 400 of them available throughout the world) to ascertain whether she harbours rats. If the inspection shows that does so, deratization by fumigation or by any other effective means is required. Other ports then recognize what has been done on the production of certificates carried with the ship's papers.

The whole system is regulated by the 1926 Convention itself, and its working is subject to periodical survey at Paris by the Permanent Committee of the International Health Office. It has now been in operation for seven years. Naturally it has not been established without anomalies and hard cases arising, but when they do there is machinery for their investigation and representation to the Government concerned to prevent their repetition. And, in fact, we find such cases get fewer year by year. The system has the full sympathy of shipowners, who now know what is expected of them in this respect, and on their side have come to realize how much can be done on the ship itself to avoid fumigation by making the ship, as it is termed, "rat-proof." A notable example of this tendency was lately furnished by a report, made by the joint committee appointed by the Chamber of Shipping of the United Kingdom and the Liverpool Steamship Owners' Association, where the essentials of rat-proofing are laid down for the guidance of shipbuilders.

That all these measures have enormously diminished the rat-infestation of ships is indubitable. They need to be supplemented, more than at present, by rat-proofing and rat-destruction at certain docks and warehouses, but if both continue as they are doing the object will soon be achieved. Plague will continue in certain regions of the world, but it will no longer be a disease of world diffusion. Its lines of communication will have been effectively cut. I could give you no more striking example of the advantages of combined international action supplementing, or even ultimately superseding, individual national defence.

The same principle has been applied in different ways to other diseases, notably to cholera, which, if it follows its usual epidemic cycles, will require special attention next year. Here we have secured a common recognition by all countries of precautions taken in the cholera-infected country, including anti-cholera vaccination. Of yellow fever I will speak in a moment in connexion with aircraft.

Variola Minor in England and Wales

I may dwell for a little while on the importation of small-pox, in view of the interest which all local authorities represented here have in dealing with that disease. Let us consider small-pox for a moment from the British end. The two epidemiological types of small-pox, *variola major* and *variola minor*, are now well understood, though both of them remain, and rightly, notified and notifiable under the term "small-pox." In most parts of England, though happily not in Scotland or in Ireland, we have, since 1922, become habituated to local prevalence of *variola minor*, the kind of small-pox which practically stops with the first characteristic rash, does not go on to the secondary fever or pustulation, leaves little or no pitting, and causes an almost negligible mortality and usually only a brief period of real illness, if any, to the patient. From 1922 to 1933 we had no fewer than 81,061 such cases notified in England and Wales. Regarded simply as small-pox, the number of small-pox cases in this country has been relatively far higher during this period than in any part of the Continent, with the possible exception of Soviet Russia.

Besides this we have the fact that the severe epidemic type of small-pox, *variola major*, exists and persists in Eastern countries—a notable epidemic of it occurred in Alexandria in the early months of last year—in which none of the characteristics of small-pox which have made that disease so much to be dreaded are absent. There is the heavy toxicity, the severe mortality—I am, of course, referring to persons unprotected by vaccination—the pitting, the scarring, and all the rest. If this infection is imported into this country it breeds true; in other words, it is the small-pox with which we were only too

well acquainted in 1893 and 1902. That it can do so has been proved by several examples of its importation by persons coming to England or Scotland in the incubation stage, or when the importation has been by cases that were missed at the ports. We are able to deal with such cases before they get much hold on the local population by strict measures of isolation, by surveillance of contacts, and by vaccination. The success of our practice in this respect, thanks to our system of central intelligence and the vigilance of local authorities, is well known and needs no restatement; I find that it constantly brings us credit when described to my colleagues of other countries. But it is a formidable and costly business for local authorities. The importation ought not to happen, if it can possibly be avoided.

This being the case, we have had, during recent years, to ask two things of the health administrations of other countries. The first was that they should recognize our epidemic variola minor, a differentiation on which we ourselves took—and needed—some time before we could make up our own minds. If you put yourselves in the position of the European countries you will realize that they, with no experience of variola minor, required some convincing. Apart from Switzerland, which had had an experience of the mild epidemic type of small-pox very close to our own, the Continental countries knew small-pox only in its classic or major epidemic form, and knew it from fairly frequent importations—in France, for instance, from her African possessions. When these importations took place and epidemics of small-pox occurred the health authorities applied drastic measures for their extinction, including obligatory vaccination of persons in the infected regions or entering other regions from infected areas. They had every right, confirmed by the text of the international agreements, to treat in the same way arrivals from a foreign country in which small-pox was epidemic. These arrivals should satisfy them of their immunity by producing evidence of recent vaccination, or should be vaccinated.

Episode of the Ship "Tuscania"

Even as late as 1929 the question came to a head by the episode of the ship *Tuscania*, which many of you may remember. For reasons I need not go into, the *Tuscania* landed at British ports forty-five persons actually incubating small-pox of the major type, who developed the disease in this country, nine of them dying from it. Our system of notification of contacts and surveillance was so good that no more than six secondary cases occurred; in other words, the whole group of variola major cases in the country only totalled fifty-three, all duly isolated and controlled. But the incident had become good newspaper copy all over the world, and at once the fact of our ordinarily having at the time a hundred or more notified cases of small-pox in England every week was mixed up with it. Variola minor was taken as a mere term of camouflage. England was a country in which small-pox was epidemic, and vaccination and other measures must be applied to those coming from it. For a while this was the view taken at French ports, and much inconvenience resulted until the situation was cleared up.

As a digression, I may say here that this foreign action had nothing to do with the English Vaccination Acts. It would not have mattered whether those Acts had or had not a conscience clause, or did not exist at all. The English Vaccination Acts, so far as they apply compulsion, relate only to the vaccination of infants. What the foreign countries were concerned with was the vaccination of the travelling adult. The international understanding on this point is that it is only vaccination within three years which counts in the case of arrivals from a small-pox-infected area. It is perhaps as well to

point this out, as the question of "international reprisals" has, I think without sufficient warrant, been introduced into some of the discussions about our own vaccination legislation.

Recognition of Two Epidemic Types of Small-pox

Apart from the *Tuscania* incident, no inhibitions have been imposed abroad upon travellers from England on account of the considerable small-pox prevalence of recent years, and another *Tuscania* incident now would not have the same consequences. The characteristics of our variola minor are now well understood in all responsible quarters, and this has been brought about in large measure by the system of international co-operation which the Post Office provides. If you have your facts, and can bring them twice a year before a committee of critical official technical representatives of every country interested, and can reply to their questions and get their experience, the administrative position is bound ultimately to clear, at least if you have enough persistence. In this case the Permanent Committee of the Office International d'Hygiène Publique, beginning with many doubts and hesitations on the question of stability of epidemic type, collected, session by session, the facts of past epidemics—for example, in Australia—and of the actual distribution of small-pox at the time. Though Europe was not generally familiar with it, extensive epidemics parallel to our own were going on in the United States and elsewhere, persistently mild in clinical type, of lower power of spread, and tending to natural extinction after three or four years of local prevalence. There emerged a mass of evidence, well put together for us by the delegate for Portugal, Professor Ricardo Jorge, on which the differentiation of the two epidemic types, major and minor, could be accepted both for scientific and, if need be, for administrative purposes. With this authority the two terms were embodied in the last *International Nomenclature* of causes of death, as also in the last official *Nomenclature of Diseases* issued by the Royal College of Physicians of London. They now govern the national precautions which we decide to take, and we know where we are.

If I have dwelt on variola over-long it is because of the advantage of presenting you with a good concrete example to show how one side of the international work is done.

Work on Other Infectious Diseases

The same system is habitually applied to other infectious diseases where the great necessity is to have prolonged international epidemiological study. It is in this way that the Permanent Committee of the Paris Office dealt with the discovery of that rare condition called *post-vaccinal encephalitis*. It was as invaluable to Holland and to two or three other countries as it was to ourselves to pool experience with a view to determining the circumstances of age, vaccination, etc., which were associated with this newly understood complication of vaccination. You will find abundant evidence of the practical use made of these studies in the reports of the English Departmental Committee on Vaccination.

The occurrences a few years ago, in several countries, of a virus disease contracted from parrots received similar international study with great advantage, since we were not only able to collect information bearing on the origin and causes of *psittacosis*, but also to settle between ourselves the advice which should be given to our Governments regarding the exclusion of parrots or attempts to control their importation. No one country wanted to be the dumping-ground of parrots which other countries refused to take. So also with *undulant fever*, which used to be called Malta or Mediterranean fever, as soon as it was ascertained that it could be prevalent in Northern

Europe. The warning of its prevalence in Scandinavian countries, brought to the table in Paris, led to inquiries here by the Ministry of Health, on which much of our present understanding and recommendations about this disease have been based. I could continue the list, mentioning particularly *cerebro-spinal meningitis*, on which information about prevention or treatment comes up to the Paris sessions year by year, and gives each of the delegates something new to take back and work upon. All inquiries of this kind ultimately appear in the *Monthly Bulletin* of the Office International d'Hygiène Publique, which represents one of the most solid contributions to the science of epidemiology which we possess to-day.

An International Intelligence System

To illustrate another side of the international work I go back to small-pox and to the second English requirement—namely, to keep down importation of small-pox from countries where the severe type is prevalent. Here we have to encourage all measures taken in small-pox-infected countries to prevent the embarkation of infected persons, and to know if particular ships are likely to be carrying small-pox cases or contacts, without complicating our administration with a mass of unnecessary inquiries at the port of entry, or, subsequently, in all parts of the country in order to keep particular individuals under daily observation until the incubation period is up.

For this day-to-day administration a system of international intelligence is essential. The work done here goes on independently of the six-monthly discussions in Paris which I have just described. We are dealing with intelligence about epidemic occurrences rather than with epidemiology. Under the terms of the International Sanitary Convention, 1926, the occurrence of new outbreaks of small-pox, cholera, plague, typhus, and yellow fever in different parts of the world is to be made known at once to the different health administrations, and followed by information about their progress. For this purpose the Convention provides for immediate notifications to the International Health Office in Paris, which transmits them to the various Governments concerned. By a further provision of that Convention Paris is able to work regionally in this matter, for a large part of the East, through the Far Eastern Bureau of the League of Nations at Singapore; for the Near East, through the Quarantine Board of Egypt; and for the Americas, through the Pan-American Sanitary Bureau.

As compared with the conditions which obtained before the 1926 Convention, the results are certainly satisfactory. The countries for which we have still to depend wholly on consular information are few. For countries as a whole it can be said that neither with small-pox nor with other diseases dealt with in the Convention is there anywhere any notable inclination to withhold information or to delay its transmission. Telegraphic codes and wireless messages, including wireless telephoning, are freely used. Indeed, if any reproach can be brought against this service it is usually either for an excess of activity in sending telegraphic or wireless messages about occurrences which, except possibly to their immediate neighbours, can have no administrative interest in other parts of the world, or when, in addition to transmitting the official communications received from the health departments, some of the international bodies add their own commentaries.

To meet these objections the Paris office has lately done a good deal to encourage direct local communications between neighbouring countries and from port to port. A recent agreement has been made, for example, to cover all the North Sea area, by which port medical officers of the different countries, including the United Kingdom, communicate direct with their opposite numbers abroad where any special risk has been noted. Again, we have

special arrangements with the Suez Canal health authorities and with Marseilles about small-pox on ships bound for English ports.

I mention these details only as an indication that the intelligence system which now obtains, effective as it is, always requires attention. No doubt there will be some revision and simplification of it when another international sanitary conference is held. The important point now, however, is that as a whole it is working very well and producing the results desired. In this it affords a striking contrast to previous methods. In the earlier years, when we worked not on co-operation but on the system of regulating our mutual defence against one another, everything depended on the declaration of ports as "infected," and such declarations were often made in a most arbitrary fashion. The label was put on and taken off often for quite unsubstantial reasons, and there was every inducement to avoid having it put on at all. It was not until 1926 that the international convention explicitly stated that information about the occurrences of infection at a foreign port was merely to be taken as a guide to the extent of inspection or inquiry necessary on the arrival of the ship, and that it was the condition of the vessel itself which should determine the quarantine measures taken.

Present Position Concerning "Bills of Health"

So, too, this co-operative international system of intelligence about epidemics has removed almost the last vestige of reason for the traditional document carried by the ship called the "bill of health." The bill of health records that a particular port has been free or otherwise from pestilential diseases at the time the ship was there, and every owner and ship's captain has been brought up to consider it as one of the most important of the ship's papers which they have to produce.

Dating as it does from the period when no country would be satisfied with statements from another without confirmation from its own representative, these bills of health have to be seen, stamped, and viséd by the consul of the country which the ship is going to visit. This does not apply merely to the original port of departure of the ship, but to every other port at which it calls and in relation to every port at which it proposes to call. The delay in the ship's time and the cost of the bills and fees are very considerable. The practice was so consecrated by centuries of use that it had never been assailed in any international sanitary convention before that of 1926, when, for the first time, an article was inserted by which the signatory Governments undertook to take any practicable measures to dispense with the consular visa and ultimately with the bill of health itself. The article was by no means a strong one, but the Office International d'Hygiène Publique has kept it to the forefront by efforts to secure local agreement between different nationalities on the subject.

Lately, in the *British Medical Journal*, attention has been forcibly drawn to the inconveniences of the system, to use no stronger term, by a ship surgeon, who quoted some extreme instances of the waste of time and money it involved. I trust that with patience—for it requires patience to deal with deep-rooted sea traditions—their number can soon be diminished. Governments have now before them an international agreement for dispensing either with visas or bills of health, or both, for ships of their respective nationalities, and there is every reason to believe that this agreement will receive the adhesion of most of the important maritime countries of the world. Here it is the shipowners who stand to benefit, and one may expect them to do all they can themselves to support the efforts which the hygienists are making to get rid of proceedings taken in the name of health but bringing no advantage to it.

Importation by Aircraft

Lastly, I must add a few words about the importation of infectious diseases by aircraft, since, with any sort of vision, we must appreciate a growth of air routes and air lines which will make them as ordinary and as much used for travel from distant countries as sea and land routes. Already the world air routes are considerable, although the total number of passengers carried is but a small fraction of the whole. Already we have had demonstration that they can carry infections, and that passengers from one non-malarious country to another can contract malaria in course of an ordinary air journey from the bites of infected mosquitos on the aircraft.

Air flights are so short in time that they mock at incubation periods, and rarely allow initial symptoms to occur before the aircraft reaches its destination. If the notion is now out of date and usually futile of putting passengers by sea, and the ship they go in, under special observation for no other reason than that the ship has touched at a seaport labelled as "infected," how much more futile is it when applied to airports! Blindly following precedent, some countries have, in fact, demanded that the commander of the aeroplane must, as a condition of landing his passengers or crew, produce bills of health, attested in each instance by the appropriate consuls, to show that every place of embarkation on the air route was free from plague, cholera, or other maladies. How seldom could this procedure ever be a guide to the discovery of dangerous persons or infected articles? The whole matter has had to be taken on a wider basis, with all the help that the Air Ministries and air lines, and particularly the International Commission of Air Navigation, could give us, and with separate consideration of the natural history of each disease with which we were able to deal. If for us in this country Eastern small-pox is the chief importation to be guarded against, in the tropical and subtropical parts of the world, where the *Stegomyia* mosquito is common, it is yellow fever. This disease now could easily be imported through air traffic by infected persons or insects into countries where yellow fever would have all the opportunities of spread possessed by a new disease which is introduced into highly susceptible populations.

A Sanitary Code in Aerial Navigation

The International Sanitary Convention for Aerial Navigation, signed at The Hague last year, was hammered out at the International Office of Public Health in order to meet all the chief contingencies of transmissible and preventable infections, and to provide an international code of conduct—on the one hand something practicable and reasonable from the side of air traffic, and on the other something which, when it had to be applied, would offer a substantial security without illusory formalities. This convention deals, naturally, with the action to be taken if infectious diseases occur on aircraft, and with those insanitary conditions *en route* which require an international understanding to deal with—for example, the throwing out of excreta.

The guiding rules for special diseases are particularly detailed in the case of yellow fever, and have been drawn up with the aid of the experience of America as well as of Africa. In regard to the detection of persons arriving in an infectious state from any disease, we have two key positions. The first is that the airports open to arrivals from other countries are, for political and customs reasons, few. It is thus not difficult or costly to see that they are provided with the necessary nucleus medical service, able to deal with an infectious case, and with

access to hospital and laboratory; able to supervise the health of the personnel of the aerodrome and its cleanliness; able also, when circumstances require, to make necessary interrogations regarding the recent movements of particular persons coming from distant countries and exposed to particular infection, and so to secure the same surveillance of them in the places on land to which they go as would be imposed if they had arrived at a seaport.

In this country the co-operation of the local authorities and medical officers concerned has already been secured for this purpose. The second key position, without which the first would be useless, is the existence of the international intelligence system about the chief preventable diseases which I have already described. Without it no rational or tolerable system could have been devised; with it we may reasonably hope that the agreement is one which will help and not hinder both the national health authorities and the interests of air passengers and air lines.

The wide acceptance it has already received, and the advantage which it has even at this early stage been shown to possess in dealing with yellow fever in Africa, are good auguries for the success of the Convention. Of course, where conditions change so rapidly as they do with air travel, no code of conduct can be expected to be complete once for all; the Convention itself contains provisions for its amendment as the result of experience, and its working is already being reviewed regularly by the Permanent Committee of the Office International d'Hygiène Publique, which reports on it to all the Governments concerned.

Co-operation of British Public Health Officers

If time permitted I should have been glad to add details of the International Agreement of Brussels providing for treatment of venereal diseases in seaports; as it is, I mention it in passing as an important section omitted. I trust, however, that even with this omission I have not selected the examples so badly that a representative audience of British local authorities and medical officers of health will think of my subject as too remote from their own practical work. I cannot think it is so; the daily work of public health departments and their officers on the prevention of communicable diseases cannot help being affected by the results of these regular international studies and pooling of experience. In this matter what I have said about small-pox, plague, undulant fever, or psittacosis would apply to many other diseases. If the results are not brought to public health officers directly, through the *Bulletin Mensuel* of the International Health Office, or through the *Quarterly Journal* of the Health Organization of the League of Nations, their lessons are considered and incorporated in circulars and reports from the Ministry of Health or other central Departments, and presently come into the stock of the accepted technical knowledge on which our health authorities work, whether they are central or local.

Local authorities and public health officers sometimes can help the work materially. It may be that, as in a recent international inquiry about disinfection, in which the medical officers of health of several of our larger local authorities were good enough to participate, the information to be had from other countries in return for the trouble of answering an interrogatory sometimes is not, and could hardly be expected to be, of much use to ourselves. But often the boot may be on the other leg, and I venture to express the hope that when information is asked of local authorities for international health purposes it will never be grudged. There is much to take as well as give.

Results Obtained without International Dictation

If you ask me to go further and end by specifying in some conveniently quotable figures what this international system has saved the country in the way of avoiding importations of infectious diseases, I fear I must be disappointing. It is impossible to estimate events which have not occurred. Even if it were attempted the increased individual efforts and efficiency of our own port sanitary authorities in recent years, as well as changes in epidemic characterization, would have to be weighed in with the international factor, and responsibility apportioned between the three. But at least the extreme rarity of these importations, notwithstanding modern facilities of communication, when contrasted with the experiences of the end of the last century and the pre-war period, in which we relied almost wholly on our own "defence" measures, is some testimony to the value of the willing international co-operation I have outlined. I would insist on its willingness; in my experience the best work has been done by avoiding any semblance of international expert dictation, any suggestion of international inspection, or any interference with national administration. It has been achieved by working steadily for conferences and agreements between responsible health officers throughout the world, determined to help one another to carry out their respective national duties.

THE TREATMENT OF ADOLESCENT KYPHOSIS*

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The danger against which the orthopaedic surgeon must fight in adolescent kyphosis is the spontaneous formation of compensatory lordoses in the cervical and lumbar regions. This is true of all types of the deformity, whether due to late rickets, sometimes called "kyphotic disease" and characterized by an osteomalacia of the dorsal vertebrae with a poor general state of health, a type that may be called "somatic kyphosis"; or whether it is the painful adolescent kyphosis, which is a special disease of indeterminate nature, regarded by some (Schmorl and his pupils) as connected with a subcartilaginous nuclear hernia, by others (Schauerbach, Sorrel, and Delahaye) as with epiphyseal trouble, and by others again (Calvé, Galland, Meyer, etc.) as connected with nuclear hernia combined with epiphysitis—a kyphosis of disk origin as opposed to the preceding type. This orthopaedic principle applies whether the kyphosis is capable of being actively and passively reduced—that is to say, a kyphosis due to bad posture—or whether it is irreducible with a certain number of dorsal vertebrae attacked by definite lesions, forming, as in Pott's disease, an actual focus. The aim of this short paper is to show why, in adolescent kyphosis, spontaneous lordoses form: why they are harmful; how they can be avoided; and by what they should be replaced. First of all it is necessary to recall several essential points in the normal and pathological physiology of the spine.

Movements of Flexion and Extension of the Normal Vertebral Column

Ignoring, for the moment, lateral, rotary, and twisting movements, the vertebral column can be divided into (1) regions of hyperextension, and (2) regions of flexion.

There are two regions of hyperextension: the cervico-dorsal, and the dorso-lumbar and lumbar region. As shown in the attached diagrams, the cervical spine with the three first dorsal vertebrae form the principal region of hyperextension—that is, a region in which the vertebrae as a whole allow quite a pronounced movement of hyperextension, very pronounced in certain persons who can touch the upper dorsal spine with their occiput. On the other hand, this region allows little or no range of flexion. The dorso-lumbar and lumbar region includes the ninth, tenth, eleventh, and twelfth dorsal, and the first, second, third, fourth, and fifth lumbar. Movements of hyperextension are highly developed here, and, in supple persons, when the trunk is bent backwards the head can be placed between the heels.

FIG. 1.—Normal physiology of the dorsal vertebrae. Region of flexion: (a) a certain degree of flexion is possible; (b) impossibility of extension.

FIG. 2.—Normal physiology of the lumbar vertebrae. Region of extension: (a) a certain degree of hyperextension possible; (b) with possibility of flexion.

The regions of flexion are the suboccipital and the dorsal. The movements of flexion which occur at the occipito-atlodian articulation should be considered separately from the rest of the vertebral physiology. They are, moreover, very limited, and play no part in the subject with which we are dealing. There remains the dorsal region, the seat of most of the movements of flexion of the vertebral column in its entirety. There are no movements of hyperextension.

The Disk and the Nucleus Pulposus in Flexion and Extension

This matter, which I have discussed elsewhere, has been the object of some very important research in Germany—research that is very well described in a recent work (Mauric: *The Intervertebral Disk*). It must be remembered that the disk acts as: (1) a nuclear axis through its gelatinous centre—the "nucleus pulposus" (Luschka); and (2) as a true anterior and posterior check ligament through the fibrous ring which connects the intervertebral disk with the overlying and underlying vertebrae (see diagram).

In the regions capable of flexion (mid-dorsal) the nucleus is situated at the junction of the posterior and middle thirds of the disk. The movement of flexion pinches the disk in front and pushes the nucleus backwards to a very slight degree. If the reverse movement is attempted—that is, an effort is made to stretch a dorsal intervertebral disk in front and pinch it behind—failure results. It seems as if, on the one hand, the anterior margin of the fibrous ring acts as a check, and on the other, the somewhat posterior situation of the nucleus in this region prevents the compression of the disk behind. Movement is thus blocked in a position in which the

* A communication to the Section of Orthopaedics at the Annual Meeting of the British Medical Association, Bournemouth, 1934.