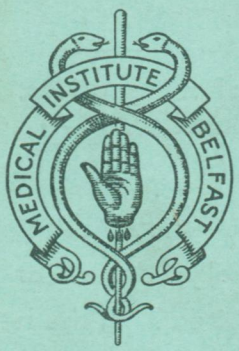
MAY, 1943

THE ULSTER MEDICAL JOURNAL



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THE ULSTER MEDICAL JOURNAL

:: PUBLISHED ON BEHALF OF THE ULSTER MEDICAL SOCIETY ::

Vol. XII 1st MAY, 1943 No. 1

ULSTER DOCTORS AND THE WAR

Much has been said, and much has been left unsaid, about the war effort of Ulster. It is not in any sense within our province to contradict the British Government's decision to decline Lord Craigavon's and Mr. Andrew's request that conscription should be applied to Northern Ireland; but it is our privilege to review the position as it affects the supply of doctors to the fighting services and with pride to publish the results of these enquiries.

For purposes of what is called medical recruiting, doctors are divided into three classes—medical consultants or specialists, general practitioners, and recent graduates. In the first of these categories our contribution ranks as almost equal to that of other parts of the United Kingdom, when we remember that the peace-time proportion of specialists to general practitioners is lower here than there; this lower ratio is almost certainly because the line of demarcation between the consultant and the general practitioner is more definite in Northern Ireland. So many members of staffs of voluntary hospitals have gone, that it has only been possible to carry on the work by retaining or bringing back from retirement senior members of staff: without such help, so generously given, many departments would have been even more seriously handicapped, and the normal increase of staff required to cope with increasing hospital work simply cannot be considered.

Amongst general practitioners the proportion serving with the forces is considerably lower than in England and Wales or Scotland, but one reason for this is that here partnerships are rare and it is difficult for a doctor to find a suitable locum tenens. In many cases the Northern Ireland Medical War Committee has been reluctantly compelled to refuse to forward the names of general practitioners who are eager to serve, because of the impossibility of supplying the needs of the civil population in the areas concerned. A careful survey by the Committee has shown that doctors who are still civilians are with very few exceptions engaged with the Home Guard or other forms of Civil Defence.

It is the third group, the recent graduates, whose record is the most remarkable. Of the men who qualified since 1938, three out of every four have volunteered for the services. Such is their eagerness, that almost all have enlisted immediately on completion of the statutory six months residence in hospital, and there has been no tendency to stay out in search of higher qualifications in the hope of accelerated promotion after eventual enrolment. This admirable keenness has indeed embarrassed honorary secretaries of staffs who find it difficult or impossible to find candidates for "B" house-appointments.

Surely it is the duty of the British and American Medical Schools to see that ample and international opportunities for post-graduate study will be available after the war for those who sacrificed their professional advancement for the common cause.

We are informed that when, as so frequently happens, one of our graduates serves as a houseman in England and joins H.M. Forces after six months residence there, his name is credited to England and not to Northern Ireland on the official lists of the Central War Committee.

The four hundred names sent in by the Northern Ireland Committee do not, therefore, by any means represent all the Ulster doctors who are with His Majesty's Forces. Amongst them are thirty women doctors, some of whom are already serving with their brothers overseas in R.A.M.C. or R.A.F.

In every part of the world and on all the seven seas Queensmen are serving, and there will be no brighter page in the history of the Medical School than that which they are making now.

Here may we suggest to the authorities that a volunteer doctor should be given the privilege of serving in which he chooses of the three medical services (provided always that he is considered fit to serve in any), and to remind them of the truth of the old adage that "one volunteer is worth ten pressed men"?

There is a fourth group which we mention with pride and thanksgiving : these are the medical students who have left the safe shelter of the cloisters for the camp, and who set out "asking a thoroughfare through the angers of the air" bearing the motto "per ardua ad astra." We hope that they will soon return to their studies and that a grateful country will give them generous grants for this purpose.

To the relatives of those who have already given their lives in their endeavour to lessen the sufferings of others we offer our sympathy.

To our colleagues who endure the unearned penance of prisoners of war we send a message of affection and remembrance. To those who have been awarded decorations for gallantry or mentioned in despatches to His Majesty, and, to all those who have earned our undying gratitude, we offer congratulations and good wishes, though indeed they well may say with Pericles : "we need no Homer or other man of words to praise us : for such give pleasure for a moment, but the truth will put to shame their imaginings of our deeds."

THE QUEEN'S UNIVERSITY OF BELFAST
FACULTY OF MEDICINE

Graduates and undergraduates who have been killed in action or who have died on active service, September, 1939—April, 1943 :

Corry, S. D., M.B., Captain, R.A.M.C.
Cromie, R. S., M.D., Flight-Lieutenant, R.A.F.
Ervin, G. H., Sub-Lieutenant, Fleet Air Arm.
Graham, M. A., Sub-Lieutenant, Fleet Air Arm.
Graham-Cook, A. S., Sergeant-Pilot, R.A.F.V.R.
Marks, Hugh, L.R.C.P.S.I., Surgeon-Lieutenant, R.N.V.R.
Miles, Wm., M.B., Captain, R.A.M.C.
Morrow, Martin, M.B., Major, R.A.M.C.
McElney, W. H. C. D., Sergeant-Pilot, R.A.F.V.R.
MacIlwaine, A. G. C., C.S.I.E., L.R.C.P.S.I., Lieut.-Colonel, R.A.M.C.
McWhirter, J R., M.B., Squadron-Leader, R.A.F.V.R.
Orr, W. B. F., M.B., Major, R.A.M.C.
Reid, A. E. H., M.B., Captain, R.A.M.C.
Stewart, H. T., M.B., Captain, R.A.M.C.
Wilson, A. V. S. H., Pilot-Officer, R.A.F.V.R.

Graduates and undergraduates who are missing or known to be prisoners of war :

Armstrong, Brian, M.B., Captain, R.A.M.C.
Barrett, E. J. St. Clair, M.R.C.S., L.R.C.P.Lond., Lt.-Col., R.A.M.C.
*Brennan, W. B. F., M.B., Major, R.A.M.C.
Draffin, D. A., M.B., Captain, R.A.M.C.
Irwin, J. W. S., M.B., Captain, R.A.M.C.
Lennon, R. W., M.B., Captain, R.A.M.C.
*Lewis, T. J., M.D., B.Sc., F.R.C.P., Lieut.-Colonel, R.A.M.C.
Longmore, Louis, M.B., Captain, N.Z.A.M.C.
Mark, J. Allison, M.B., Captain, R.A.M.C.
Moss, J. E., Captain, R.A.M.C.
Mulligan, James, M.B., Captain, R.A.M.C.
Mackenzie, Kenneth, D.F.C., Flying Officer.
Pantridge, J. F., M.B., Captain, R.A.M.C.
Smiley, Thomas, M.B., Captain, R.A.M.C.
Thomson, H. B., M.B., Captain, R.A.M.C.
Wallace, H. B. C., M.B., Colonial Medical Service.

*Recently repatriated.

Graduates and undergraduates who have been awarded Decorations by His Majesty the King or whose names have been Mentioned in Despatches to him, for services rendered since September, 1939:

Order of the British Empire.

Commander:

Tyrrell, W., D.S.O., M.C., M.B., Air-Vice-Marshal, R.A.F.

Officers:

Gilbert, Edward T., M.B., Captain, R.A.M.C.

MacLaine, E., M.B., Captain, R.A.M.C.

Member:

Montgomery, D. A. D., M.B., Major, R.A.M.C.

The Military Cross.

Browne, H. J., M.B., Captain, R.A.M.C.

Lord, J. G., M.B., Major, R.A.M.C.

The Distinguished Service Cross.

Kirkpatrick, R. McF., M.B., Surgeon-Lieutenant, R.N.V.R.

The Distinguished Flying Cross.

Mackenzie, Kenneth, Flying-Officer, R.A.F.V.R.

The Volunteer Officers' Decoration.

Allison, R. S., M.D., F.R.C.P., Surgeon-Commander, R.N.V.R.

Hall, R., M.B., Surgeon-Captain, R.N.V.R.

Hall, H. E., M.D., Surgeon-Commander, R.N.V.R.

MacLaughlin, F. A., M.B., F.R.C.S., Surgeon-Commander, R.N.V.R.

Mentioned in Dispatches.

Bateson, W. G., M.B., Major, R.A.M.C.

Browne, H. J., M.B., Captain, R.A.M.C.

Forsythe, K., M.D., Surgeon-Commander, R.N.V.R.

Houston, John, M.B., Captain R.A.M.C.

Stanage, R. B., Major, R.A.S.C.

Stewart, G. E., M.B., Major, R.A.M.C.

Wallace, D. W., M.B., Surgeon-Lieutenant, R.N.V.R.

Wilson, D. A. O., M.B., Major, R.A.M.C.

"THE EDITOR"

THE Council of the Ulster Medical Society and the Editorial Committee of the ULSTER MEDICAL JOURNAL have received, and accepted with very great regret, the resignation of Dr. R. H. Hunter from the office of Editor. Dr. Hunter has earned the very warm thanks of Ulster doctors for his work, and the fact that it has been a labour of love in no way lessens either its effort or its value. The Society may well be gratified at his promise of continued help in a less exacting capacity, and that this Journal will not be suddenly bereft of the sane criticism, the profound scholarship, and the self-effacing efficiency which have in its earlier volumes enriched its pages.

The Problems of Diphtheria in the Light of Modern Knowledge

A ROBERT CAMPBELL ORATION

By Professor R. A. Q. O'Meara, M.D., D.SC., F.R.C.P.I., F.T.C.D.

IT is my very great honour to address you in memory of Robert Campbell, who during his life so adorned his profession, and by his personality and his practice of surgery in Belfast so inspired his colleagues, that after his death the Robert Campbell Memorial Committee was formed to perpetuate his memory. I wish to express my deep sense of gratitude to the committee for extending to me an invitation to address you in memory of so great a man.

Broadly speaking, there are two main problems which have to be faced in connection with diphtheria at the present day. The first of these is the relative failure of diphtheria antitoxin to achieve in the treatment of diphtheria what might reasonably be expected of it, in view of its apparent success when first introduced. The second is the assessment of the value of diphtheria immunisation. To what extent is it successful? Can we hope that by its aid diphtheria will be abolished, in fulfilment of the promise made when it was first introduced, or must we take a more moderate view of its function in dealing with the disease? I propose to discuss these problems in detail, bringing to bear on them the light of recent advances in medical science and the work which has been done and is being maintained in Dublin with a view to their solution.

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Following the discovery of diphtheria antitoxin by Behring in 1890, it became generally recognised that a therapeutic advance of the first magnitude had been

made. So valuable was antitoxin found in the treatment of diphtheria, that very few clinical experiments designed to assess its worth under controlled conditions were possible. Scientific method demands that in the clinical testing of a proposed remedy a large series of cases shall receive the new treatment while it is withheld from a comparable series treated in otherwise exactly similar circumstances. Only two experiments approximating to the scientifically perfect are extant. Subsequent attempts to repeat them had to be abandoned on humanitarian grounds, owing to the tragic results consequent upon withholding antitoxin from the controls.

In my presidential address to the Section of Pathology of the Royal Academy of Medicine in Ireland for the year 1939 I have reviewed the two experiments of first-class evidential value. One of them, conducted by Fibiger in the Blegdams Hospital at Copenhagen in 1898, shows that antitoxin is effective in mild diphtheria. Fibiger treated all cases admitted on one day with antitoxin and those admitted on the next day without antitoxin for a period of a year. He then had records of 239 cases treated with serum, and 245 without. The fatality rate in the serum-treated cases was 3.3 per cent., and in those treated without serum 12.2 per cent. It is clear, therefore, that he was dealing with very mild diphtheria, since the fatality-rate in his control group, treated without antitoxin, is less than that found in many modern hospitals in which the most intensive antitoxin therapy is combined with all the resources which have come to the aid of medicine since Fibiger's time.

In assessing the severity of diphtheria, pride of place must be accorded to the degree of toxæmia with which it is associated. Toxæmia from absorption into the system of the toxic products of the diphtheria bacillus growing in the local lesion is a characteristic of all forms of the disease, although it varies in degree, depending upon a number of circumstances. In its most severe form, the toxæmia is responsible for the clinical manifestations of hypertoxic cases. In these cases a striking feature is the relatively slight membrane formation in proportion to the degree of prostration induced in the patient. The membrane may be confined to the tonsils, or may extend upwards, involving the soft palate and uvula. Less commonly, the membrane may involve the hard palate and gums as well, but it shows little tendency to spread to the larynx and trachea. It is relatively deep-seated in the tissues to which it is attached, and causes locally considerable necrosis and much œdema. The glands draining the area are enlarged, and the cellular tissues of the neck become the seat of a massive œdematous swelling. This swelling, combined with a glandular enlargement, has received the clinical appellation of "bull-neck." The appearance is mentioned in the French literature of the subject half a century ago as *"l'aspect proconsulaire"*—a somewhat more picturesque title. By whatever name it is known, it is a sign of grave import and is accompanied by other toxic manifestations; albuminuria, which starts early and persists, myocardial degeneration, which may lead to acute heart failure with fatal consequences usually about a fortnight from the time of onset of the disease, and subcutaneous and submucous hæmorrhages, which are not always present, but, when found, weigh heavily against a favourable prognosis. Should the victim of the toxæmia survive the acute stages, he is faced with the prospect of post-

diphtheritic paralysis during convalescence, since a high incidence of post-diphtheritic paralysis which may have late cardiac failure as an accompaniment is common in hypertoxic cases. All shades of toxæmia in decreasing severity are encountered in infection with the diphtheria bacillus, from those of extreme degree, such as I have described, to the negligible toxæmia associated with many nasal infections. It is noteworthy that laryngeal cases are, in general, accompanied by relatively little toxæmia, and in these cases the membrane, though it may be very extensive, is superficial and readily detached. Death ensues in laryngeal cases as a rule either from suffocation or from an extension of the membrane into the lower air-passages setting up broncho-pneumonia. Nevertheless, there are some laryngeal cases which, relieved by Brettoneau's tracheotomy from the danger of suffocation, die from toxæmia.

It was the early recognition of the toxic nature of diphtheria which led to the preparation of diphtheria toxin by Roux and Yersin in 1888 in the form of sterile culture filtrates of the bacillus, which the work of Klebs and Loeffler had made it possible to identify as the causal organism a few years before. The bacillus, when grown outside the body, elaborated a substance which could be obtained in sufficient concentration, in the fluid medium used for growth, to kill animals. The discovery of the toxin and later, by Behring, of the antitoxin which was capable of neutralising it, were the starting-points of a branch of the science of immunology dealing with toxins and antitoxins which has since assumed almost unbelievably large proportions. It is impossible for those who have not devoted a considerable period to the study of this branch of the science to appreciate fully the overriding influence which has been exerted upon its development by the attention devoted to diphtheria toxin and its antibody. They have been far more studied than any other toxin and antitoxin, and most of the statements which are made in immunological literature about toxins and antitoxins as a whole, are generalisations based upon experiments with diphtheria toxin and antitoxin. The study of tetanus toxin and antitoxin, which must claim second place, has, by comparison, been slight. It is, therefore, imperative that our interpretation of the knowledge which has accumulated during the course of years should be correlated with the facts in the most comprehensive manner possible.

The pioneers of toxin and antitoxin were doctors in close touch with the clinical as well as the laboratory side of their problems, but from an early date the production of antitoxin became so important from the commercial point of view that laboratory investigation was divorced from treatment. The production of quantities sufficient to meet clinical demands became the aim of manufacturers rather than the preparation of antitoxin which would be clinically effective. The clinicians, moreover, lulled into a sense of security by articles in their journals and by a decline in the severity of diphtheria which commenced about the time when antitoxin was first introduced, demanded higher unitage so as to enable the therapeutic volume of serum to be reduced, thus diminishing the risk of serum reactions which were early recognised as a disadvantage in antitoxin treatment. In the course of time, those engaged in serum manufacture obtained a monopoly

of research and of influence, so that independent investigation by members of our profession became almost impossible.

It is not surprising, therefore, that the first function of antitoxin, namely its ability to neutralise toxin, should have been forgotten. When diphtheria, after a period of years during which hypertoxic cases were uncommon, began to manifest severity once more, it became apparent that modern antitoxin was ineffective for the purpose of neutralising the toxin produced by the diphtheria bacillus in the patient. It is well known to those who have the treatment of such cases entrusted to them that antitoxin has relatively little influence on the outcome, even though it be administered in enormous doses. Many cases die although they receive more than 100,000 units of antitoxin on the day of onset. It is regrettable that statements to the effect that failure of antitoxin in these cases is due to the fact that it is administered too late and not by the intravenous route should continue to be made. This fallacy has been repeated as recently as January last in a leading article in the "British Medical Journal" on the "Control of Diphtheria." That it can be repeated with such apparent authority illustrates the great influence of what may be termed the official or laboratory viewpoint, since it would be impossible for any member of our profession who had seen these cases in hospital to write in such terms. The plain fact is that the antitoxin in current use when injected into the victims of hypertoxic diphtheria often has no more apparent effect than an injection of saline.

It is necessary, in considering the failure of modern antitoxin to cope with the toxæmia of diphtheria in its severer forms, to enquire whether antitoxin was ever of value in the treatment of toxæmia of this type. The evidence that it was of value is to be derived from the second clinical experiment under controlled conditions which was conducted when antitoxin was first introduced. The experiment was carried out by Roux, Martin, and Chaillou at the *Hôpital des Enfants Malades* in Paris in 1894. Clinical accounts of the disease as it occurred in Paris about the time of the experiment show that it was not uncommonly associated with severe toxæmia. *"L'aspect proconsulaire,"* albuminuria, cardiac irregularities, and post-diphtheritic paralysis were frequently observed, many of the deaths being due purely to toxæmia. If we consider solely that group of cases among the treated in which there was no involvement of the larynx, and it is in this group that deaths explicitly due to toxæmia occur, we find that among 169 cases of bacteriologically proved diphtheria there were 21 deaths, giving a fatality-rate of 12.4 per cent. The controls for this experiment are the cases of similar type treated without antitoxin at the neighbouring *Hôpital Trousseau* during the period of the experiment. The fatality-rate among the children in this group was 32 per cent. As controls we may also use the mean fatality-rate in a series of cases of similar type treated in the *Enfants Malades* by Martin and Chaillou without serum in 1891 and 1892, which was 49.2 per cent., and the mean fatality-rate in the hospital for this type of case for the four years prior to 1894, which was 33.94 per cent.

The statistical evidence in favour of an amelioration of the toxæmia by antitoxin is supported by clinical observations. The authors observed marked and rapid

clinical improvement in the treated cases with separation of the false membrane (in most instances) within thirty-six to forty-eight hours. They no longer encountered cardiac irregularities which had previously been the rule during convalescence, and there were but a few cases of paralysis of the palate of short duration. In only two cases was the paralysis more extensive, and one of these died. It may be objected that diphtheria was declining in severity at the time that the experiment was conducted, and this must be admitted. The fatality-rate in the type of case under consideration had declined from 47.3 per cent. in 1890 to 32 per cent. in 1893, but it still stood at the latter figure in 1894, as is shown by the results in the *Hôpital Trousseau*. The other objection which may be made is that the number of cases treated was small. This is likewise true, but it is offset by the results of clinical observation in the treated cases and by the smallness of the doses of antitoxin used for treatment. Exact standardisation of antitoxin had not been achieved at the time of the Paris experiment, but it is possible to estimate from the figures for neutralisation in laboratory tests given by the authors that the serum used contained about 50 and not more than 100 units per cubic centimetre. The greatest dose of antitoxin administered to any case did not exceed 8,500 units, and was probably not more than 5,000 units. Most of the patients received much less, and the injections were given subcutaneously. By contrast, the maximum dosage of those days corresponds with the minimum employed nowadays for mild nasal cases. It falls far short of the maximum administered by the intramuscular and intravenous routes to cases of moderate severity to-day, with results less striking than those of the original investigators. About the time of the Paris experiment promising results were also being obtained with diphtheria antitoxin in Berlin, and in 1894 Ehrlich, Kossel, and Wassermann published their clinical experiences using a serum, the antitoxin content of which appears to have been in the neighbourhood of one unit per cubic centimetre. Their maximum dosage in any case was twenty-five cubic centimetres, or about twenty-five units, a quantity of unbelievably small dimensions. I have taken the opinion of those whose clinical experience covers the entire period of antitoxin therapy, and they have no doubt that, unit for unit, antitoxin is clinically much less potent than formerly. It is difficult to express this decline in potency in numerical terms, but it is probably no exaggeration to state that modern antitoxin is less than one-tenth as active therapeutically as when antitoxin was first introduced. There is still no doubt that it is a valuable therapeutic agent, if given in sufficient doses, in cases in which toxæmia is not a prominent feature. Most cases of laryngeal diphtheria, for example, derive great benefit from it, and mild faucial or nasal cases yield to treatment. In cases with moderately severe toxæmia, its influence on the outcome is more difficult to assess, and in severe toxic cases it is doubtful whether it has any influence at all. It must be recalled that severe toxic cases of diphtheria were well recognised before the introduction of antitoxin therapy, and not infrequently recovered. Some time ago I was reading Moore's translation of Donders's classic on "Accommodation and Refraction of the Eye," printed in 1864, and was most interested to find an account of an outbreak of typical toxic diphtheria affecting

both children and adults, as does this toxic form, in the village of Bennekom. Many of the victims recovered after the usual stormy passage so much in evidence in cases treated with antitoxin at the present time, and the author attributed the successful outcome to the cauterisation of the local lesion with mineral acids. Strong cauterisation reduced mortality and decreased the incidence of post-diphtheritic paralysis.

By contrast it is apparent that in our own time, where severe diphtheria has revisited areas in which the fatality-rate was formerly high but had fallen since the introduction of antitoxin, the antitoxin now in use has been found relatively ineffective in coping with the altered conditions. In 1927 Deicher and Agulnik recorded a steady rise in the fatality-rate of diphtheria in the *Virchow Krankenhaus*, Berlin, from 5 per cent. in 1924 to 26.7 per cent. in the first five months of 1927. Many of the cases appeared to give little response to serum therapy, and the disease had changed in character from one causing deaths, few in number, among infants and young children, to one in which deaths were frequent equally among infants and children over five years of age. The increased fatality-rate, moreover, was due not to laryngeal diphtheria, but to toxæmia. Following on this experience, outbreaks of unusual severity began to be reported from all parts of Europe, including Great Britain and Ireland. The failure of antitoxin in treatment of the severe type of diphtheria was all the more striking owing to the technical improvements which had rendered it possible to give doses of enormous unitage by the intramuscular and intravenous routes, thereby ensuring rapidly a very high concentration of antitoxin in the blood-stream. The order of dosage employed for a single case would be capable of neutralising a quantity of the usual laboratory toxin sufficient to kill twelve million guinea-pigs in weight approximately three thousand tons.

For a time no explanation of the failure of antitoxin was forthcoming, but in 1931 Anderson, Happold, McLeod, and Thomson from the Leeds School published their investigations, which showed that different types of diphtheria bacilli could be recognised on morphological, cultural, and biochemical grounds. One type in particular, which gave characteristic colonies on their special medium and different from the others in its ability to ferment starch, was found to be prevalent in areas in which the incidence and mortality of diphtheria were high. This type they termed *"gravis,"* and another, which was found in areas in which the disease was mild, was named *"mitis."* A third type could be identified, intermediate in its characteristics between the two, but to this, the *"intermedius"* type, its proper place as a cause of toxæmia in diphtheria was not assigned until later. Subsequently work in Leeds and elsewhere proved that the three types have a clear relationship to the severity of diphtheria in different areas and to the incidence of toxic complications on the one hand and laryngeal complications on the other. In areas where *"gravis"* and *"intermedius"* infections abound, the fatality-rate in diphtheria is high and the outstanding clinical features of the disease are those of toxæmia. The toxæmia is out of proportion to the extent of membrane formation, and "bull-neck," albuminuria, subcutaneous, and submucous hæmorrhages, cardiac failure

and paralysis of greater or less degree, are common features of the disease. Where the *"mitis"* type prevails, cases present extensive membrane formation. The membrane tends to be superficial and, in view of its extent, is associated with surprisingly little toxæmia. On the other hand, spread of membrane to the larynx and trachea is more common than with the other types. The fatality-rate in areas in which the *"mitis"* type predominates is low.

It must, of course, be recognised that not all infections with *"gravis"* and *"intermedius"* types of diphtheria bacilli present the clinical features of toxæmia described above. It is understandable that not all such strains are of equal toxicity, and individual variation in resistance to toxæmia must be allowed the victims of infection. Similarly *"mitis"* strains may be isolated from some cases which present the features of severe toxic diphtheria. A slight complicating factor also is the occurrence in certain areas of atypical strains which do not conform exactly to the three main types. These atypical strains, which are difficult to classify, may be capable of causing severe toxic infections. Nevertheless, the position as outlined by Cooper, Happold, McLeod, and Woodcock in 1936 stands in the main unchallenged. In an analysis of 5,794 cases of diphtheria compiled from many areas they found that 2,313 *"gravis"* infections had a fatality-rate of 13.3 per cent., 1,993 *"intermedius"* infections gave a fatality-rate of 8.6 per cent., and 1,488 *"mitis"* infections a rate of only 2.3 per cent. The toxic complications had a relatively high incidence in *"gravis"* and *"intermedius"* infections, while the laryngeal complications were relatively frequent with the *"mitis"* type of organism.

The findings of the Leeds School constituted a great advance in the study of diphtheria and marked a break from tradition which was wholly salutary. Needless to say, they have been questioned, but they have stood the test of time and are now firmly established. With the increase in knowledge which they brought, the suggestion was at once apparent that the three distinct types of diphtheria bacillus each produced a different toxin. Experimental evidence in support of this hypothesis was not, however, forthcoming. On the contrary, in animal experiments no difference could be shown in the toxins produced by the three types, and all were neutralisable by the antitoxin produced in commercial laboratories by the inoculation of horses with a toxoid or toxin made from the Park-Williams No. 8 strain, which is famed for its potency as determined by its lethal power in guinea-pigs. This observation was at variance with the clinical inefficacy of the same antitoxin.

For fifteen years I have been especially interested in the problems of diphtheria, and soon after my return to Dublin in 1938 I began experimental work, with a view to elucidating, in the light of the newer knowledge, the conflicting and contradictory features associated with the disease. I had been prevented from undertaking this investigation in England. In Dublin I had the good fortune to find in Dr. C. J. McSweeney, Medical Superintendent of Cork Street Fever Hospital, a colleague who placed at my disposal not only his extensive clinical knowledge, but the freedom of his hospital. I cannot speak too highly of the facilities granted to me by Dr. McSweeney and his admirable staff. He was at

the time dealing with many cases of the severest form of toxic diphtheria, and it was from him that I received enlightenment as to the clinical nature of this condition. It was then obvious to me that the concept of hypertoxic diphtheria current in laboratory circles, namely a form of diphtheria in which the patient is rapidly overwhelmed by an overdose of toxin such as that produced in the laboratory from the Park-Williams No. 8 strain, has no foundation in fact. Clinical hypertoxic diphtheria had no parallel in laboratory experience. When guinea-pigs are inoculated subcutaneously with quantities of laboratory toxin just sufficient to kill in four or five days, the so-called minimal lethal dose, they develop a slight local thickening at the site of injection with slight necrosis and œdema, and post-mortem show suprarenal congestion, pleural effusion, and congestion of the intestines. Larger doses kill in a shorter time, but the local lesion is less than before, and the post-mortem findings are pleural effusion and sometimes congestion of the suprarenal glands. Doses smaller than the minimal lethal dose also cause less local reaction from which the animals rapidly recover and with fresh toxins, at least, never develop paralysis later. The picture of hypertoxic diphtheria as it occurs in the human subject is, therefore, never encountered in the guinea-pig inoculated with diphtheria toxin freshly elaborated by the Park-Williams No. 8 strain. The striking features of the disease as it occurs in the human subject are all missing, there is no massive local lesion with pronounced œdema corresponding to "bull-neck," and no late paralysis. The guinea-pigs either die in the first few days with post-mortem appearances quite unlike those of the human case or, surviving the acute stage, rapidly return to normal health.

Reference may here be made to a suggestion of Mueller's in 1941 that the hypertoxic form of diphtheria may be due to the ability of the *"gravis"* type of diphtheria bacillus to elaborate toxin freely in the presence of iron derivatives. Toxin production by the Park-Williams No. 8 strain takes place only in the presence of a narrow range of iron concentrations minute in quantity. Mueller found that a *"gravis"* strain of diphtheria bacillus was able to elaborate toxin freely in the presence of much higher iron concentrations than usual, and suggested that certain strains are likewise able to elaborate toxin freely in the throat, where the iron concentration is high and may thus produce the hypertoxic type of case. This hypothesis must fail to explain the occurrence of hypertoxic cases, because it fails to take into account the clinical features of these cases. Excessive production of the classical toxin cannot be the explanation, because the classical toxin does not cause a massive local lesion and in large doses kills rapidly with virtually no local lesion. In the typical hypertoxic case, on the other hand, there is a massive local lesion, and death, as a general rule, only ensues as quite a late event. Moreover, the failure of modern antitoxin of high unitage to alleviate the toxæmia contrasts so strongly with the success of the pioneer antitoxin of low unitage in similar cases that one is clearly dealing at the bedside with somewhat more than excessive toxin production. The sooner this purely laboratory concept of hypertoxic diphtheria is abandoned the better, as it is a stumbling-block to scientific progress.

I had abandoned it in 1938 when I started experiments in the laboratory with a

view to studying more minutely the type of reaction which could be obtained in experimental animals by means of preparations of "*gravis*" strains of the diphtheria bacillus. Starting from first principles, it was apparent that diphtheria toxin as produced in the laboratory was a highly artificial substance. The reason for this opinion may be summarised as follows. The strain used for its production is the Park-Williams No. 8 strain originally isolated from a very mild case of diphtheria, but found in the laboratory to be a particularly good strain for the preparation of toxin as estimated by its lethal power for guinea-pigs. During the period of nearly fifty years since this strain was first isolated it has been maintained on artificial culture media and has given off many substrains which have been selected for toxin production and preserved for further use on the basis of the lethal power of their toxin for guinea-pigs. In the preparation of laboratory toxin a broth medium of carefully selected properties is used, and growth is permitted to continue for many days under conditions which favour oxidative mechanisms of obtaining growth energy such as the diphtheria bacillus is unlikely to find available when growing in the throat, where, incidentally, it flourishes on a solid, not a liquid, medium. A latent period of many hours must elapse following the injection of the classical toxin into animals before any reaction can be observed, whereas in hypertoxic diphtheria the local lesion is often fulminating, an extensive inflammation appearing where a few hours previously nothing abnormal was visible.

I found that by growing freshly isolated "*gravis*" strains from hypertoxic cases on solid media for forty-eight hours, washing off the growth with saline, centrifuging and filtering the supernatant, a preparation was obtained which differed in its properties from the classical toxin. It was relatively non-lethal for guinea-pigs, and when injected into them subcutaneously gave little reaction. When inoculated intradermally it had certain distinctive properties. The wheal raised by the inoculation spread slowly outwards to attain a diameter of about an inch in thirty minutes, and within a few hours became covered with a red flush. Some of the guinea-pigs showed evidence of irritation at the site of injection, a symptom which was entirely lacking with injections of the usual laboratory toxin. The most interesting results were obtained by the subcutaneous inoculation of animals with mixtures of the saline extracts combined with sub-lethal doses of the classical laboratory toxin. By this technique it was found possible to reproduce in the guinea-pig a close imitation of hypertoxic diphtheria as it is found in human beings.

When fractions of the minimal lethal dose of Park-Williams No. 8 toxin were mixed with varying quantities of the saline extracts of "*gravis*" strains of diphtheria bacilli and inoculated subcutaneously into guinea-pigs at the central point of the abdomen, the mixtures caused the development in a few days of an enormous swelling often extending from the neck to the pubis. Death sometimes ensued about eight days from the time of inoculation when the dose was large enough, but it was very obvious that the effect of adding the saline preparations was not to accelerate death. Just as in clinical hypertoxic infections death does not supervene with exceptional rapidity, so in the parallel condition in animals death was delayed for a significant period.

Many of the animals survived the acute stage, and in time the swelling subsided and a large necrotic slough separated. Wasting, which is such a frequent feature of hypertoxic diphtheria, set in, and between the twentieth and thirtieth day paralysis, frequently fatal, supervened. In guinea-pigs dying about the eighth day the post-mortem appearances were local œdema and necrosis, large pleural effusion sometimes accompanied by œdema of the lungs, pale suprarenal glands, and occasionally small hæmorrhages in the spleen. We may probably interpret the pleural effusion and œdema of the lungs as evidences of cardiac failure. The post-mortem findings in the animals had a good resemblance to those described by McLeod, Orr, and Woodcock in 1939 as found in human beings dying from the hypertoxic form of diphtheria. The picture was, therefore, complete and it could be safely stated that the hypertoxic form of diphtheria as found clinically was reproducible in guinea-pigs.

The only possible deduction from these experiments was that the full toxæmic effects of the diphtheria bacillus are the consequence of the combined action of two substances which are not equally represented in all types of toxin. Both must be represented in Park-Williams No. 8 toxin, because it is capable of causing some local œdema and in suitable combination with antitoxin may give rise to late paralysis although, injected subcutaneously by itself, when fresh, it never does. Similarly, both must be present in the saline extracts of *"gravis"* strains, since these will, if given in large enough doses, kill guinea-pigs within a few days. The guinea-pig lethal constituent of diphtheria toxin which is preponderant in the Park-Williams No. 8 toxin I have called Substance A. The second constituent which preponderates in preparations of *"gravis"* strains I have called Substance B. The classical toxin which has become the standard of reference for all diphtheria toxins and is that used for the production of diphtheria antitoxin and for the preparation of diphtheria prophylactics, has an overwhelmingly high proportion of Substance A to Substance B. On the other hand, the type of toxin which is of gravest clinical significance and is responsible for toxæmic deaths in the victims of diphtheria, has a high proportion of Substance B and relatively little Substance A.

The characteristics of Substance A, its high lethal power for the guinea-pig and the artificial post-mortem appearances which it gives in the experimental animal, more especially the deep congestion of the suprarenal glands so rarely met in the human case, are too well known to require elaboration. It is undoubtedly the lethal constituent of the toxin, but its action is governed by the second constituent, Substance B, which, as we shall see, also influences the neutralisation of Substance A by antitoxin. One of the most striking features of Substance B is the spreading effect with which it is associated both on intradermal inoculation and when, in combination with Substance A, it is injected subcutaneously into animals. Inoculated intradermally, it can be seen to spread through the skin, and in the subcutaneous experiments recorded earlier it greatly enhanced and enlarged the extent of the local lesion, and in doing so distributed Substance A more widely through and into the tissues of the animal, leading to the subsequent cardiac failure, wasting, and paralysis.

The work of Feiner, published in 1941, brings a new fact to support this hypothesis. Feiner has shown that paralysis may be induced in guinea-pigs by the injection of sublethal doses of toxin intravenously, although their injection subcutaneously or intradermally fails to induce it. She finds that toxins from the Park-Williams No. 8, *gravis, mitis,* and *intermedius* strains, all behave alike in this respect, showing that it is the same constituent (Substance A) which is responsible for the paralysis in each case. She considers that the origin of the paralysis is peripheral and not central. The paralysis must, therefore, result from the wide dissemination of the toxin by the intravenous route. Intravenous injection is, in this respect, similar in its mode of operation to Substance B, which, by spreading Substance A widely through the tissues of the animal, can cause it to bring about paralysis. In recent years the property possessed by certain biological extracts of causing spread or diffusion through the tissues by increasing their permeability has attracted much attention. Duran-Reynals in 1928 first demonstrated the presence of such a substance in certain organs and tissues of the body, particularly the testis. It was soon observed that this substance was able to increase the lesion caused by micro-organisms, and in 1933 Duran-Reynals demonstrated the production of a similar substance by staphylococci. McClean in 1936 proved the production of a spreading factor by a wide range of organisms. The second constituent of diphtheria toxin, Substance B, appears to have properties very similar to these diffusing substances.

When I had been able to show that diphtheria toxin is not a single entity, but is composed of two distinct parts, both of which are necessary for the complete action of the toxin, it was reasonable to expect that diphtheria antitoxin would be found to contain two antibodies, one against Substance A and the other against Substance B. Experimental evidence for their existence in antitoxin was soon forthcoming, and it was possible to explain on the hypothesis of two constituents of toxin and two corresponding antibodies in antitoxin many of the anomalies of toxin and antitoxin interaction which have constituted such a puzzling feature of this branch of immunology. Thus Ehrlich's phenomenon, the Danysz phenomenon, and the failure of toxin and antitoxin to obey the simple laws of chemical neutralisation, may all be explained from consideration of the results of interaction of a toxin made up of two constituents with an antitoxin containing two antibodies.

From the practical point of view, the most interesting feature of the new hypothesis was that it gave an explanation of the phenomenon of avidity. By an avid antitoxin is meant one which will combine firmly with antitoxin. A non-avid antitoxin, on the other hand, combines loosely with antitoxin, and when a mixture of the two is diluted, dissociation of the toxin from its antitoxin takes place. A mixture of toxin and antitoxin which, in a small volume, appears to be non-toxic will become highly toxic when made up in a large volume. It was found that mixtures of toxin with an avid antitoxin could by the addition of Substance B be made to behave like mixtures of toxin with non-avid antitoxin. Furthermore, it was shown that mixtures of non-avid antitoxin with toxin, inoculated intradermally into animals, spread outwards in the skin in a manner similar to toxins rich in

Substance B. Mixtures of avid antitoxin with toxin on the other hand gave little spread. These observations suggested very strongly that non-avid antitoxins were those which lacked the antibody to Substance B. They likewise suggested that the type of antitoxin which would be required for treatment of the hypertoxic case in which Substance B was being produced in excess, in the body of the patient, was antitoxin as rich as possible in the antibody to this substance, or in other words, antitoxin of the most highly avid character.

There was a host of collateral evidence from the literature of diphtheria and the established facts of immunology to support this contention. It is well known that an animal immunised with two antigens is liable to respond poorly to that which is in low concentration as compared with the other. For many years the toxin of the artificial Park-Williams No. 8 strain prepared so as to possess as high a concentration of the guinea-pig lethal factor as possible, irrespective of its other constituents, had been used as antigen in the immunisation of horses for the production of therapeutic serum. It was to be expected that antitoxin so prepared would be of high value in the antibody to Substance A and low in value in respect to other antibodies. In the technical developments which had taken place in the production of antitoxin, its concentration by precipitation and its refinement by digestion, which splits the molecule of antitoxin, emphasis had been laid at all stages on neutralisation of the guinea-pig lethal factor, which could now be regarded as only part of the toxin, namely Substance A. In accordance with what one would have expected from this neglect of Substance B and its antibody, it was known that therapeutic antitoxins were at best of moderate avidity as shown by Barr and Glenny in 1931. Likewise, as shown by Glenny, Barr, Ross, and Stevens in 1932, immunisation of animals with diphtheria prophylactics prepared from the Park-Williams No. 8 strain commonly results in the production of a non-avid antitoxin. From all points of view, therefore, there was an overwhelming probability that my view of the nature of hypertoxic diphtheria and its relation to the failure of antitoxin in treatment was correct.

Having formulated my hypothesis on the basis of experimental observation, the next step was to put it to the test. Horses should be immunised so as to produce antitoxin, not of high potency, as estimated by its content of standard units, but of high quality, as shown by its antibody content to Substance B, of which its avidity would constitute a reliable measure. For this purpose the animals should clearly be immunised with antigens containing a high proportion of Substance B relative to Substance A, such as might be presumed to have been used in the early days of antitoxin production. The antitoxin resulting should be estimated in terms of its avidity rather than its unitage, and it should then be tested on the severest types of toxæmic case. While willing to undertake the immunisation of horses myself, it was clear that this type of investigation would have to proceed very slowly with the limited resources at my disposal while, on the other hand, it was the type of work which might reasonably be expected to advance rapidly in an establishment equipped for the production of antitoxin. I was anxious to ensure that a therapeutically active antitoxin should be made available as soon as possible for the

treatment of diphtheria and at the same time wished to see the clinical trials of the antitoxin which was to emerge from my work conducted in Ireland, since it was with a grant from the Medical Research Council of Ireland that it had been carried out. It was natural, too, that I should wish to see the clinical trials, in the first instance at least, conducted in Cork Street Fever Hospital, Dublin, where I had been introduced by Dr. McSweeney to the clinical aspects of hypertoxic diphtheria and where such a trial would, I felt, be carried out to perfection. In these circumstances I considered the possibility of entering into an agreement with a firm engaged in the manufacture of antitoxin whereby they would have six months knowledge of my work prior to publication in return for which they would endeavour to supply the avid type of antitoxin for clinical trial by Dr. McSweeney.

The work I have recounted to you was all completed in 1939 and about the time that I was considering the next step I was invited to London for consultation with representatives of a firm engaged in the manufacture of antitoxin. The consultations were conducted in such a manner as to suggest that a true spirit of co-operation could be engendered. When I mentioned, therefore, that I was considering an agreement relative to the production of an improved type of diphtheria antitoxin, I was asked to give preference to the firm whose representatives I was meeting and to recommend them to the Medical Research Council of Ireland. I was promised every possible assistance. Conditions, therefore, appeared favourable to my project for putting my hypothesis rapidly to the test, and after I had acceded to a request from the firm to extend the period to a year instead of six months, a formal agreement was entered into between the firm, the Medical Research Council of Ireland, and myself.

Under this agreement, instead of publishing at once my paper, which appeared in the "Journal of Pathology and Bacteriology" in 1940, I allowed the firm prior knowledge of its contents for a year. The paper is published exactly as it was written in 1939 a year before publication, except for such usual alterations as are made in editing. It was in the hands of the editor of the Journal during the interval. Owing to circumstances which I need not recount, it became impossible for the agreement to bear the full fruit which might have been expected and for which I had hoped.

Early in 1940, however, I visited the serum department of the firm and arranged that a horse which was undergoing immunisation by the ordinary methods should be selected on account of the avidity of its antitoxin and that the immunisation should not be pushed too far. It was well known to me that horses often give an avid serum early in immunisation, and that as they become hyperimmunised the avidity of the antitoxin declines. This is in accordance with what would be expected to occur if toxin is composed of two substances, since early in immunisation the animal would respond to both elements in the toxin and later only to that which was in great preponderance over the other. The serum of low potency concentrated to retain its avidity was to be sent to Dr. McSweeney for clinical trial. Before the clinical trial I tested it and found it to be highly avid, giving a dilution of 1·2. It was possible to forecast, therefore, to the Medical Research Council of Ireland

and to Dr. McSweeney that the special antitoxin would have a greater therapeutic value than ordinary commercial antitoxin, since the dilution ratio of commercial antitoxin is 1.0 or less.

The amount of serum which became available for clinical trial was small, but its effects were striking. It was used only on cases of the severest toxic type, selected by Dr. McSweeney in the light of his great experience, and sixteen of these were treated, with only one death. Two features of the clinical trials were particularly noteworthy. One was the excellent response evoked by doses much smaller than the 120,000 units of commercial antitoxin usually given to such cases with little effect. One-third to one-eighth of the amount was enough. The other feature was the marked and rapid improvement following administration of the antitoxin. The membrane separated rapidly, and cardiac complications, inevitable in this type of case treated with the usual antitoxin, failed to materialise. It was quite apparent that one was dealing with the same order of response to that obtained by Roux, Martin, and Chaillou with small doses of serum in their toxic cases in 1894.

When the horse from which the serum was obtained was further immunised the expected happened. The antitoxin lost its avidity as the antigen rich in Substance A and deficient in Substance B continued to be administered. A further sample of antitoxin taken from the animal was tested by me and found to have a dilution ratio of 1·0, the same as for ordinary commercial antitoxin. Again I was able to predict to the Medical Research Council of Ireland and to Dr. McSweeney that the serum would be ineffective, and this forecast was fulfilled by clinical trial. The results given by the avid antitoxin could not be elicited with the non-avid antitoxin taken from the same horse at a later stage of immunisation. Twenty cases were treated with it, and of these eight died, although they received full doses of 120,000 units.

The hypothesis of two constituents in diphtheria toxin and two corresponding constituents in antitoxin had, therefore, been elaborated from first principles and put to the test of clinical trial with success. Powerful support had also been obtained for that body of opinion which has maintained that the curative power of antitoxin and its unitage do not run parallel. Roux pointed out this fact in 1900 and Cruveilhier in 1905. Kraus and his associates, more especially Kraus and Bæcher in 1913, reverted to the problem with a suggestion that the curative power of antitoxin was related to the rate of neutralisation of toxin by antitoxin rather than to unitage. To this property the name avidity was first given, but it is now used to denote firmness rather than speed of combination, following the work of Glenny and his associates. As time went on, the clinical aspects of the subject received diminishing attention, until eventually the laboratory unit became generally recognised and received the sanction of law, so that those who maintained that it was not a true measure of therapeutic efficiency had to cease being vocal.

Since the original work was published I have, in conjunction with my colleagues in the School of Pathology, advanced further on the road to the production at will of a therapeutically active antitoxin. Reference to some of our results which will later be published in full may be of interest. Dr. McNally and I have found, for

example, that the hypertoxic form of diphtheria may be reproduced in guinea-pigs by the injection of sublethal doses of Park-Williams No. 8 toxin in combination with sublethal doses of other bacterial toxins such as those of *staphylococci* and *Cl. welchii*. This result suggests that other bacteria produce a factor corresponding to Substance B. Testicular extract has also been successfully used to fulfil the same rôle. In view of McClean's statement in 1941 that only a small proportion of diphtheria bacilli produce detectable amounts of diffusing factor, Dr. Baker, Dr. Balch, and I have investigated the question in two separate series of fifty strains isolated from throat-swabs of cases, sent to the laboratory for diagnosis. We have found that, with one or two possible exceptions, a diffusing substance was produced by all. McClean appears to have been influenced in his opinion by his failure to demonstrate the production of hyaluronidase by diphtheria bacilli. Hyaluronidase is an enzyme which hydrolyses the hyaluronic acid present in the mucin of synovial fluid, vitreous humour, umbilical cord and skin, and, as shown by Chain and Duthie in 1939 and 1940, acts as a spreading factor. It has been shown by Hobby, Dawson, Meyer, and Chaffee in 1941 that other substances beside hyaluronidase can cause spread in the tissues so that the failure to demonstrate hyaluronidase in diphtheria cultures cannot be interpreted as meaning that diphtheria bacilli produce no spreading factor. It is a matter of simple experiment to demonstrate that they do, and there is ample evidence to link this spreading property with the behaviour of Substance B.

We have also begun the immunisation of horses with antigens high in content of Substance B relative to Substance A, in order to obtain sera which will be therapeutically active in the treatment of the toxæmia of diphtheria.

We may now turn to a consideration of the present position of diphtheria prophylaxis. When diphtheria prophylaxis was first introduced, it was expected that its application would rapidly lead to the eradication of the disease. It is now recognised, on the other hand, that cases of diphtheria not infrequently occur among those who have been artificially immunised, although a notable degree of success in the reduction of the incidence of the disease appears to have been achieved by immunising agents in certain areas. The application of prophylactic measures has been most complete in the United States of America and in Canada, where, in some cities at least, a marked reduction in incidence has followed the intensive application of immunisation. In Toronto it has proved its worth, as nowhere else, since in 1940 there was not a single case of diphtheria in the city where ten years previously there had been more than a thousand cases annually. The American experience must, however, be viewed in the knowledge that diphtheria on the North American continent has always been of a mild character. The *gravis* type of diphtheria was unknown there, until in 1941 it was reported that a number of cases occurred in Halifax, Nova Scotia, the infection presumably being imported by evacuees. Whether there have been any further outbreaks it is not possible to say at the present time.

In areas in which diphtheria has been of a severe character and associated with a high incidence of toxæmia, the occurrence of cases in the artificially immunised

is comparatively common. The relevant proportion in which these cases occur is difficult to estimate owing to the faulty methods used in the presentation of official statistics which have a bearing on the point. It is useless, for example, to state that in a certain area so many cases have occurred, mentioning a large number, and that a small number, also mentioned, were in immunised individuals. One has to know the relative incidence in the two groups in order to be able to form a proper estimate of the value of immunisation. The only reliable published work in relation to the statistical aspect in an area in which the disease has been severe is that of Glover and Wright in 1942. They found that in the Liverpool area, immunisation undoubtedly conferred protection, but were not satisfied that it was as effective as might be expected. So many factors have to be taken into consideration, that it is most difficult to arrive at definite conclusions, but I must refer to the statistical study of diphtheria in Dublin shortly to be published by my colleague Dr. J. C. Gaffney of the School of Pathology, Trinity College. In addition to studying the trend of diphtheria in Dublin over a long period of years, Dr. Gaffney has attempted to form an opinion concerning the influence which immunisation has had and is likely to have on the disease. Circumstances were favourable, since in 1941, owing to a big immunisation campaign, the proportion of chidlren under 15 who had received immunising injections was raised to seventy-five per cent. Dr. Gaffney found that immunisation had a definite protective influence but that the likelihood of contracting the disease after immunisation varied with the severity of the disease prevalent at the time. Assuming that the incidence in the immunised was the same as that in the non-immunised, it was possible to calculate a figure for "expected" cases. This represented the number of cases which might be expected to occur each year in the immunised group if immunisation had no protective action. By comparing this figure with the actual number of cases occurring in each year in the immunised group, a good indication of the effectiveness of immunisation as a means of lowering the incidence of diphtheria could be obtained. The ratio of expected to actual cases varied from 2.8 to 1 to 9.9 to 1, showing that in some years the influence of immunisation as a means of prophylaxis was of a low order. The author was able to conclude from his study that, in spite of the fact that seventy-five per cent. of the children were immunised, a wave of diphtheria was due to strike the city. His conclusion has had remarkable confirmation, since in the first two months of this year there have been 283 notifications—a number greater than previously recorded in any year. Many of the cases are in immunised children.

There is not much doubt that the use of prophylactics lowers the fatality-rate in those who contract the disease after immunisation. Accurate statistics are again difficult to obtain, and the extent to which the fatality-rate is lowered cannot, therefore, be readily assessed. It will take further investigation over a longer period to decide this point in a manner acceptable to the medical scientist.

The finding that the incidence of diphtheria among the immunised varies with the prevalent severity is what may be expected from the use of the current prophylactics. They are prepared from the toxin of the Park-Williams No. 8 strain.

The two guiding principles in their production are to ensure that they will give the maximum response to the guinea-pig lethal or Substance A factor of toxin on injection and that they will cause virtually no reaction in the inoculated subject. The second aim is probably not entirely compatible with the establishment of complete immunity by artificial means. It has to be borne in mind that the majority of the population in an urban area fail to contract diphtheria, although exposed to risk equally with those who do. Instead of contracting the disease, they become firmly immunised by natural processes which it should be our aim to imitate as closely as possible. Too much insistence on the avoidance of reactions, as I pointed out in 1939, has led to the abandonment in these countries of the use of formol toxoid, the only prophylactic which could be regarded on theoretical grounds as providing a prospect of complete success in immunisation, by reason of the fact that it is a preparation incorporating the whole toxin of the diphtheria bacillus. The Toronto experience with formol toxoid, used, it must be emphasised, in accordance with the highest scientific principles, is a lesson to be studied, even allowing for the fact that the diphtheria prevented was of a relatively mild character.

The other prophylactics, toxoid antitoxin floccules and alum-precipitated toxoid, may be regarded as partial antigens in the sense that their emphasis is on only one fraction of diphtheria toxin, namely Substance A. The introduction of alum-precipitated toxoid has brought confusion of thought into the whole question of immunisation. Alum-precipitated toxoid was originally suggested as a prophylactic agent because it was believed that it would provide a rapid rise in antitoxin titre with only one or at most two injections. The possession of this property would be the sole excuse for introducing an insoluble precipitate into the tissues with a view to conferring immunity, and is the only argument which could be employed in its favour. As alum-precipitated toxoid has failed to achieve the result expected of it, the suggestion has recently been made in the editorial of the "British Medical Journal" referred to previously, that three or more doses should be given. It is thereby admitted that this prophylactic is no better an immunising agent than formol toxoid or toxoid antitoxin floccules, and its use should, on account of its objectionable properties, be abandoned altogether in view of the fact that it has failed in the only respect in which it was believed to excel.

The interpretation of the Schick test as a measure of immunity is also questionable. A negative Schick reaction is commonly interpreted as equivalent to immunity to diphtheria. Scientifically speaking, this interpretation is not correct, since a negative Schick reaction is nothing more than an indication of the presence of diphtheria antitoxin in the blood. It does not allow for the quality of the antitoxin present and is but a rough indication of quantity. Immunity is a much more complex matter than the mere presence of antitoxin in the blood, and experience teaches that the majority of those who are Schick-positive at an early age are also immune because they never subsequently contract diphtheria. As they grow older they undoubtedly become Schick-negative, but there is no evidence to show that they are in consequence more immune than they were earlier in life. The only acceptable test of immunity is failure to contract the disease although freely

exposed at all times to the risk of infection, and this, not the antitoxin content of the blood, must likewise in the present state of our knowledge be the acid test of diphtheria prophylaxis.

In view of the imperfect weapons at our disposal for the eradication of diphtheria, it is of great importance that we should use them to the best advantage. Our present experience shows that it is impossible to confer complete protection on all susceptibles by one, two, or three injections only of the available prophylactics. In consequence, promises of protection from the usual two or three injections are harmful because they are misleading both to parents and to the general practitioner on whom the onus of diagnosis falls if the disease be contracted later. Until such time as more effective prophylactics can be prepared, an attack on diphtheria to be completely successful must necessitate repeated injections of the existing prophylactics during the most susceptible period of life, say between the ages of six months and ten years. Such a series of injections would start with a course of prophylactic, preferably formol toxoid, at an early age, and subsequent injections would be administered in succeeding years, their number being determined by experience rather than reliance upon the Schick test. It is possible that diphtheria may be abolished if the current prophylactics be employed in this way. The available evidence does not suggest that less will do.

With this plea for a more consistent outlook on the problems of diphtheria prophylaxis I must end. I look forward to the time when the outstanding questions of diphtheria will be viewed in a scientifically detached spirit unfettered by questions of policy and opportunity. If I have appeared to speak very plainly, it is because I speak professionally and in memory of one who was esteemed as an outstanding ornament of our profession. We of the Irish medical schools have a great tradition to uphold, and it has been our pride that we have always refused to accept what is contrary to reason and observation irrespective of its sponsors. Robert Campbell upheld the traditions of Irish medicine in their best form during his lifetime. He was, moreover, devoted to children and never spared himself in his efforts to improve their health and happiness. Diphtheria is primarily a children's disease and annually takes its heavy toll from among their numbers. It is our duty to see that we do not fail them.

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THE ROYAL MEDICAL BENEVOLENT FUND SOCIETY OF IRELAND

BELFAST AND COUNTY ANTRIM BRANCH

THE honorary secretary and treasurer of the Branch begs to acknowledge with the warmest thanks of the chairman and Committee, donations and subscriptions for the financial year ending 30th April, 1943, amounting to £283. 10s. 6d. For the second year in succession gifts have exceeded the amount of the grants made to widows and dependants, and this had not been the case for many years. Five subscribers have become life members, but intend to continue their annual subscriptions, and twelve new subscribers have been enrolled. There are, however, still some hundreds of medical men and women in Belfast and County Antrim—as in other parts of the country—who, as yet, give nothing to this our own charity.

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Medical Students and the Teaching of Midwifery

By C. H. G. Macafee, M.B., F.R.C.S.(ENG.), F.R.C.S.(I.), F.R.C.O.G.

Opening Address, Royal Victoria Hospital, Belfast, Winter Session, 1942

LADIES AND GENTLEMEN,

As a member of the Honorary Medical Staff it is my pleasant privilege to welcome you at the opening of the winter session.

I regret that for the fourth year in succession the orator has to address you with the country still at war. It is the hope and prayer of all that my successor can speak to you with a world at peace.

You are students of a hospital which, while young in years, is old in traditions of work and achievement, and it is for you to add to those traditions.

It has been said that history, which appears to be the story of great men and famous occasions, would have only chaos to chronicle were it not for the fidelity and good work of multitudes of men and women whose name no man remembers.

The history of a teaching-school probably depends on the great men of that school, but its daily reputation depends on the hundreds who work within its walls and leave its precincts with their services unrecognised.

The reputation of this hospital is always in your hands, not only as students in your daily contact with the sick in the wards and out-patients, but also as house surgeons and house physicians, and later when you leave us to go into whatever branch of medicine you select.

Many of our past students are serving with His Majesty's Forces, and we are justly proud of their achievements. Some of them have lost their lives in the country's service. We honour them, mourn them, and sympathise with those who have been bereaved. Others would have been preparing for higher degrees to qualify themselves for hospital appointments. For them also the sacrifice is great.

The Honorary Medical Staff is still under strength as the result of the absence on active service of four members—Lieutenant-Colonel J. T. Lewis, who, unfortunately, is a prisoner of war; Surgeon-Commander R. S. Allison, Surgeon-Commander F. A. Maclaughlin, and Major C. A. Calvert. In addition, the following members of the auxiliary staff are also serving: Lieutenant-Colonel Howard Crozier, Lieutenant-Colonel Ian Fraser, Surgeon-Commander H. E. Hall, Major J. C. Davison, Major J. Houston, Major David Craig, Surgeon-Lieutenant W. Lennon, Major Eric McMechan, Major R. W. Strain, and Captain D. J. C. Dawson. Their absence has naturally increased the difficulties of clinical teaching, and we hope that circumstances will soon permit of their return.

In the past year death has deprived us of two colleagues. Dr. J. S. Morrow, a member of the active and consultant staff since 1903, died in April of this year. As a physician on the active staff for twenty years, he gave of his best to the hospital. During the last war he served in the R.A.M.C. on the hospital ship Britannic, and during this war, in spite of failing health, he rarely failed to fulfil his duty as

medical adviser to the firm of Harland & Wolff by acting as medical officer on newly equipped ships undergoing trials at sea under war conditions. In many ways Dr. Morrow was a remarkable man. As an after-dinner speaker and raconteur he had a style all his own, and his reminiscences of the earlier days of this teaching school were instructive and amusing. His call, as he would have wished, was sudden, within sight of the Mourne Mountains, near which he had spent many happy holidays. To his devoted wife we tender our deepest sympathy.

The death of Lieutenant-Colonel A. B. Mitchell on 3rd September means the removal of a landmark in the history of this school. He was associated with this hospital without a break for fifty-two years. His long and varied life formed a link between two important epochs of medical history. He had the experience of knowing men like Pasteur and Charcot and of having been a pioneer in the earlier days of aseptic surgery. I have heard him describe himself as a "lucky man." Many men are lucky without having the ability to benefit either themselves or others. Fortunately, "A. B.," as he was popularly and affectionately known, had this ability. In addition to being a brilliant surgeon, he was a skilled and unselfish teacher who encouraged his junior colleagues to emulate and excel him. He has left behind him pupils who have not only enhanced the reputation of this hospital as members of its staff, but in this way have added to his.

Of his public services you are all aware. His activities in sport, surgery, university and hospital administration and in politics illustrate the tireless energy of the man. His true worth will be only appreciated when the history of his time comes to be written. To his wife and family we extend our deepest sympathy.

To some at the present time this annual function may seem purposeless and time-consuming, but the addresses of my predecessors have been such valuable contributions to the annals of this school that, for this reason alone, the address fulfils a useful purpose. For myself I should prefer to be a member of the audience rather than try to emulate the addresses of those who have gone before me.

In proposing a vote of thanks to a previous orator, the late Dr. Maitland Beath said that an opening address might take the form of a sermon, an address on some subject of general interest associated with medicine, or on some subject in connection with the speciality to which the orator belonged.

I do not feel old enough or experienced enough to give you a sermon. I belong to that small repressed but irrepressible group of the staff, the gynæcologists, a representative of whom may stand on this platform only once in six or seven years.

I feel therefore that I should be failing in my duty if I did not take as my subject one which had special reference to the branch of medicine which it is my privilege to practise.

A physician of this hospital once said that the obstetricians had boosted their subject until they had raised it to a level that was far above its importance. I disagree with this opinion, and I propose to take as my subject this morning "Medical Students and the Teaching of Midwifery." Perhaps when I have finished you will appreciate the necessity for any boosting that has been done and

the debt we owe to our predecessors for advancing our subject to its present deservedly important position.

The Art of Obstetrics is age-old, and death in childbirth as old as recorded history, but the recognition of the necessity for any instruction in its conduct or pathology is of relatively recent origin.

The records regarding the teaching of midwifery are remarkably meagre, but it would appear that up to the beginning of the eighteenth century any teaching carried out was restricted to Paris and was largely for the benefit of midwives. In the seventeenth century the French hospitals, particularly the Hotel Dieu, had opened their lying-in wards for the instruction of both male and female students, but it was not until 1720 that Gregoire the Elder founded the first obstetrical clinic for teaching purposes at the Hotel Dieu.

Prior to this date men had practised midwifery in France probably as the result of the example of Louis XIV, who entrusted Jules Clement with the care of one of his mistresses at her confinement in 1663.

It may seem strange to a present-day audience that I have taken the trouble to note that men practised midwifery in the seventeenth century, but although Soranus in the second century taught and practised the care and assistance of women in labour, this custom disappeared two centuries later, and for over twelve hundred years the practice of midwifery was not only ignored by the physician, but his participation in it actually prevented by law.

This exclusion of men from the study of childbirth had risen to such fanatical heights that a Dr. Wertt of Hamburg, in 1552, put on the dress of a woman to attend and study a case of labour. On being detected he was burnt to death.

The antipathy to men-midwives may have been due to the fact that parturition was looked upon as a normal physiological function—a function to which women should only attend women. In dealing with abnormalities, the midwives were so ignorant that they were of little use, and the physicians were little better, as they were precluded from the necessary preliminary training and experience of normal cases.

We have few records of the nature of the teaching in the Paris hospitals, but from those in existence it would appear that the facilities were poor and the quality of the teaching indifferent.

For example, we read that Ambrose Pare's (1510-1590) interest in midwifery was probably aroused "in the Hotel Dieu, where the abominable practises of many of the midwives must have filled him with horror." In 1659, in Paul Portal's (1630-1703) time, the lying-in pavilion in the Hotel Dieu is described as "a semi-basement room having windows on one side, and so damp from the periodic overflow from the Seine that in 1660 other quarters were found."

It is also stated that at this period the ward was dangerously overcrowded, four or five women being in the same bed. The beds, I understand, were four and a half feet wide, but is it any wonder that in one epidemic of puerperal sepsis in this ward only one woman in twenty survived?

The training of midwives in France was largely done by the apprentice system, and it was not until 1745 that Jean Astruc (1684-1766) was appointed to give a course of lectures to the midwives and their pupils. This was recognised as a new departure in French medicine, although for nearly a century before this doctors wishing to study midwifery were compelled to seek obstetric experience in France. As Sir Feilding Ould, a contemporary practitioner, said, "the opportunities that are there met with, are no where else to be found, without which it is hardly possible to be an Adept."

The teaching of midwives in Paris during the latter part of the eighteenth century was well in advance of the age, and with the foundation of the Paris Maternité at the close of that century, the midwives received instruction for twelve months from both the Professor de l'Ecole a'Accouchment and the Sage Femme en Chef, and at the termination of this time they had to pass an examination before being permitted to practise.

The medical student, on the other hand, appears to have been neglected. When Smellie visited Gregorie's Clinic in Paris in 1740 he expressed disappointment with the character of the teaching and practice of midwifery in that city.

A pamphlet published in 1750 gives a description of Gregoire's teaching. His course of lectures was divided into two parts, namely Theory and Practice, which together occupied three months.

His theoretical lectures are described "as being indifferent, but his practical ones pretty good, as he relates many cases and makes judicious and good observations." The fees charged for Gregorie's lectures are also recorded. " The expense is eight livres to see him deliver a natural case, eighteen to see him turn and deliver by the feet, one guinea if he delivers by instruments, and if a pupil delivers any unnatural case, he pays two guineas and the same for a course of lectures."

About the middle of the eighteenth century an edict of the French government closed the Hotel Dieu to medical students on account of their indecent behaviour. The students had evidently forgotten the advice of Pierre Dionis, who laid down the attributes necessary for the surgeon who practises midwifery. He states " Surgeons ought to be well-bred men, skilful and able in their profession; but especially those who practise midwifery. Clownishness is somewhat pardonable in an Army, Town, or Hospital Surgeon, but 'tis intolerable in one who has to do with Ladies, who value themselves upon being more nice than men, and who are apt to be affronted, if he commits the smallest blunder, or drops but one unguarded Expression. . . . He must make no remarks upon what passes in time of Labour; and in a word he must shew himself a perfect honest Man, who squares all his Actions by the Word of God. He must therefore be virtuous, of a sweet temper, affable, full of compassion, and always contented with any handsome or moderate fee that is given him."

Mauriceau (1637-1709) in dealing with this subject also mentions that "He ought to have a pleasant Countenance and to be as neat in his Clothes as in his Person." But he adds "Some are of opinion, that a Practitioner of this Art ought on the

contrary to be slovenly, at least very careless, wearing a great Beard, to prevent the occasion of the Husband's Jealousy that sends for him."

The closure of the Hotel Dieu had repercussions not only in France but also in neighbouring countries. In France it meant that the great central fountain of obstetrical teaching dried up and that individual teachers of varying skill and knowledge competed for the available students.

Tolver, a London practitioner, describes the competition between two teachers Levret (1703-1780) and Payen. The latter evidently conducted his classes at a cheaper rate than the former. Tolver's description of Payen's classes is rather quaint. He says "Here barbers, women and regulars promiscuously assemble and are present together on all occasions. A circumstance very disgusting to the gentleman, and frequently repugnant to the delicacy of the Briton. There are, however, advantages attending this course that induce many to begin with him before they go to Mr. Levret; such as frequent opportunities of touching and real deliveries."

The so-called "Touching lessons" were held each week, and each student present could examine every case. For this the student paid six sous to the patient, and, as Tolver says, "it is in his choice to do the whole number present or as few as he pleases, agreeable to his pocket or inclination."

The midwives of Paris made a business of supplying cases for the students to deliver privately, and the charge for this varied according as the student watched the midwife deliver or he delivered the case himself. If he delivered an abnormal case he paid the midwife double the fee for a natural delivery.

This semi-apprentice system was similar to that which had been in vogue in England for many years.

In the British Islands the closure of the Hotel Dieu in the middle of the eighteenth century had also an important effect. At this period in England the practice of midwifery was almost entirely in the hands of midwives, and the only method by which a student could receive instruction was by apprenticeship to a recognised practitioner. Naturally, the quality of the teaching was poor, as the teacher himself had never been taught.

In the early part of the eighteenth century the position of midwifery in London was deplorable in the light of present-day standards or even compared with Paris at the same period. It was not until 1724 that there is any record of lectures to students, and these were delivered by a Dr. John Maubray. In his advertisement of these lectures he states "but because the theoretical part is not altogether sufficient for the full instruction of such as design to apply themselves in this way, the doctor proposes also to find them that enter as pupils proper subjects and sufficient opportunities for practical experience. . . ."

He also stated that he had "at great expense and trouble provided a sufficient number of pregnant women upon whom the student would occasionally, perhaps once a week, practice the touch; and when the women fall in labour the students would have the performance of the deliveries every one in his turn." There is no record of the fees charged to recompense him for "his great expense and trouble,"

but his course "consisted of twenty private lectures given every Tuesday and Friday in his house in New Bond Street." Maubray stated that the "Two courses may be sufficient to qualify students and dutiful hopefuls. [The distinction is not quite clear.] Thus in four to five months' time he may accomplish and perfect himself in this our noble art of midwifery."

While being far from a scientific or accurate teacher, Maubray must be remembered for two facts, that he was the first British obstetrician to lecture to students and he was the first to advocate the institution of hospitals for lying-in women.

In spite of this effort by Maubray it was twelve years later, in 1736, that a Mr. John Douglas wrote a pamphlet in which he expressed surprise that "Whilst other departments of surgery have been practised and improved by men, the operations necessary for the safety of women in labour, and their children; operations of more consequence to mankind than all the rest; operations so often wanted, so difficult many times to perform, and upon which always two, and sometimes more lives depend, seem to have been left to a parcel of ignorant women or to men little better qualified than they." The importance of this pamphlet is in the suggestions made by Mr. Douglas for the improvement of midwifery practice.

He advocated (1) Proper courses of instruction for midwives, (2) The establishment of a maternity hospital in London to accommodate two to three hundred poor women at the public expense to be used for the teaching of midwives, (3) A final examination before a certificate to practise is granted, and (4) That the same procedure should be set up in the principal towns in the kingdom. There was, however, no mention of the medical student in this scheme.

It is during the next few years that the effect of the change in the position of the Paris obstetrical school becomes apparent.

In London in 1739, three years after Douglas's pamphlet, a lying-in hospital was started in Jermyn Street by Sir Richard Manningham (1690-1759). This hospital was situated in a rented house close to Sir Richard's consulting-rooms in the same street, and was the forerunner of Queen Charlotte's Hospital. This was the first attempt to segregate lying-in women in a public charity and to provide clinical institution for students, doctors, and nurses which had ceased to be available in suitable form in Paris. The same year saw the arrival in London of William Smellie (1696-1763).

The many able and merited tributes paid to the memory of William Smellie render further praise from me unnecessary. But no history of the teaching of obstetrics would be complete without some reference to his work—work which earned for him the title of "Master of British Midwifery."

Smellie, born in 1696, practised as a general practitioner in Lanark for nineteen years. Confident in his abilities, he moved to London in 1739 and visited Paris in 1740. In 1741 he established himself as a practitioner and teacher of midwifery in London. This date marks a new era in the teaching of obstetrics in these islands.

The science of obstetrics was not seriously taught until after 1741. After this date the influence of Smellie's methods began to be felt.

His method of teaching was largely practical instruction at the bedside of poor women in the slums in London, but he also gave systematic lectures. These lectures, with his Anatomical Tables, run to 456 pages, and one finds that many of the obstetrical manœuvres, recommended by writers of the present century and to which their names are appended, were advised and practised by Smellie as long ago as 1752. The beautiful and accurate drawings, taken from dissections made by himself, would enhance any modern obstetrical work. His course consisted at first of twelve and later of eighteen lectures. The fee for one course was three guineas; for two courses, five; for two months or four courses, nine; for three months, twelve; for six months, sixteen; and for a year, twenty. The student had also to pay six shillings towards a fund for the support of the poor women, and a sum of from five to ten shillings for each case personally attended. And yet he was accused of undercutting his colleagues.

The thoroughness of his method of teaching is revealed in the following remarks taken from the preface to his lectures. "Nor will the reader, I hope, imagine . . . that this treatise is cooked up in a hurry, when I inform him, that about six years ago I began to commit my lectures to paper, for publication; and from that period have from time to time altered, amended, and digested what I had written, according to the new lights I received from study and experience."

His teaching was obviously appreciated, as he attracted large numbers of students and doctors. In the course of ten years he had attended and instructed his pupils in 1,150 cases, had had 900 pupils, and had given 280 courses of lectures.

This man, who contributed so much, gave the following admonition at the conclusion of his historical introduction to his lectures : "We find," he says, "among the ancients several valuable jewels, buried under the rubbish of ignorance and superstition; because the assistance of men was seldom solicited in cases of Midwifery, till the last extremity; and those disadvantages being considered, we ought to be surprised at finding so many excellent observations in the course of their practice; and be ashamed of ourselves for the little improvement we have made in so many centuries, notwithstanding our opportunities and the advantages we had from their experience."

In addition to training students, Smellie evidently trained midwives as well, because in describing one of his cases he says : "Mrs. Moore, now Simpson, whom I had taught, and kept on purpose to attend all the labours with the pupils in the teaching way, was first called. She had assembled about ten of the gentlemen."

In his book of lectures he devotes a section to the qualifications necessary for doctors, nurses, and midwives. Of the nurses he says, "Nurses, as well as midwives, ought to be of middle age, sober, patient, and discreet, able to bear fatigue and watching, free from external deformity, cutaneous eruptions and inward complaints, that may be troublesome or infectious."

As a clinical observer, practical teacher, skilful operator, and author, Smellie's contribution to the knowledge of the theory and practice of midwifery is outstanding. The impetus he gave to the teaching of midwifery in London was probably responsible for the establishment of some of the lying-in hospitals of the period.

No reformer is free from criticism, and the severity of the criticism is often in direct proportion to the value of his work.

Smellie was attacked for his reforms in the methods of teaching and practice of midwifery from many quarters, but, as one would expect, the most severe criticism came from his colleagues and the midwives. The midwives were particularly vicious in their attack. One famous London midwife, Mrs. Nihell, in a pamphlet attacking Smellie, referred to him as "a great horse godmother of a he-midwife." This attack by the midwives appears to have been most unjustifiable, as no one recognised better than he the value of a skilled midwife, and this fact is frequently illustrated in the descriptions of his cases.

Spencer in referring to Smellie makes the following remarks:—"Without powerful friends to help him, without the advantages of a hospital clinic, but attending and teaching in the homes of the poor, by sheer devotion to his art, he raised himself to the foremost position in his profession, which he enhanced by many original contributions."

From 1736 to the end of the eighteenth century teachers of midwifery in the main centres of the British Isles realised the necessity of not only providing accommodation for the parturient woman, but also instruction for the medical student. As a result of the efforts of many prominent teachers, we find maternity hospitals being established in the principal cities of the kingdom.

Of the maternity hospitals founded during this period, the Rotunda was the second and our own the sixteenth.

In London, following the establishment of maternity hospitals and the institution of clinical teaching in them, John Leake (1729-1792) appears to have been an outstanding teacher. He established the New Westminster Lying-in Hospital in 1765, and allowed what he described as "ten-guinea pupils" to attend for clinical instruction. When two or more pupils entered at the same time, the fee was nine guineas. He also announced in all probability the appointment of the first obstetric house surgeon in Great Britain. This officer was entitled to what Leake called "privileges extraordinary," which included "a double share of labours" and the attendance at all "Praeternatural and laborious labours as Dr. Leake's assistant."

I have mentioned this as probably the first instance of an obstetric house surgeon in Great Britain, because eight years previously assistant masters had been appointed in Ireland in the Rotunda.

The assistant masters were thus the first resident obstetric officers in the British Islands.

Edinburgh has the distinction of having appointed the first professor of midwifery in 1726. In this year a petition was presented to the Town Council by a Mr. Joseph Gibson, a surgeon of Leith, regarding the advisability of instituting a professorship of midwifery. His petition also stressed the importance of preventing other than licensed surgeons, who possessed the requisite knowledge, from practising midwifery in the city. He also requested that in future all midwives intending to practise midwifery in the city after that date should be required to hold a similar

licence. The Town Council passed an act in conformity with Mr. Gibson's petition, and he was appointed City Professor of Midwifery.

This act was a monument not only to the foresight and enterprise of Mr. Gibson, but also to the thrift of the Town Council, as it stated "that it should be expressly provided that he should have no fee or salary from this city out of its patrimony or revenue on account of his said profession."

Gibson was the first and only City Professor (Professor 1726-1739), as all his successors have been University Professors. The distinction between Dr. Gibson, as city professor, and his successors as college professors, was probably due to the fact that the College was for male students of medicine, and obstetrics was almost exclusively in the hands of midwives. It was, therefore, not considered necessary to teach medical students the art and science of obstetrics. Neither Gibson nor his immediate successor, Dr. Robert Smith (Professor 1739-1756), the first University Professor, appears to have given any lectures to students, and it was not until the appointment of Dr. Thomas Young in 1756 (Professor 1756-1783) that lectures in midwifery were instituted in the University.

Dr. Thomas Young was the first teacher of medical students in Edinburgh, and he occupied the chair for twenty-seven years. He was one of a group of brilliant men associated with the University at that time, and his teaching influenced the practice of midwifery not only in Scotland but in other countries.

Wm. Drennan, the Irish patriot, writer, and doctor, whose sister Mrs. McTier was instrumental in founding our own maternity hospital, was taught by Thomas Young.

In his lectures to students he gives the following advice regarding reading and note-taking, which is as good to-day as when he gave it: "So you must not only take the assistance of these cases you read, but of those which happen to yourself; and I can assure you the one who writes down his cases will have more experience at the end of 5 years than another who does not will have at the 10 hundredth."

It was also as the result of Dr. Young's efforts that parturient women were admitted to the Royal Infirmary. The record of this reads as follows: "About the year 1756 a ward in the attic story of the hospital, by permission of the managers, but at Dr. Young's expense, was fitted up for four lying-in women, or as many more as Dr. Young could accommodate, each exceeding the number of four, paying sixpence a day to the house." The thrift of the managers of the Royal Infirmary was even more marked than that of the Town Council!

In spite of Young's efforts to improve the teaching in Edinburgh, it was not until 1833, fifty years after his death, that systematic lectures in midwifery were made compulsory.

Ireland's contribution to the advancement of obstetric teaching in the British Isles in the latter half of the eighteenth century is noteworthy. Kirkpatrick, in describing the conditions of medical practice in Dublin about 1745, states: "The practice of midwifery, however, was in a more deplorable condition than any other branch of medicine. It was almost entirely in the hands of surgeons and apothecaries, being looked on as rather derogatory to the calling of a physician.

In cases of difficulty or danger, a physician might be called in consultation, but his presence must have been more useful for its moral support than for any benefit which his knowledge or experience could afford."

The surroundings and conditions of the poor at the time of their confinement were pitiable, as there was no alternative accommodation to the garrets and cellars in which their babies had to be born.

It was in these circumstances that Bartholomew Mosse opened the first Lying-in Hospital in George's Lane in 1745. This hospital was the forerunner of the Rotunda.

In Ireland Mosse did for midwifery what Smellie had done in England, only he advanced a step further. His name is immortalised as the founder of the Rotunda. Like Smellie, he was subjected to severe and almost libellous criticism. As a result of his efforts he died in his forty-seventh year.

Although he had been such a benefactor to the hospital and city, the minutes of the Board of Governors contain no reference to his great work or even a resolution of condolence with his widow.

While the Rotunda Hospital, as most of us know it, was opened in 1757, it was not until November, 1770, that the suggestion was made that systematic lectures should be begun at the hospital, and from that time this hospital has held a unique position in the practice and teaching of midwifery.

Our own hospital was not founded until 1794. While its contribution to the advancement of the teaching of midwifery at this period was small, in its latter years it has made one of which we can be justly proud.

The admission of medical students to the established maternity hospitals for clinical intruction was not secured without serious opposition. This opposition arose not only from the lay public, but also from members of the medical profession and the midwives.

To give one example; on the institution of lectures at the Rotunda, a pamphlet, written by a medical man and entitled "Reasons against Lectures in the Lying-in Hospital," was published and circulated to the ladies of Dublin. This pamphlet suggested, "That the patients in the hospital were to be subjected to all sorts of indignities in order to afford instruction to a parcel of Brats of Boys, the Apprentices of Surgeons and Apothecaries."

In my presidential address to the Belfast Medical Students' Association last year I referred to the opposition which was raised in this city to the same proposal as recently as 1855.

For the first half of the nineteenth century the position of obstetric teaching was precarious. It was restricted to various large centres, not only in the British Islands, but also on the Continent, and was entirely dependent on the efforts of individual teachers, without any uniformity of standard or central authority.

Obstetric teaching on the Continent at this time did not reach the standard of that in the British Islands, but two important factors must be borne in mind, namely that from 1746 war had not occurred within the boundaries of the British Islands, and that incompetent midwives were being gradually replaced by somewhat

more competent doctors with the conservative attitude of Smellie instilled into them.

In France, following the closure of the Hotel Dieu, there was no provision for medical students at any clinic until 1834, and Arneth, describing his visit to Paris in 1850, found the Paris Maternité was almost hermetically sealed even to distinguished visitors. He states: "Even members of the staff of the institution have to make formal application to the lay directors for permission to take a visitor with them into the Maternite."

In the eighteenth century the state of the teaching and practice of midwifery in Central Europe was even worse than in France.

It was not until 1751 that an obstetric clinic for medical students was started in Göttingen by Roederer (1727-1763), a pupil of Smellie, and no teaching was carried out in Berlin until 1817.

When Semmelweis (1818-1865) was Professor in Budapest in 1855 it is recorded that "In his class of midwifery at one time he had 68 medical students, paying no attention, because midwifery was not a compulsory subject for the degree examination."

The treatment of Semmelweis when he was assistant in Vienna and later Professor at Budapest is characteristic of the narrow outlook of his contemporaries. His doctrine of the cause of puerperal infection was rejected, with the result that surgery had to await the discoveries of Pasteur and Lister twenty years later before the cause of wound infection was recognised.

In his short life from 1818-1865 he performed a great service to the teaching and practice of midwifery and the elucidation of the cause and prevention of puerperal infection, but he "too rashly charged the troops of Error and remained a Trophy unto the Enemies of Truth."

While the conditions in the British Islands were somewhat better, in Ireland alone do we find any real advance.

In the School of Physic in Trinity College, Dublin, there had been a Professor of Midwifery from 1745, but no lectures were given until those of Dr. Fleury from 1761-1769. Following this, there was a long interval before lectures were resumed.

In 1833 attendance at systematic lectures was made compulsory, but it was not until 1867 that the Board of Trinity College made compulsory the production of a certificate of practical midwifery and attendance on six cases.

The establishment of the Queen's University of Ireland in 1849, with its three constituent colleges at Belfast, Cork, and Galway, marks the first attempt at obtaining a uniform standard of teaching with central authority to enforce it. In 1852 an ordinance of the University arranged that lectures on midwifery should be given on four days per week for six months, and in addition candidates must have attended "Practical instruction at a recognised Midwifery Hospital, with the clinical lectures therein delivered, for a period of three months, in a Hospital containing not less than thirty beds; or six months in a hospital containing not less than fifteen beds."

To realise the foresight of those men who decided that these were the minimum requirements, one must remember that it was not until six years later, in 1858,

that the Medical Act was passed and the General Medical Council established. Even to this day (1942) the standard of training required by the Council does not approach that laid down by the Irish Medical Schools in 1852.

The establishment of the General Medical Council in 1858 marks the beginning of a new era in medical education. The Council, however, seems not to have been particularly interested in the teaching of obstetrics.

In England, in 1859, the Obstetrical Society of London presented a memorial to the General Medical Council, petitioning for some improvement in the standard of teaching and examination in midwifery.

In this memorial the Society pointed out that no compulsion was placed on a candidate for a degree or licence to have any practical instruction in midwifery, and of the Examining Bodies in London only the Society of Apothecaries conducted any examination in the subject in the final examination.

In spite of this and also an appeal from Trinity College, Dublin, and the Royal College of Surgeons in Ireland in 1869, it was not until 1871 that any serious attempt was made to improve the existing state of affairs. In this year the Education Committee of the Council proposed the extension of the course in midwifery and that students should attend twenty cases of labour and have practical instruction in gynæcology. In the full Council this suggestion met with serious opposition, and the suggested reform was defeated.

In 1886 a new Medical Act was passed, and for the first time midwifery is mentioned as a necessary subject for qualification.

In 1890 a petition from over three hundred general practitioners was presented to the Council, asking for some improvement in the teaching of midwifery. In it they stated "so inadequate an amount of training in this most important part of medical practice is adverse to the public good and the highest interests of the profession."

As a result of this petition, a resolution, rather similar to that of 1871, was presented to the Council by a Dr. Glover, but again it was defeated. In the following year, 1891, Dr. Glover again attempted to secure the passage of a resolution urging the necessity for examining bodies demanding additional guarantees of practical instruction in obstetrics. His resolution only demanded that the candidate conduct six labours personally and be present at an additional twenty-four. In spite of these modest demands, the resolution was again defeated.

In the history of the teaching of obstetrics, the minutes of the General Medical Council of the years 1871, 1890, and 1891 must stand out as dark pages.

In 1896 the Council made some recommendations which were accepted by many licensing bodies, but the Irish Schools expressed their regret that the recommendations were far below the requirements demanded by the Irish Colleges.

It was not until 1906 that the recommendations which are enforced to-day were ultimately secured, but in spite of that we find that even as late as 1923 the examinations of the Universities of London and Cambridge were declared insufficient, as there was no clinical examination.

The introduction of a clinical examination was only secured after a prolonged

struggle. Edinburgh University had a clinical examination as early at 1873, but in the majority of schools this was not secured until 1908, and was only forced on the Conjoint Board of England by the teachers of midwifery in London as late as 1929.

In the eighty-four years since the establishment of the General Medical Council the teachers of midwifery have had an uphill struggle in their endeavour to improve the status of midwifery.

That struggle has been necessitated by the opposition of their colleagues at the hospitals, the hospital authorities, and those who controlled the universities and examining bodies.

It is of interest to note that in the first twenty-five years of its existence the General Medical Council had no obstetrician as a member, and that during the forty-eight years from 1881 to 1929 only eight obstetricians and gynæcologists served on the Council.

The late Sir Robert Johnstone was one of these. At the moment, of the thirty-nine members comprising the Council, only two are obstetricians; one is Professor Lowry, the other Mr. J. Prescott Hedley.

The physicians who have occupied this platform in previous years have laid stress on the importance of the Church, superstition, and polypharmacy as obstructions to the advancement of medical knowledge. While these have played their part in obstructing progress in the teaching of obstetrics, the greatest obstructionists of all have been the physicians themselves. To a lesser extent the surgeons have also played their part.

As Sir Comyns Berkeley so aptly puts it, " It is a curious thing that those medical practitioners who turn their attention to medicine and surgery, should for all these years have belittled the urgent necessity of students being adequately trained in midwifery. The reason for such an attitude is difficult to understand, but it must charitably be attributed, in part at any rate, to ignorance of the immense importance of this subject to the community."

While ignorance of the importance of the subject may be a charitable explanation, it can scarcely excuse the persecution of the obstetricians which has persisted throughout the ages up to a very recent date.

For example, in 1753 the Royal College of Physicians in Ireland passed a by-law to the effect that no practitioner in midwifery should be examined for a medical degree or for a licence in medicine of the College. Acting on this by-law, the College refused to examine Mr. Feilding Ould, afterwards Sir Feilding Ould and second Master of the Rotunda, on the grounds that the practice of midwifery was derogatory to the dignity of the profession of medicine. This drew from Gilhorne the following verse :—

" Why may not any doctor that would chuse
For man's relief his total knowledge use?
Or does some portion of Apollo's trade
More than the rest his votaries degrade?"

In England an obstetrician could not be a Fellow or Member of Council of the Royal College of Physicians, and at the same time the College of Surgeons would

not admit to the Council or Court of Examiners anyone who had practised midwifery.

In 1825 Sir Henry Halford, President of the Royal College of Physicians, wrote to Sir Robert Peel, saying that no man who had an academic education ought to practise obstetrics.

Following the establishment of the English Obstetrical Society in 1825, which had as its object "to raise to a proper and dignified station the practitioner in midwifery," an address by Sir Anthony Carlisle, Surgeon to the King and the Westminster Hospital, was published in the "Times" of 1st May, 1827. This was addressed to "His Majesty's Judges, Coroners and Justices of the Peace, cautioning them against the worldly designs and the injurious practices of men-midwives," and ended as follows: "It is my firm conviction that the establishment and further prevalence of man-midwifery sanctioned as a branch of surgery would compromise the justice of the country by exposing the lives of Child-bed women and infants to many dangerous and unnecessary operations." In the "Examiner" of June of the same year a letter to the editor appeared, drawing attention to a pamphlet "On the impropriety of man being employed in the business of midwifery." It speaks of the practice as "Most odious, unnecessary and cruel and productive of infinite mischief; cruel to the modest wife and to the sensitive husband," and urges the editors of papers to use their powerful influence to suppress it.

The long struggle in the General Medical Council, which I have mentioned, was waged against the bitter opposition of the physicians. Jellett quotes one eminent medical man who, during this struggle, decried the necessity for any improvement in the teaching of obstetrics on the ground that already more time was devoted to the teaching of obstetrics than to that of ophthalmology, while he said all humanity have two eyes whereas only one part of it has one uterus.

In 1869, John Ringland, President of the Dublin Obstetrical Society, made the following prophetic remarks in his presidential address. "Medicine held no status as a profession until its professors were gathered together as a college; surgery was but a trade—allied and even subordinate to one of the meanest occupations until after the incorporation of its followers into a united body. 'Tis true that midwifery does not now want any extraneous aids to its position, but I maintain that its status can be confirmed and placed beyond the possibility of retrogression by the united action of its professors. . . . Why should there not be a Royal College of Obstetricians as well as of Physicians and Surgeons?"

His prophecy was not fulfilled for sixty years, but in September, 1929, the College of Obstetricians and Gynæcologists was born in spite of the united opposition of the Royal Colleges of Physicians and Surgeons.

"No past event has any intrinsic importance. The knowledge of it is valuable only as it leads us to form just calculations with respect to the future" (Macaulay).

While taking the role of a prophet is most dangerous, there are certain obvious changes which we must face in the future.

The day is past when a general practitioner must do midwifery, however much he dislikes it, to retain a general practice.

The day is also past when a graduate had to embark on general practice with little or no opportunity of receiving practical experience in midwifery. This experience had to be gained at the expense of his patients in his practice, but can now be obtained under supervision in modern teaching maternity hospitals.

The last few years have seen the gradual disappearance of a misconception once prevalent among the lay public and some members of the medical profession, that every qualified practitioner is sufficiently trained to carry out single-handed any obstetrical operation. Now, if he should seek the assistance of an anæsthetist or consultant, it is not regarded as a reflection on his skill, but rather as evidence of his good judgment.

The increased number of institutional confinements has limited the number of cases in general practice, and the vastly improved training of midwives—a length of training which is better than that received by medical students—has again put midwives into competition with doctors.

As a result of these factors it would appear that only a limited number of the medical profession will require or receive the adequate experience and training to deal with obstetrical complications.

The last twenty years have seen great changes in the status of obstetrics, but it is your generation that is most likely to see revolutionary changes in the teaching and practice of the subject.

Already it has been suggested that, after qualification, a graduate should be licensed to practice only in an institution for a period of twelve months. During this time he should receive further instruction in medicine, surgery, and midwifery, being excused the last only if he stated that he did not intend to practise in this branch.

At the present time no graduate is accepted for the Services until he has had six months residence in a general hospital. If this is considered necessary for those who attend what should be the fittest section of the population, how much more necessary should it be for those who attend the civilian population?

This suggested reform sounds revolutionary, but more revolutionary changes have been witnessed, and whether this change is enforced or not, it is clear that all maternity hospitals, and indeed all hospitals, must cater for larger numbers of post-graduate residents as well as under-graduate students.

Under the exigencies of war we have seen the voluntary system disappear in other walks of life, and it is unlikely that the medical profession will remain untouched.

Obstetrics is a branch of the Public Health Services for which in the past the State did not have to pay, and in recent times has only provided a mere fraction of the cost.

If my judgment is correct, the practice of obstetrics will become, in part at any rate, a state service. This will alter the teaching of the subject in a radical manner, as no graduate will be able to enter that service without producing evidence of post-graduate training.

To carry out this training the teachers will have to be mainly full-time officers,

with full-time assistants, because the training of post-graduate students, and indeed of undergraduates also, should be performed by men of experience who are in the position to give this instruction by day or night.

The teaching of midwifery, unlike medicine or surgery, cannot be carried out at set times, as the most interesting and instructive clinical material may present itself as most irregular hours.

Therefore the teacher should be placed in a position where the earning of an adequate income does not interfere with the performance of his teaching and hospital duties.

It seems to me that two great deficiences in this school are apparent—the lack of financial provision for the young consultant between the stage of obtaining his higher degree and receiving a hospital appointment, a stage at which he should be engaged in teaching and clinical research; and secondly, the failure to attract the experienced clinician from private practice to the teaching and research side of his branch of clinical medicine.

To ensure the teaching staff necessary for the changing conditions of to-day and to-morrow, these deficiencies must be corrected.

Every generation receives a vast accumulation of experience bequeathed to it by antiquity, and it is the duty of every generation to transmit that experience, augmented by acquisitions, to future generations.

I have shown you, however imperfectly it has been done, what your inheritance is, and I hope you will not only enjoy it in peace but augment it by your efforts.

Should the orator of 2042 be a gynæcologist, I hope he will be addressing a post-graduate as well as an undergraduate audience, and that he will be able to refer with pride to the contributions of the Belfast School of Medicine to the science and art of obstetrics and perhaps, in particular, to the contribution of some one in this morning's audience. Let it be said of this School: "Its law is progress. A point which yesterday was invisible is its goal to-day, and will be its starting-point to-morrow" (Macaulay).

I have to express my thanks to Dr. T. Percy C. Kirkpatrick of Dublin for not only supplying me with works of reference, but also for his helpful suggestions and reading the proofs of this paper.

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REVIEW

TEXTBOOK OF MEDICINE. Edited by J. J. Conybeare, M.C., D.M. (Oxon), F.R.C.P., Physician to Guy's Hospital, London. Sixth Edition. Edinburgh: E. & S. Livingstone. Price 28s.

IN his preface to the sixth edition, Dr. Conybeare states that "one of the greatest problems of the editor of a textbook with numerous contributors is to prevent a progressive increase in the size of the book with successive editions." Comparison of the first edition published in 1929 shows that he has not entirely succeeded in preventing such an increase; the original book was the work of ten collaborators in 947 pages; eighteen have contributed 1,123 pages in the latest edition. It can be justly claimed, however, that the book retains its admirable qualities of brevity and clearness. Every section is written in simple English, in short sentences, and with scarcely an unnecessary word. The older reader may at times regret that the writer has rationed the fruits of his wisdom and experience, and one at least regrets that the excellent account of acidosis and alkalosis which appeared in earlier editions has been omitted, doubtless because it pertains to physiology and biochemistry rather than to clinical medicine. The following sections have been rewritten: Tropical Diseases, Vitamins, Tuberculosis, Diabetes, and Polyneuritis; new matter has been added on several other subjects. Nevertheless there is the danger that the student may not realize how much is left unsaid. It is easy for a reviewer who has never essayed so formidable a task to make suggestions, but here are two, made very tentatively and with great respect: first, that a short account of the history of a disease, even in small print, might precede its description; and, secondly, that at the end of each section, or by footnote, the earnest student might be given specific instructions as to where to ask for more.

"Conybeare" has established itself as a standard textbook, and well deserves the high reputation it has achieved by six editions in fourteen years.

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Begone Pestilence!

By F. F. KANE, M.D., M.R.C.P.I., D.P.H.

Presidential Address delivered before the Belfast Medical Students' Association

THE ideal of Medicine is the prevention of disease, and in our daily lives each of us is striving towards the goal of health. Everyone is directly involved in the eternal struggle against disease, and happily nowadays people appreciate that the forestalling of it is more significant than its cure or care. Much has been done to rid the world of illness, and the course towards positive health is still largely concerned with the prevention of infection and the avoidance of circumstances favouring infection. The story of the conquest of infectious diseases is a long one, brimful of triumph with much accomplished but still much to be done.

In opening the story, it is proper to recall some of the more serious pestilences of history. Frequently in the Bible is mention made of the pestilence, usually in association with the sword and famine. A thousand years before Christ, in the time of David, an epidemic destroyed seventy thousand persons in three days. We are told in II Samuel 24, that David for a punishment had the choice of seven years' famine, three months of war, or three days of plague, and he chose pestilence, with the results mentioned. It is probable that those amazing early civilizations of Central America disappeared as a result of a "sudden sickness," possibly the first manifestation of the power of disease to overthrow an apparently splendid civilization.

In the eighth century before Christ, Rome was laid low by a terrible epidemic. Some years later 185,000 of the Assyrian army are said to have perished at the siege of Jerusalem, and Italy too was afflicted by this same plague. In the fifth century the army of Xerxes in retreat from Salamis was destroyed by disease. In 452 B.C. half of the people of Rome died in an epidemic, and further outbreaks so ravaged the population that Livy referred to Rome as a city exhausted by continuous burials.

The plague of Athens which began in 430 B.C. and raged continuously for five years, may have been typhus or smallpox, but more probably was the true bubonic plague. An epidemic of 206 B.C. in Italy was preceded by immense swarms of locusts. The Christian era saw many epidemics in Rome, and in the year A.D. 80 more than 10,000 deaths a day occurred. This plague seemed to follow the Roman forces throughout the world, and in the years A.D. 88 to 92 caused 150,000 deaths in Scotland. It has been said that the real conquerors of the Eternal City were not the Goths and Vandals, but the plague and malaria which ravaged it for centuries.

For more than a thousand years after Rome lost her sway the world reverted strongly, and the greatest epidemics of the world occurred in the period known as the Dark Ages. The personal hygiene of the golden age of Greece and the public sanitation of Crete and Rome were replaced by filth, so that disease and pestilence reigned in the forms of plague, typhus, and smallpox. The history of the Dark Ages is one long chapter of war, poverty, famine, and disease. Of these, disease

decimated the population, with famine a good second, and war only a trivial slayer of mankind. Disease and death are the outstanding features of the history of the Seven Crusades from 1097 to 1270, and in a peroid in 1097 from September to November there died from the pestilence one hundred thousand. The one healthy outcome of the Crusades was the establishment of a number of knightly orders to create and maintain hospitals, among them the Hospitallers or Knights of St. John and the Teutonic Knights. The buildings erected by these orders are said to have been equipped with bathrooms and water supplies and with separate tower-latrines flushed by running water.

The epidemic which came nearer to the annihilation of the human race than any other was known as the Black Death, and occurred in the middle of the fourteenth century. This was truly bubonic plague, and removed fifty million people between 1348 and 1720. (The pandemic, or world-wide outbreak, of influenza in 1918, within the memory of some of us, is estimated to have caused twenty million deaths.) One quarter of the population of Europe succumbed to the Black Death, and, apart from this loss of life, the series of epidemics waning to rise again with the advent of a new population of susceptibles affected and changed the social and moral characteristics of the time. In London all houses which harboured plague patients were marked with a red cross and the inscription "God have mercy upon us." In three epidemic years in London over one hundred thousand deaths occurred from plague. As recently as 1907 in India 1,318,880 deaths from plague were registered. England was only freed of the plague by another disaster in 1666, the original great fire of London, which probably burned out the rats now known to be instrumental in carrying the disease. The mortality during the epidemic was so great that there was insufficient consecrated ground in which to bury the dead, and eventually corpses were left to rot in hovel and palace, for no one dared touch them.

In Venice in 1348 is the record of the establishment of the first board of health. This board drew up regulations, and isolated all people and merchandise from the Orient on an island. The period of isolation was for forty days, for no scientific reason, but because that was the duration of Christ's stay in the desert. The forty-day period gives us the modern word "quarantine," from the Italian of "forty."

Other measures against the plague included, in one locality, a law that all concubines were to be expelled or married, and a ban placed on dice, the theory being that these instruments of worldly pleasure brought down the wrath of God. It is said that the concubines promptly got married and the dice manufacturers converted their wares into rosary beads.

The last serious outbreak of plague was in China in 1893, and during this epidemic the bacillus pestis was discovered in the blood and tissues of plague patients. It had been noted that outbreaks of plague in humans were invariably preceded by an outbreak of the disease among rats, and more rarely among other rodents, and that plague rarely spread from man to man, save in the rare pneumonic form of the disease. Attention being directed to rats, who are great

travellers, but at a slow rate, it was suggested by Simond in 1897 that fleas are the intermediary agents for the transmission of the disease from rats to men. An infected rat can harbour as many as one hundred fleas. The rat flea (Xenopsylla Cheopis) is not the same as the human flea (Pulex irritans), but will leave an infected rat when it dies, and will then bite humans. The seasonal increase of fleas is followed by an increase of rodent plague, and by examination of rats in a port for the extent of their infestation with this flea there is derived some measure of the possibilities of plague invasion. Subsequent experiments including the finding that a rat flea only jumps from three to five inches, never six, proved conclusively that plague is spread only by the rat flea, and that by controlling rats, plague can be entirely controlled. In this disease protective inoculation is only of secondary importance as a means of control.

Although the home of cholera is normally India, this disease has in the past spread rapidly westward with disastrous results in the shape of epidemics. Of these probably the most famous was that associated with the Broad Street pump in 1854 in London. It revealed sanitary detective powers of a brilliant order in Dr. John Snow, a member of an official Cholera Enquiry Committee. His preliminary investigations disclosed the apparent localization of the outbreak to the parish of St. James in Westminster. He next found a concentration of the disease around the area of the Broad Street pump, that most of the victims had constantly used the water from this source, and that apart from those imbibing water from this well there was no unusual incidence of cholera. Further weight was given to Snow's indictment of drinking-water as the source of infection by the experience of Hamburg and Altona, towns on opposite sides of the Elbe. The difference in the water supplies to these two communities was the efficiency of the sand filtration of the Altona water before its delivery to consumers, with the result that during two months of 1892 Hamburg had seventeen thousand cases of cholera, while Altona had less than five hundred. Apart from water as a source of infection of cholera, other foodstuffs such as milk contaminated by water, and oysters and other shell-fish derived from sewage-contaminated layings, are rich purveyors of the disease.

This draws us at once to the group of food-borne diseases, including as well as cholera, enteric, dysentery, and the various food poisonings. Public health measures directed against these diseases are designed to secure pure, healthy food supplies and ensure an efficient safe disposal of sewage material. It was in 1872 at Lausen in Switzerland that an outbreak of enteric fever was traced to well-water polluted from a dammed-up sewage-contaminated stream. Further outbreaks of enteric in 1874 at Cambridge and in 1879 at Caterham were traced to fæcal contamination of water supplies. Other water-borne outbreaks of enteric occurred at Blackburn 1881, Worthing 1893, Maidstone 1897. Milk-borne epidemics were recognised at St. Marylebone in 1873, Llandudno 1908, Chorley 1924, and Hertfordshire 1927. This disease is invariably of human origin, and the contamination of the particular vehicle or article of food entailed some fault in hygiene. Modern outbreaks easy of recall are those of Croydon in 1937, where the work upon a new water system allowed a urinary carrier easy access with his wares to the unsuspecting consumers :

those of Poole and Bournemouth of 1936 and Belfast 1936, both of which were spread by milk supplies infected from contaminated water used in the cleansing of the dairy utensils. The eating of shell-fish gathered indiscriminately from sewage-contaminated layings is known to have caused outbreaks of the disease, and some unfortunates have even developed enteric from drinking beer. In this case the source of the infection was traced to the water used for cleansing the tankards. No chronicle of food-borne disease would be proper without mention of a character of the early years of this century, known eventually as "Typhoid Mary." Her standards of personal hygiene may be gauged from her ravages in the capacity of a cook—twenty-six cases of typhoid fever in seven different homes in which she was employed were traced to her products.

The control of enteric infection has been secured by the measures mentioned, i.e., the provision of a pure water supply and the development of a proper sewage-disposal system. Nowadays the enteric rate of a community is regarded as an indication of the enlightenment of the inhabitants in sanitary matters, and our own city is entirely beyond criticism in its control of food-borne diseases. Immunization against the enteric group of infections is available, but is only necessary under the abnormal sanitary conditions likely to be met with in primitive peoples or in time of war. The case for this T.A.B. vaccination needs no further support than the figures of the incidence of enteric during the South African War, as compared with the European War, when the armies were largely protected. In the South African campaign the British Army employed 557,653 men, of whom 57,684 developed typhoid, with 8,022 deaths—more than died to Boer bullets. In the Great War of over four years in six theatres of war, with an average strength of nearly two million troops, there were only 20,149 cases of enteric fever, with 1,191 deaths.

Another food-borne disease with an instructive story in preventive medicine is undulant fever, known also as Malta or Mediterranean fever or abortus fever. As its name implies, this disease was first recognised in Malta, where it affected almost half of the British garrison, and to a lesser extent in Gibraltar. It was commoner among officers and women rather than non-commissioned officers and men, and was not related in any way to sanitary defects. Bruce recognised the organism in the blood of patients, and some years later it was found in the milk of apparently healthy goats. It was shown that at Gibraltar, Malta fever disappeared when, owing to the expense of importation, Maltese goats were no longer available, and Spanish goats were substituted. In 1905 an unintentional human experiment established the fact that goat's milk conveyed the infection. Some sixty milch goats were exported from Malta to America, and as they appeared healthy and were good milkers, the crew of twenty-three drank freely of this beverage. Almost all had acute febrile attacks, several were confirmed as undulant fever, and upon slaughter of the goats on arrival in America thirty-two of them were found to be infected. Nowadays if and when sailors drink goat's milk they first have it boiled as the ordinary citizen does, and undulant fever presents no problem to preventive medicine.

According to the Encyclopædia Britannica, the louse is defined as "a wingless insect, parasitic upon birds and mammals, and belonging, strictly speaking, to the

order of Anoplura;" and yet to our knowledge, this insect has been the means of conveying the pestilence which in the past has devastated cities and transformed conquering armies into tottering remnants as no sword could have done. This pestilence is typhus fever, which was not distinguished separately in the returns of the Registrar-General until 1869. It has always been the accompaniment of war, poverty, and famine, and another name for it was gaol fever, a title earned for it by its prevalence in the overcrowded and insanitary prisons of long ago. There still appears in textbooks of medicine, religiously copied from author to author, the statement that this disease is still to be found in regions of Ireland, a crude attempt to suggest that we of this country might be described as lousy. It is true, however, that typhus was rife in the Balkan States during the last war, in Spain following the recent Civil War, and occasionally we draw hope from stories of its presence in the Axis forces of the present struggle—can we wish them better than extreme lousiness and its companion disease? Many of the ravages of the pestilences of history were almost certainly due to typhus, for the louse is no new-comer, and it has never been decided whether Adam or Eve harboured the original lice—plural, for Mister Louse is a most assiduous citizen in the propagation of his kind. It is known that lice are present on the most ancient mummies from many parts of the world, and these creatures have been described by early travellers on all savage races encountered. A habit, now possibly restricted to monkeys, of eating lice is recorded of several races.

There is a story of a use of the louse in political circles of the Middle Ages. At Hurdenburg in Sweden the mayor was chosen by having the eligible persons sit round a table with their heads bowed forward, so that their beards rested on the table. A louse placed on the centre of the table indicated the new mayor by seeking refuge in his beard. The former habit of shaving the scalp and wearing a wig was probably an attempt to control vermin, and so typhus, and Pepys remarks of being cruelly vexed by a new wig found to be infested. The treatment of lice was a serious problem even in highest society, and Reboux, referring to the education of a princess of France in the seventeenth century, says : "One had carefully taught the young princess that it was bad manners to scratch when one did it by habit and not by necessity, and that it was improper to take lice or fleas or other vermin by the neck to kill them in company, except in the most intimate circles." It is most unlikely that lice can ever be exterminated, but much has been done towards their disappearance by the education of the people to utilize sanitary facilities and by frequent bathing rid themselves of these parasites. The present position of typhus fever as being an extreme rarity has been secured by two factors—(1) the diminution of lousiness, and (2) the prevention of the passage of lice from typhus patients to others.

At a stage in the lives of all, or nearly all of us, when we were much less querulous and when our opinions were of little import, we were submitted to the process of vaccination, that in our turn we might assist in maintaining the eradication of smallpox from our midst. This disease of Variola seems to have been known in India from earliest times, and for at least two thousand years in China. The

Crusades were probably powerful means of diffusing the disease, and during those wars it was brought from East to West. The English term "smallpox" and its French equivalent were first employed after the appearance of the great pox or syphilis at the end of the fifteenth century. Epidemics of the disease, with death-rates up to twenty-five per cent., were frequent, but the survivors never overcame the disfigurement produced by the scarring. Inoculation, or the practice of transferring the contents of a blister from the arm of a patient to an arm of a susceptible individual to confer protection, had been practised from earliest times in India, China, and Persia. Lady Mary Wortley Montagu introduced the process to England in 1721 from Constantinople, where her husband had been ambassador. It was practised largely until 1840, when it was made illegal: it was difficult to control, complications such as sepsis were frequent, and the inoculated individual became a further source of infection to others. In 1798 Edward Jenner, a country practitioner in Berkeley, Gloucestershire, published his work entitled "An Inquiry into the Causes and Effects of the Cowpox." For twenty years in his work he had noted the protection dairymaids appeared to enjoy against smallpox following their acquisition of cowpox in the course of their work. On 14th May, 1796, Jenner had performed his first vaccination upon a boy James Phipps with cowpox matter obtained from a dairymaid, and two months later when inoculated with smallpox matter the boy was found to be non-susceptible. Vaccination by calf-lymph took a strong hold, and was made compulsory in England in 1853. Since then by its constant application to all save conscientious objectors vaccination has removed from our midst one of the greatest scourges in smallpox, and the name of Edward Jenner is for ever revered.

In 1802 Napoleon, who too had grandiose ideas for a vast colonial empire, sent an expedition of twenty thousand picked troops to San Domingo, with the intention of conquering that country and then moving on to the banks of the Mississippi. The subjugation of the disorganized blacks was an easy matter for the veteran French troops. The black leader, a famous soldier, promptly fled to the interior, there to await the slaughter of the invaders by his insidious ally, yellow fever. He had predicted August as the time when no French would remain to fight him, and he was right, for within six months of the landing of the invaders in February the French forces were completely annihilated. In fact within two months two-thirds of the soldiers had died of yellow fever, and in despair, Napoleon sent replacements whose fate was similar. With the disappearance of these troops who could conquer human enemies, but were helpless against disease, Napoleon's hopes for American colonies vanished.

The early history of yellow fever is full of similar tragedies. Its incidence in America was such that it caused 4,041 deaths in 1793 in Philadelphia, a city then of 40,000 inhabitants; in New Orleans in 1853 8,101 deaths occurred, and in Memphis in 1878 5,750 deaths—all from yellow fever. In Britain in 1865 infection was brought to Swansea by a sailing-vessel from Cuba, and of seventy cases fifty died. It was recognised that the disease occurred mainly between the latitudes 45°N. and 35°S, commonly around ports, most fatal in large cities, and epidemics were invariably arrested by the arrival of frost. The apparent immunity of negroes

is probably explained by their survival of mild attacks in early youth. During the United States War with Spain in 1898, 266 of their soldiers were killed in battle, 275 died from wounds, and 3,500 died of disease—mainly yellow fever and typhoid. Out of this war eventually came the conquest of yellow fever, and no chapter of the story of medicine is more thrilling.

A commission was sent to Cuba in 1900 from Washington, and had as its personnel Drs. Reed, Carroll, Lazear, and Agramonte. They failed to discover the microbe of the disease, but, working on the theory of Dr. Finlay, identified the mosquito *stegomyia fasciata*, now known as *ædes ægypti*, as the insect vector of the infection. Dr. Carroll was the first to allow himself be bitten by an infected mosquito, and he developed a severe attack of the disease, from which he barely recovered. Then Dr. Lazear allowed another similar mosquito to bite him, and twelve days later, on 25th September, 1900, he died from a severe attack of yellow fever. The mosquito was definitely incriminated, and the further work necessary to prove the transmission was carried out at Camp Lazear, six miles from Havana. Volunteers were called for from the American troops, and sufficient were forthcoming to prove conclusively that yellow fever was transmitted only by the particular type of mosquito. This *ædes ægypti* is a domestic mosquito breeding in the neighbourhood of houses in any collection of water, and tends to remain within one hundred yards of its breeding-place, so that a vessel moored a quarter of a mile off shore is safe from attack. It became obvious that the control of yellow fever demanded the control of its mosquito host and the removal of the breeding-grounds of this insect by treatment of all swamps and marshes and the covering of domestic water stores. The findings of the Reed commission were so efficiently applied by Major Gorgas, Chief Sanitary Officer of Havana, that after repeated disasters from yellow fever, the work on the construction of the Panama Canal was carried through, and this engineering triumph stands as a memorial to the heroism of Reed and his colleagues and a tribute to the thoroughness of their investigations.

It might almost appear that with the removal from our midst of plague, cholera, smallpox, typhus, and yellow fever and the efficient control of typhoid that medicine had lost much of its romance. Undoubtedly the work of pioneers in these diseases has been so applied that no fear of these formerly devastating pestilences remains any longer; the tools were forthcoming and the jobs were finished. It is probably for the good of mankind that the familiar mild infectious diseases exist, for all of us, to survive, must learn, consciously or subconsciously, to overcome sickness for ourselves. Many of us have seen the distressingly poor fight put up by a child when ill for the first time, as compared with the almost nonchalant response on the part of the youngster with previous wins, home or away, to his credit over the milder infections such as scarlatina, chickenpox, and measles or whooping-cough at a reasonable age. These are all conditions we may well control without actually exterminating, for there is some truth in the lay view of the constitutional improvement in a child following an infectious disease—probably best manifested during convalescence by a ravenous appetite and a peroid of rapid growth.

But what of our present-day scourges of tuberculosis and diphtheria? Is it not true of these diseases that we have been given the essential research work and the

weapons to combat them, and the disappointing results, we must admit, are due to our failure, as yet, to apply our knowledge. It is true that in the last sixty years in our islands there has been a steady decline in the death-rate from tuberculosis, but it is still one of the chief causes of premature death and chronic invalidism, and causes the death of more than half of its victims during the working years of life, 20 to 65. The increase in tuberculosis that occurred in the last war emphasised the disease as a national problem, and so, in the immediate post-war years, much was done to improve conditions which were regarded as lending themselves to the increased incidence. In this war an increase in tuberculosis was foretold, and unfortunately this is only too true, and again we must accelerate the means of control of this disease, one of the greatest problems of Social Medicine.

We have learned that predisposing causes are poverty, bad housing, dirt, alcoholism, and dusty trades. In 1885 Dr. Henry McCormac, the first Professor of Medicine of this School, is quoted as saying : "In a cosy room the consumptive is bound never to live, nor in any room indeed, for great lengths of time. So long as he is able to be out of doors, he is in his best and safest home. Wherever there is foul air, there we meet consumption, we meet scrofula, and an untimely death." It is said of Dr. McCormac that he was so insistent upon fresh air for his tuberculous patients and their relatives that he often broke their windows with his umbrella. A story is told that he appeared in the local police court on one occasion for window-smashing—one can but wonder how he would have regarded our war-time ventilation with the limitations imposed by black-out regulations.

The prevention of tuberculosis can only be attained by a long sustained attack on numerous social evils. We must aim at higher standards of living, better conditions of work, healthier housing, and safe milk. Next to actual prevention the best we can achieve is detection of the disease in its earliest stages, when it is most likely to respond to treatment. The general practitioner is the person most likely to see the early stages of the disease, and his prompt notification will lead to proper supervision of the patient. Those inspecting school children may detect suspects and refer them for observation, diagnosis, and, if necessary, treatment. Treatment may be domiciliary, dispensary, or sanatorium, the latter especially during the active and most infective stages of the disease. One of the earliest advocates of sanatorium treatment was Dr. Edward Livingstone Trudeau, of New York, who, apparently in the last stages of consumption, in 1873 went to the Adirondacks to die, but there survived and lived to exert an influence on the tuberculosis movement for many years. He established a sanatorium in the Adirondacks to which Robert Louis Stevenson came as a patient in 1887, and it was probably Dr. Trudeau that Stevenson had in mind when he wrote this eulogy of the physician : "There are men and classes of men who stand above the common herd, the Soldier, the Sailor, and the Shepherd not infrequently : the Artist rarely, rarelier still the Clergyman, the Physician almost as a rule. He is the flower (such as it is) of our civilization : and when that stage of man is done with, and only remembered to be marvelled at in history, he will be thought to have shared as little as any in the defects of the period, and most notably exhibited the virtues of the race. Generosity he has, such as is possible to those who practise an art, never

to those who drive a trade : discretion, tested by a hundred secrets : tact, tried in a thousand embarrassments : and what are more important, Herculean cheerfulness and courage. So it is that he brings air and cheer into the sick room, and often enough, though not so often as he wishes, brings healing."

All who enter the profession of medicine are potential physicians, and our subsequent training and experiences fit us better to attempt to follow the way blazed for us by men like Dr. Trudeau. The ideals he prescribed for the treatment of tuberculosis in the foundation of his sanatorium at Saranac in 1884 are still to be attained, and with the inspiration of Dr. Trudeau's life we might well pursue a more active war against the white scourge. On his monument, erected near the entrance to the sanatorium, is inscribed what might well be an ideal to all of us : "To cure sometimes, to relieve often, to comfort always."

I have left diphtheria purposely to the last, that I might plead for its extermination. The case against this disease is constantly and most eloquently kept before us by repeated appeals on the wireless, references in the public press, and screen and poster approaches to parents to have their children protected. The figures of the incidence of diphtheria in our islands are such as to suggest that the wireless appeals must fall upon deaf ears, and parents, if they read, do not understand or appreciate the menace of the disease and the ease and certainty with which it can be combated. In England and Wales sixty thousand cases of this condition are notified annually, and of these some three thousand end fatally. In our own city we have lost over eighty children in a year, and still struggle to reduce the death-rate below one per week. These fatal cases are nearly all in children under tea years, an age at which young life is very sweet to a child and its parents, and yet these are all entirely unnecessary deaths. Painful deaths, too, to the little sufferer and those in attendance alike, for the blissful loss of consciousness is usually denied the diphtheria patient. To the bereavement of parents must be added the anguish of the thought that reasonable care and the acceptance of the safety arising from immunization would have spared their child its suffering.

It was as far back as 1894 that the world hailed the conquest of diphtheria through the discovery by Roux in the Pasteur Institute, of diphtheria antitoxin to combat the poison elaborated by the diphtheria organisms. Since then developments have gone on apace, so that nowadays the existence of the disease is inexcusable. The Schick test to determine susceptibility to diphtheria has been elaborated, but since about ninety per cent. of children are susceptible, the test is now frequently dispensed with and immunization carried out. The course of protection, too, is modified so that in most cases only two subcutaneous injections are necessary to carry the child over the danger period of the early years. From Toronto, a city of six hundred thousand inhabitants where protection of pre-school and school children has been largely carried out, we find figures showing sixty-four deaths from the disease in 1929, and with success of intensive immunization, by 1934, five years later, there were only twenty-two cases of diphtheria without a single death. A former Dean of Canadian Public Health Officials, described as a beloved Medical Officer of Health for Toronto, the late Dr. C. J. O. Hastings, declared that every death from diphtheria should be investigated by the coroner. Such was his

conviction and belief that diphtheria is completely preventable, and only occurs because of insufficient attempts to stamp it out. To secure its extermination, the active co-operation of all citizens is necessary. It is realized that to produce a material reduction in diphtheria incidence two-thirds of the school children and at least one-third of pre-school children must be immune. Surely what has been done in other countries is not beyond the power of our own people, who would be loath to have themselves regarded as inferior parents. At times I have felt that part, possibly much, of the blame for our position in regard to diphtheria is attributable to the lack of enthusiasm for immunization on the part of the medical profession, to my mind a very culpable state and possibly due to the agonal phases of diphtheria sufferers being confined to hospitals. I trust that this appeal for the most intensive application of our means to combat this dread disease does not fall upon deaf ears, and that every student of medicine here will become an active propagandist against diphtheria—public enemy number one of childhood.

It is the privilege of the general practitioner in the course of his daily visits to act as guide, counsellor, and friend, not only to the parents, but to the children, and how better could he manifest appreciation of his position than by teaching positive health and happiness by eliminating the dread of diphtheria from the family circle.

It cannot be given to many of us to rival the great figures in the history of our war against disease. Men of the calibre of Snow, Jenner, Reed, Carroll, Lazear, Gorgas, and Trudeau are not born every day. They have blazed the trail, others have carried on their work, and to-day we are all beneficiaries of their pioneer efforts and morally entitled so to continue their labours as to make the world a better and healthier place for all to live in, with a higher expectation of life and less tragedy from diseases now known to be preventable. Here may I close by quoting to you, I hope appropriately, the closing paragraphs of an address given by Sir William Osler under similar circumstances: "Useful your lives must be, as you will care for those who cannot care for themselves, and who need about them, in the day of tribulation, gentle hands and tender hearts. And happy lives shall be yours, because busy and useful: having been initiated into the great secret—that happiness lies in the absorption in some vocation which satisfies the soul: that we are here to add what we can to, not to get what we can from, life. And, finally, remember what we are—useful supernumeraries in the battle, simple stage accessories in the drama, playing minor, but essential, parts at the exits and entrances, or picking up, here and there, a strutter, who may have tripped upon the stage. You have been much by the dark river—so near to us all—and have seen so many embark, that the dread of the old boatman has almost disappeared, and

> "When the Angel of the darker Drink
> At last shall find you by the river brink,
> And offering his cup, invite your soul
> Forth to your lips to quaff—You shall not shrink.

"Your passport shall be the blessing of Him in whose footsteps you have trodden, unto whose sick you have ministered, and for whose children you have cared."

The Education of the Medical Student

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FROM the point of view of intelligence the population may be divided into (a) geniuses, (b) men of ability, (c) men of average intelligence, (d) "morons," (e) men who are mentally defective. Those of classes (a), (b), and (c) are to be welcomed into our medical schools. Those of class (e) will not trouble us. The "morons" have sufficient intelligence to earn their living in office, shop, or on the soil. They can be trained to do routine work, but they do not make good doctors. They may take up medicine from a genuine interest in the subject; they may be forced into medicine by a father who is himself a doctor, or by a father who wants his children to rise in the social scale; they may think that medicine is an easy way of making a livelihood. They must be eliminated from the medical schools. Psychological tests will not do this satisfactorily. A reasonably stiff entrance examination and the weeding out of those of obviously poor intelligence in the first or, at latest, second medical year is the best solution.

What are the minimum requirements in general education for entrance to the study of medicine? The three Rs, general knowledge, English. Latin is unnecessary. The argument that a knowledge of classical Latin is essential in order that a student may understand medical terms and the dog-Latin of prescriptions is unsound. Very few students of to-day know Greek, yet they can understand the numerous words of Greek derivation which occur in medicine. The writing of many students borders on the illegible. This may be due to laziness or to pedantry, fostered by the popular idea that illegibility is the hall-mark of a good doctor or a person of literary talent. Many serious mistakes arise through illegible prescriptions and directions. The figure four should not be formed so badly as to be mistaken for seven. The symbol for a dram should not be written in such a slovenly fashion as to simulate the symbol for an ounce.

The present medical curriculum embodies the wisdom of the ages. The medical course is constantly being added to; nothing is ever subtracted from it. In the pre-medical year a sound foundation is laid in the Preliminary Sciences—Chemistry, Physics, Botany, Zoology. Then the structure and functions of the human body are scientifically treated. The human structure and functions as disturbed by disease are then studied under the pathologist and the bacteriologist. Materia medica is not forgotten. Finally the student does his hospital work and studies sick people as they really are. All the specialities must be attended to, not omitting six hours spent in learning how to vaccinate. This is an excellent system for a man of ability who has had a thorough secondary education up to the age of nineteen, who has studied chemistry and physics for three or four years at school, who is in no hurry to earn a living, and who can spend two years as house physician or house surgeon after qualification. The defects of the system are obvious. Many students have done no science at school; a student cannot acquire a scientific outlook by

one year's compressed study of chemistry and physics; the average doctor has not, and need not have, a scientific outlook in the narrower sense of the term. What actually happens is this. As soon as he has passed his examination in chemistry and physics, the student says "Thank God!" and hastens to the second-hand book-shop to dispose of his textbooks. He clears his brain of chemical and physical facts at the same time. It is easy to prove the truth of this by asking the student a few simple chemical or physical questions at his final examination. "The specific gravity of this sample of urine is 1015; do you think that the specific gravity was higher or lower immediately after the patient passed it?" The student mentally tosses a penny before answering. Or again, how many final students can explain the chemical changes taking place when Fehling's solution is reduced, and write down correctly the formulæ of the two oxides of copper?

Too much time is spent in listening to lectures. Including the pre-medical years the student of to-day spends more than a thousand hours in the medical school listening to lectures; this does not include the time spent at practical classes. The centre of gravity has moved from the hospital to the medical school. One freely admits that most recent discoveries of importance in medicine have been made in laboratories and not at the bed-side. This is, of course, altogether beside the point. The present curriculum induces a theoretical outlook. The student's interest flags because clinical work is postponed to such a late stage. He has to memorize so many facts that swotting for examinations becomes necessary: learn quickly—forget quickly. Clinical work is neglected.

Since the new curriculum only came into force in 1938, it is too early to pass a final judgment on it. One does, however, get the impression that it is definitely worse than the old.

I would suggest the following. A straight five-year medical course, with no camouflage of a pre-medical year:—

(1) *First year:* chemistry and physics—not so many facts, less lecturing, more laboratory work, opportunity for the good man who has already done some science to do more advanced work. Anatomy and elementary physiology (including biology). Hospital: one hour, once or twice a week—bandaging, taking temperatures, etc.

(2) *Second year:* anatomy (on functional lines) and physiology (without "frog jumps"). Hospital: methods of examination.

(3) *Third year:* pathology: bacteriology (not too much): hygiene: therapeutics (with drastic cuts in materia medica). Hospital.

(4) *Fourth year* and (5) *Fifth year:* a few lectures in medicine and surgery (on special subjects), but no formal course: six months residence in a general hospital, in latter half of fourth year or first half of fifth year—the hospital should have departments for children, venereal disease, tuberculosis, fevers, gynæcology, nose and throat, eye. Special hospitals are not good for teaching unless they take resident students—lunacy accepted: one or two months residence in a maternity hospital, attendance at out-patient department, these to be done *after* period of residence in general hospital.

Examinations: framed to nullify swotting and excessive book, as opposed to, practical knowledge : an examination at end of each summer term; if student fails to pass he can have another "shot" in the autumn, if he fails again he must repeat the year : at the end of the fourth year an examination in clinical methods.

Medical textbooks for students : many are too dear—binding is unnecessarily substantial, often too many plates and reproductions of X-rays which show little : not enough diagrams : poor and clumsy style. Why must a medical writer say "not infrequently" instead of "often;" "not uncommon" instead of "common;" "fatal termination" instead of "death;" "stethoscopic examination reveals a *bruit* in the mitral area, which is systolic in time" instead of "there is a systolic mitral murmur." Students reading-rooms often contain many out-of-date textbooks, which have been kindly presented by members of the staff when they get a new edition of the book themselves. It would be desirable for a textbook in medicine to be published by the teaching physicians of a medical centre in collaboration, rather than by one individual. The views expressed would embody the pooled opinions of the authors, and in minor points in which the authors were not in agreement the different view-points could be briefly stated.

Special points in teaching and advice to those about to practise :

(1) Errors in diagnosis : all doctors make mistakes, with two exceptions—those who have no patients, and those who do not tell the truth. If you make a mistake find out whether it was due to (a) insufficient history of symptoms, (b) insufficient examination, (c) faulty judgment, (d) refusal to change the first diagnosis made, (e) unavoidable cause. Try not to make the same mistake again.

(2) Neutralize your own mental twists : (a) in dealing with an acute abdomen the physician tends to go too slow, he should get a surgeon to see the case sooner. (b) In dealing with a chronic abdomen the surgeon goes too fast, he should get a physician to see the case. (c) If you see one case of an uncommon disease, do not imagine that other cases are likely to occur soon.

(3) Do not have an exaggerated idea of the importance of laboratory tests. A pathologist or biochemist or radiologist can make mistakes too—his results are not final. A red cell count of 3,232,572 means that the count is 3,200,000, but there are grave doubts as to the competence of the pathologist, because he has no conception of his own errors.

(4) Understand the patient's view-point. If you get scarlatina or appendicitis while you are a student, don't grouse; you have learnt much more while lying in bed as a patient than you would have learned by attending lectures for the same period. You can now understand the patient's view-point better. The modern patient wants to know, not so much the scientific name of his disease, but rather, whether he is going to recover or not and how long he will be laid up. He has little fear of death, and would much rather leave things in order when he dies. Only patients of the Victorian mentality like the doctor to look wise and say nothing. The patient's language should be understood.

It will vary with different localities. If you come to a patient one morning who is obviously much better than he was the day before, you may say "You are much better to-day." He replies, "No, I'm not better yet." You may misunderstand him unless he adds, " But I'm well improved." The word "better" to him means "cured." Or again, the father of a child whom you are treating may say, " Doctor, I'm annoyed the way my boy is doing." Don't be offended, he means no harm. "Annoyed" in his language means "anxious." Remember popular fallacies and point out their absurdities. A great many patients believe that the third stroke kills, that valvular disease of the heart is next to cancer, about the most serious disease from which one can suffer, that pain in the back is always evidence of kidney disease.

(5) Don't pander to popular whims. Patients' ideas in medicine are usually at least thirty years out of date. Wholesale removal of the appendix, tonsils and adenoids, the foreskin, are unnecessary. Children with a "catarrhal diathesis" are not benefited by the removal of tonsils and adenoids, and an intact soft palate and pillars of the fauces have some use. A "bottle of medicine" is not always necessary.

(6) Proprietary medicines. The more respectable commercial firms often bring some valuable products on the market. Do not be unduly impressed by advertisements, they are grossly overdone. Do not be flattered by pictures of a doctor with serious face pompously writing out a prescription for a pretty, delicate-looking woman, who registers ecstatic delight—a prescription for some simple proprietary remedy, which the woman, if she had more sense, might have obtained from the nearest chemist without a prescription.

A final word to ourselves : it should be the exception for a student to fail in his final examination. If he fails we, as his teachers, should regard his failure as our failure too.

REVIEW

FRACTURES AND DISLOCATIONS.—"The Practitioner" Series. By various authors. Edited by Sir Humphry Rolleston, Bart., G.C.V.O., K.C.B., M.B., F.R.C.P., and Alan Moncrieff, M.D., F.R.C.P. Eyre & Spottiswoode. Price 7s. 6d.

This booklet, compressing as it does its subject matter into eighty small pages, must be looked on as a guide to the General Practitioner in his daily work rather than an abridged edition of the subject of Fractures and Dislocations which he might want to read in his more leisure moments.

The booklet concisely represents the chief bony injuries met with in everyday practice, their diagnosis and their treatment.

Two criticisms can be made about an otherwise excellent publication :—

(a) No mention of fractures of the foot or toes occurs, and

(b) The basic principles underlying the treatment of all fractures are not sufficiently stressed. The inclusion, in a future edition, of chapters dealing with these two points would greatly increase the usefulness of the booklet. This publication can be strongly recommended to every General Practitioner.

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R. J. W. W.

A Case of Spirochætosis Ictero-Hæmorrhagica

By DAVID KIRKPATRICK, M.B., B.Ch.

MOST men in general practice, especially perhaps in rural areas, are liable to see a case of spirochætosis ictero-hæmorrhagica at some time or other. With the increased food production drive, rats are to be expected where grain is collected in and around farmyards, in spite of the constant warfare against these rodents. According to Hurst, about twenty-five per cent. of rat population is infected. Leptospiræ are present in the urine of infected rats, and so the risk to man coming in contact with substances soiled by this agent is very definite. Leptospiræ, it is now agreed, can gain access to the blood-stream by penetrating through the skin; whether the presence of minor abrasions is a necessity is difficult to say, but is of little moment. Standing in water contaminated by rat excreta exposes the worker to the risk of infection, and the disease comes under the Workmen's Compensation Act.

Perhaps these few remarks may in some measure exculpate me for wishing to report the following interesting case, recently under observation, as the patient presented absolutely the clinical picture of Weil's disease.

The patient had been ill for about two or three days when I saw him, the illness being ushered in by shivery feeling, malaise, headache, and increasing weakness. When first seen, he had severe headache, physical and mental torpor, acute myositis evidenced by stiffness and soreness of all muscles, especially those of back and neck, accompanied by tenderness; joints were stiff and painful, and upper abdominal pain was complained of. Tongue was very dry, furred, and deeply fissured. Albuminuria was present; T°102; P120. Heart and lungs: nothing abnormal detected. Abdominal reflexes were absent; plantar reflexes, flexor and knee jerks very sluggish; actually these later disappeared entirely.

There was thus difficulty in diagnosis, meningitis, influenza, nephritis, toxæmic gastritis, and acute rheumatism all deserving consideration.

Sodium salicylate was administered, and patient revisited after six hours; muscular stiffness was now relieved to some extent, and meningitis could be ruled out.

Next day the patient was very ill and still undiagnosed; in addition, he now had complete anorexia, nausea, no actual vomiting, languor, and apathy. On third day of seeing him, i.e., on fifth or sixth day of illness, jaundice was visible; this rapidly deepened, and stools became clay-coloured; toxæmia was now severe. Liver became enlarged to two finger-breadths below costal margin and was tender on palpation, suggesting hepatitis. Spleen was not enlarged. After another two days, petechial hæmorrhages occurred at areas over abdomen, back, forehead, and left upper eyelid. Next the patient had two attacks of hæmatemesis, one rather copious—about one pint, according to nurse. Prostration was now extreme, and one felt that a big hæmorrhage could throw the balance against him; fortunately there were no big purpuric eruptions or epistaxis, which can be troublesome. Gradually from eleventh day onwards improvement set in, tongue moistened and cleaned, fæces

regained normal colour, jaundice intensity lessened, albumen cleared, but bile persisted in urine for considerable time.

After five days' quiescence patient again became pyrexial, with deterioration in his condition, and it took another ten days for this recrudescence to subside. During this stage he developed a generalised confluent papular eruption almost resembling measles, but duller in colour; this faded over two days.

By this time the patient was mentally depressed, irritable, and emotionally unstable. Convalescence was slow and otherwise uneventful.

Treatment given was fluids, alkalis, glucose, calcium, vitamin C; organic arsenic was not given owing to hepatitis.

Laboratory tests were as follows:—First test taken tenth day reported provisionally positive, as patient's serum agglutinated leptospiræ in dilution up to 1 in 100, not a high end-point. Two weeks later patient's serum was strongly positive, agglutinating leptospiræ up to a dilution of 1 in 1,000. Blood was negative to typhoid, paratyphoid, and br. abortus. Blood-film showed secondary type of anæmia, with no definite leucocytosis.

Clinically the most striking features were the initial myositis, severe prostration and toxæmia, jaundice, hæmorrhages, and absent knee-jerks, which together produce a typical picture, leaving little doubt as to the diagnosis on clinical grounds alone, but nowadays agglutination tests against the leptospiræ are a welcome help in finally clinching the diagnosis.

I am much indebted to Professor Wilson, Dr. Bartley, and Dr. Boyd Campbell for laboratory investigations.

REVIEW

NATURAL DEVELOPMENT OF THE CHILD. By Agatha H. Bowley, Ph.D. Edinburgh: E. & S. Livingstone. 8s. 6d.; postage 6d.

This is a good book, and fills a need in the mass of literature on child psychology. It is written for the "believer," and makes no attempt to convince people that a proper control of the child's mental development is as important as the control of bodily development. This volume is short—one hundred and sixty-eight pages of reading matter, and in many instances is in the nature of a summary.

A chapter on infant development follows the introduction, and then chapters on pre-school period, middle childhood period, and adolescence follow. The penultimate chapter deals with children and the war.

Special sections are rightly devoted to backwardness, delinquency, and antisocial behaviour; anxieties and habit disorders. Such conditions and their causes should be better understood, as prevention seems to hold the best, if not the only hope, of dealing with these difficult conditions.

The book is intended for parents and teachers, but the general practitioner will benefit from it as well. The facts are put forward in a clear, succinct fashion, and a notable feature is the list at the end of each chapter of recommendations for further reading for those interested.

Dr. MacCalman, lecturer on psycho-pathology in Aberdeen University, writes the foreword, in which he points out that dependable information on this subject is usually reported in professional journals, and is therefore for the most part inaccessible.

The book is illustrated by many photographs of child development at different ages, but the reason for their inclusion is not so evident.

The book can be thoroughly recommended. It answers a great many questions which doctors, parents, school teachers, and children often ask.

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Introduction to the Surgery of the Gall-Bladder

By P. T. CRYMBLE, M.B., F.R.C.S.ENG.

MATERIAL, 1935-1942 INCLUSIVE.

Cholecystectomy—		
With Stones - - -	116	
Stoneless - - -	34	
		150
Cholecystostomy - -		13
Common Duct Stone - -		5
Cholecyst-Duodenostomy - -		2
Cholecyst-Gastrostomy - -		2
TOTAL Gall-Bladder Operations		172

Operation Mortality 5 (2.9%).

HISTORY.

WHILST history records the existence of gall-stones and diseases of the gall-bladder for some thousands of years, the first surgical attack on this organ is of comparatively recent date. As far as I am aware, the first surgeon to open and drain the gall-bladder was Sims in 1878. Lawson Tait, referring to this first cholecystostomy, made the following rash statement: "The entire possibilities of treatment of gall-stones and distended gall-bladder are exhausted by Sims' paper." The first cholocystectomy was performed by Langenbuch in 1882, and it was twenty-nine years before a Belfast surgeon followed suit.

In March, 1909, Fullerton and Kirk removed gall-bladders, and they were closely followed by Robert Campbell in April. It almost looks as if Fullerton had stimulated Kirk and Campbell. There is no doubt about the Kirk operation, as the notes clearly state that the cystic duct was ligatured with linen thread, the duct divided, and the gall-bladder, containing stones, removed. The notes on Fullerton's case are not so clear, as they state that the cystic duct was cut across and a stone removed from the cystic duct, but they fail to mention that the gall-bladder was removed.

As operative mortality was gradually reduced, surgeons became bolder, and many battles have been fought over "removal v. drainage," with the result that at the present time one feels that there is a proper field for each operation. More recently there has been much discussion over the stoneless gall-bladder, and much adverse criticism of the high proportion of stoneless gall-bladders in some cholecystectomy lists. Where this figure reaches thirty to forty per cent. it is felt that the gall-bladder has been unnecessarily sacrificed. At the present moment the main point at issue is when to explore the common duct.

ANATOMY.

Whereas the anatomy of the normal gall-bladder is comparatively simple, the

pathological anatomy is most varied and complicated. Reference to a text-book of anatomy gives a good description of the normal, but where will you obtain a description of the gross pathological changes? Only the surgeon has the opportunity to record the varying conditions, and he rarely has the ability or inclination. Let me give a few examples of confused anatomical terminology.

"The cystic duct is never ligatured until it has been traced *upwards* into the neck of the gall-bladder."

One writer compares the relationship of Hartman's pouch to the cystic duct as that of the cæcum to the terminal ileum, or, in other words, he places the pouch lateral to the cystic duct, whilst Hartman figures his pouch medial to the cystic duct.

Another surgeon introduces the term pelvis in place of Hartman's pouch. Much of this confusion is probably due to the surgeon describing the gall-bladder as he may see it at operation, in the inverted position. The body and its contents should be described in the erect position, and the terms medial, lateral, anterior, posterior, superior, and inferior used.

As a result of obstruction, the gall-bladder may increase enormously in size, and a pouch of miniature size in the normal may undergo considerable dilatation. Such pouches are found in the region of the neck, and may be found medial, anterior, or lateral to the cystic duct. They lead to difficulty in defining the cystic duct.

Marked variations in the cystic duct may be found at operation :

1. The normal text-book type—A 1½-inch duct passing upwards, backwards, and medially to join the common duct. In its lower or gall-bladder half its lumen is obstructed by the spiral valve, a valve which frequently holds up small stones.
2. The short straight wide cystic duct, which easily transmits stones into the common bile duct. In this variety the spiral valve may be absent.
3. The S-shaped cystic duct or the kinked duct, with the kinks maintained by peritoneal attachments.
4. Close adhesion of the cystic duct to Hartman's pouch.

Ascertainment.

The two outstanding fingerposts guiding the patient to the surgical ward are biliary colic and "a positive X-ray," and without these the large majority of gall-stones would be missed. Rare signs may be present, such as tenderness over the gall-bladder, a palpable gall-bladder, varying degrees of jaundice and dyspepsia. The radiogram may show stones in the clear picture, and after cholepulvis there may be absence of a gall-bladder shadow or filling defects in the shadow. The typical gall-stone shadow is facetted, has a clear centre and an opaque cortex, but others show a uniform opacity.

"Living Pathology."

Having opened the abdomen in the expectation of finding a surgical gall-bladder, the surgeon may encounter one of the following conditions—

(a) The liver is diseased and the gall-bladder is normal. Commonly the disease

takes the form of cirrhosis, but there may be secondary tumours or hydatid cyst.

(b) The gall-bladder is normal, and the symptoms are due to gastric ulcer, duodenal ulcer, or a chronic appendix.

(c) The stoneless pathological gall-bladder. The changes may appear as thickening of the wall, distension, a change from the normal sea-green to white, deposit of fat, adhesions.

(d) Gall-stones in the gall-bladder or cystic duct.

(e) Gall-stones in the gall-bladder with pus or bile.

(f) Distension of the gall-bladder and common duct due to a tumour of the head of the pancreas or of the ampulla of Vater.

(g) Common duct stone.

(h) Gall-stones associated with perivesicular abscess.

(i) Gall-stones with a fistula into the duodenum or colon.

(j) Carcinoma of the gall-bladder.

Complications.

Jaundice.

(a) The jaundice may be due to some liver condition, such as cirrhosis or malignant disease, and be unsuitable for surgical interference.

(b) A slight degree of jaundice may accompany gall-stones limited to the gall-bladder or cystic duct, with no visible or palpable pathology of the common duct. The jaundice is probably due to a hepatitis, and cholecystectomy is indicated.

(c) The jaundice may be due to obstruction of the common duct by a stone. The supra-pancreatic portion of the duct will be visibly dilated and the stone may be palpable somewhere along the common duct. There will probably be stones in the gall-bladder. The essential point is the relief of the common duct obstruction by removal of the stone. Stones should be removed from the gall-bladder and the gall-bladder drained, if patient is well enough.

(d) The jaundice may be due to obstruction of the common duct by a tumour of the head of the pancreas or by a carcinoma of the ampulla of Vater. Here one will be limited to some palliative operation, such as an anastomosis between the gall-bladder and the stomach or between the gall-bladder and the second part of the duodenum. In one case in this series obstruction of the ampulla of Vater was relieved by removal of a pedunculated adeno-carcinoma attached to the region of the ampulla. The patient was free from symptoms for three years, and then died of pneumonia.

External fistula.

Gall-stones, mucus, or bile may escape from the fistula, and there may have been a previous operation.

If stones are being discharged the gall-bladder should be explored, any stones present removed and the gall-bladder removed or drained, according to the conditions found.

A mucus fistula will be due to an obstructed cystic duct. The obstruction will usually be due to a stone in the duct, in Hartman's pouch or in the neck of the gall-bladder. The fistula will be cured by cholecystectomy.

Biliary fistula is usually post-operative, and is due to an unrelieved obstruction of the common duct or to an injury to the common duct. There are three probable explanations of the fistula—

(a) The fistula leads into the gall-bladder and there is a stone impacted in the common duct. The fistula will be cured by removal of the common duct stone.

(b) The fistula leads into the gall-bladder, and there is an obstruction of the common duct by a tumour of the head of the pancreas or by a carcinoma of the ampulla of Vater. The external fistula will be cured and the condition temporarily improved by a cholecyst-gastrostomy or a cholecyst-duodenostomy.

(c) The gall-bladder has been removed and the fistula leads into the common duct or common hepatic duct. Here it may be possible to reconstruct the common duct and close the fistula.

The acute gall-bladder.

This is one of the most difficult problems in gall-bladder surgery. Are we to allow our gall-bladders to settle down before operating, and thus obtain a low operation mortality, or are we to operate early so as to save the occasional perforation? One's own practice is to delay operation for seven to ten days, when the temperature will have settled to normal and the general condition has much improved, but one must be on the look-out for the acute perforation, and operate immediately. Fortunately, acute perforation is rare, but it has similar signs to those of a perforated peptic ulcer or an acute pancreatitis.

Stones impacted outside the biliary track.

The stone usually ulcerates through the wall of the gall-bladder into the second part of the duodenum. It is large, and may obstruct the lower ileum. Instead of entering the duodenum, it may enter the transverse colon, and may be large enough to obstruct the large bowel. Once the stone has escaped into the intestine, the fistula tends to contract down and requires no treatment, but the intestinal obstruction must be relieved.

The stone may escape from the gall-bladder and lie in a cavity between the gall-bladder and duodenum. Here there is a danger of duodenal fistula following operation for removal of the stone.

Secondary operations for recurrent symptoms.

(a) Where stones have been removed from the gall-bladder and the gall-bladder closed or drained. On September 29, 1942, one operated on a woman whose abdomen had been opened five years previously through a sub-umbilical mid-line incision. Through this incision gall-stones had been removed. A recent cholecystogram showed poor filling of the gall-bladder and a ring-like opacity above the fourth lumbar right transverse process, suggesting gall-stone. For six months she had been having attacks of biliary colic. The second operation,

by a sub-costal incision, revealed an elongated gall-bladder which contained two moderate-sized stones of mixed infection type. The fundus of the gall-bladder was adherent to the gastro-colic ligament. The gall-bladder was removed.

(b) Biliary colic with jaundice appearing after cholecystectomy. One has encountered this condition on two occasions, and in both cases the symptoms were due to common duct stone. Removal of the stone cured the condition.

Removal of the Gall-bladder.

This operation was performed for the first time by Langenbuch in 1882, and was first performed in the Royal Hospital, Belfast, in 1909. For many years it was a rare operation, and surgeons contented themselves with a simple opening of the gall-bladder, removal of stones, and external drainage. At the present time, in my own unit it ranks second to appendicectomy in frequency, and I look upon the gall-bladder as the second most important viscus in the abdomen to the general surgeon. With careful selection of cases, suitable pre-operative medication, interference in a quiescent period, and a clear demonstration of the anatomy during operation, one should aim at an operation mortality of two to three per cent. Once the case is complicated by obstruction in the common duct, the mortality becomes much higher, and many of the gall-bladder deaths in our hospital occur in such cases. One is often disappointed in surgical writings by the complete absence of any technical details, but the teaching of our text-books favours :

Isolation of the cystic duct,
Division of the cystic duct,
Ligature of the cystic vessels,
Separation of the gall-bladder from the liver.

I must admit that I have not practised this method for many years, as I could not be sure of my anatomy until I had thoroughly mobilised the gall-bladder and cystic duct. The alternative method of removing the gall-bladder, and the one which one practises and recommends, is :

Separation of the gall-bladder from the liver from below upwards;
Control of the bleeding-points on the gall-bladder wall;
Ligature and division of the ligaments (including the cystic vessels) attaching the neck of the gall-bladder to the region of the portal fissure. So far this has been an antero-lateral approach.

We now attack the cystic duct from the medial aspect by removing the peritoneum and fat overlying it. Here one may find the cystic lymph-gland or a Hartman's pouch or a Hartman's bassinette. The cystic duct when found should be traced to the common duct. One now returns to the antero-lateral aspect to ligature and divide any ligaments which may still anchor the gall-bladder neck. The cystic duct should now be straight and in full view. It can be palpated for stones and opened for their removal. Ligature of the cystic duct and division distal to the ligature is the last step in removal.

This may be a very easy operation or a very difficult one. A small highly-placed

liver with a small thick-walled gall-bladder surrounded by adhesions are difficulties in the way of anatomical exposition, and one may be forced to remove only the lower part of the gall-bladder by dividing the neck and ligaturing the bleeding-points in the cut edge. This is a safe technique, as one can define the neck by exploring the cavity of the gall-bladder with the finger or probe. The only objection to this modification is that small stones may be left in the cystic duct.

Almost invariably one uses the oblique sub-costal incision. It is easy to make, easy to close, permits drainage through its lateral angle, and shows no tendency to hernia. It also permits exploration of the appendix.

The position of the patient is of great importance, and since using the tilted position one has been able to discard illuminated retractors. The head of the table is raised to an angle of forty-five degrees, whilst a foot-piece and a strap across the knees prevent the patient slipping.

Causes of Death after Gall-Bladder Operation.

An investigation into the cause of death in gall-bladder operations in the Royal Hospital, during the seven years 1935 to 1941, was carried out by my resident pupils, Denise Corkey and Margaret Mitchell.

Out of 768 operations there have been 71 deaths. This gives a mortality of 9.2 per cent., a figure closely approximating to global mortality. The following is a list of the outstanding features of the cases:

No reason for death	16	Gall-bladder ruptured during removal	4
Common duct stone (37 per cent. mortality)	13	Technical difficulties	6
Ileus	3	Hæmorrhage	4
Fæcal fistula	3	Previous operation on gall-bladder or common duct	3
Rupture of intestine	3	Lung trouble—	
Impaction of stone in jejunum	1	Collapse 1	
Subphrenic abscess	4	Pneumonia 4	
Cirrhosis of liver	2	Embolus 1—	6
Pancreatic tumour	2	Uræmia	1
Gangrenous gall-bladder	3	Cardiac	1

When one investigates the cause of death in the hospital cases, it is usually only possible to point out some outstanding feature. Many of the cases were not subjected to post-mortem examination, and in some of the cases the notes are incomplete. It is not easy to estimate the resistance of an abdomen to operative interference, and I have found the physician of little value in deciding this problem. So many viscera are concerned in the post-operative course that no one test is likely to be of any value. The heart, the lungs, the liver with its various functions, the kidneys, and general morale are all concerned. Any one of these may give out and lead to defeat.

One notes in this series sixteen cases with no satisfactory explanation of death, and some of these cases might have been left alone safely. What was the hidden weakness which prevented them surviving even sometimes a most trivial operation?

Common duct stone showed a mortality of thirty-seven per cent., a figure closely allied to those of Barrington Ward (thirty-five per cent). Wilkie gave twenty per cent. as a reasonable rate for this condition, but Flint's last series was down to four per cent., as a result of very careful pre-operative treatment and liver function tests.

It is evident that one should limit the surgical technique to the minimum which will relieve the obstructed duct—opening the duct and removing the stone. It is not always easy to find the stone, and one notes that in a case subjected to operation the stone could not be found, but was found, at post-mortem, in the ampulla of Vater. In one of my cases a stone was palpated in the ampulla, could not be found transduodenally, but was found and removed by an anterior approach. Most frequently the stone lies in the accessible suprapancreatic part of the duct, or the stone can be milked from the pancreatic into the suprapancreatic part. In one case the stone had to be manipulated from the hepatic duct into the common bile duct.

Should one drain the duct with a T tube or leave a drain down to the closed incision in the duct? One has tried both methods, and I think that the convalescence is shorter when the duct is closed.

It is remarkable that the very simplest operation on the gall-bladder may result in death, and there may be no explanation for it. In one of the cases the technique consisted merely in dividing a peritoneal band connecting the gall-bladder to the duodenum. In several of the cases the gall-bladder contained no stones, was the seat of chronic inflammation, and its removal presented no technical difficulties. This, I think, is important, as it shows that mere simplification of technique will not prevent the occasional death. Age is an important factor, and some of the deaths were in people over 70.

The Problems of Gall-Bladder Surgery in 1942.

The problem of the stoneless gall-bladder.

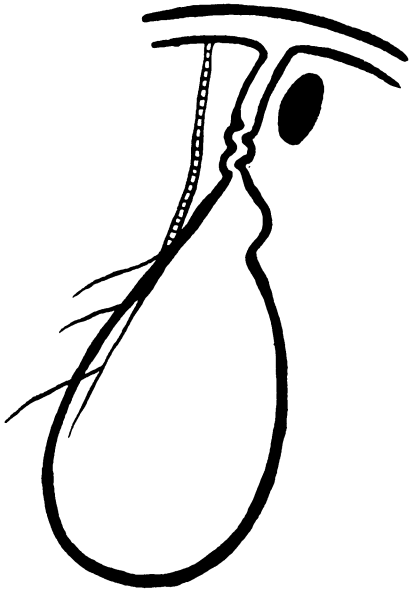
The operation has been undertaken for the relief of dyspeptic symptoms or biliary colic, with poor concentration as seen on the radiogram. If one finds definite living pathology, then one should remove the gall-bladder, but there are a number of border-line cases which will give rise to indecision. On the one hand he may remove a gall-bladder without relieving the symptoms, or he may leave a gall-bladder which had it been removed would have cured the patient.

Cholecystostomy v. cholecystectomy.

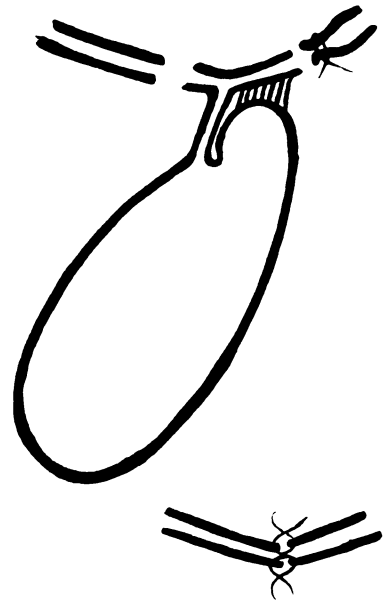
Should one perform a simple and safe operation, and run the risk of reformation of stones, plus the chance of leaving stones in the cystic duct, or aim at a permanent cure with a somewhat higher mortality.

When should one explore the common duct and how determined should one be in this exploratoin?

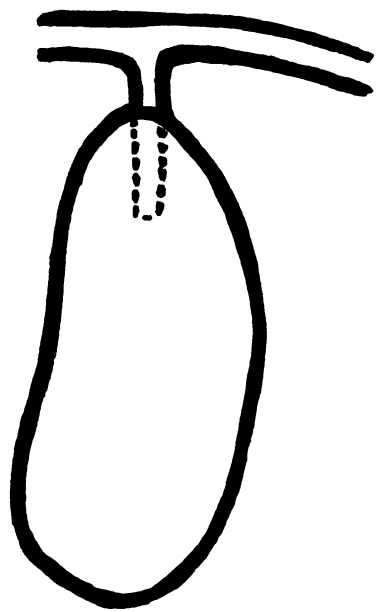
In an article in "British Journal of Surgery" (Mackey, October, 1934) the following statement is made: "The risk of attack upon the gall-bladder has been



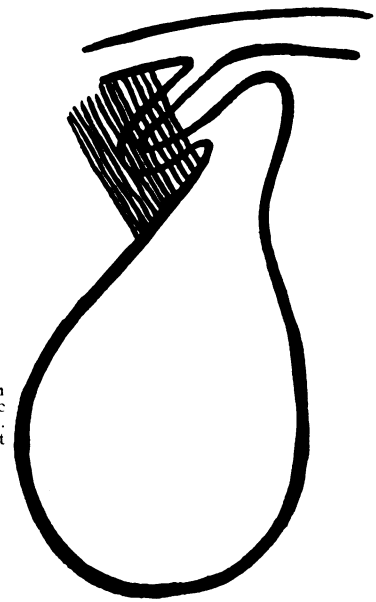
1.—Normal gall-bladder and cystic duct. Note the cystic gland medial to the duct, the cystic artery lateral to the duct, the spiral valve in the lower half of the cystic duct, and the small medial bulge of the neck of the gall-bladder (Hartman's bassinette).



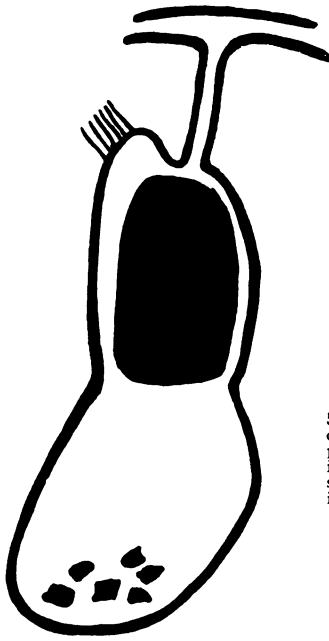
2.—A gall-bladder with a Hartman's pouch lying medial to the cystic duct. The pouch is attached to the common bile duct by a peritoneal fold. In removing this gall-bladder the mistake was made of removing the entire cystic duct, plus a portion of common hepatic duct and common bile duct. The small diagram below shows the end-to-end anastomosis between the common hepatic and common bile duct, which was performed successfully three days later. The patient made a good recovery, and the biliary fistula closed rapidly.



3.—A gall-bladder with a Hartman's pouch lying anterior to the cystic duct. This is the gall-bladder from the famous Man 50, whose sections have been used for many years in the Anatomy Department.



4.—Gall-bladder showing a Hartman's pouch medial to the cystic duct and a kink of the cystic duct maintained by ligamentous attachments. The gall-bladder was stoneless, but distended. It was removed.



5.—Gall-bladder showing a pouch lateral to the cystic duct, which was fixed by a ligament to the portal fissure. There was a large stone impacted in the upper part of the gall-bladder and a few stones in the fundus. The large stone was visible in the straight X-ray. After removal of the stones, the gall-bladder was removed.

to a great extent eliminated, and interest has moved away from mortality statistics, bacteriology, and pathology, to be focused upon end-results and theories of gall-bladder function." The figures of this hospital do not justify this statement, as we are still a long way above the par figures of the course. One should aim at a two per cent. mortality for gall-bladder operations uncomplicated by common duct obstruction.

Operation mortality.

Operation mortality depends much upon selection of cases, upon avoidance of the bad case, and upon luck. All the worst cases gravitate towards the surgeon with a reputation, and thus spoil his figures. It is said that Treves only did easy appendices, and left the fifth-day cases to his assistant. The wise old owl knows what to avoid.

The common bile duct.

The common bile duct still remains somewhat a problem to me. I am accustomed to leave alone the common duct which looks normal and feels normal and is not accompanied by jaundice. Still, on two occasions a patient has returned, after cholecystectomy for gall-stones, with a stone in the common duct. This passage of a sound down the common duct into the duodenum may be possible through a short wide cystic duct, but otherwise the common duct must be opened. One surgeon confessed to me that on one occasion he pushed a sound through the wall of the duct into the head of the pancreas, with the result that the patient died. I cannot believe that the single passage of a sound through the bile papilla will permanently relieve obstruction or permanently stretch a sphincter of Oddi. Systematic sounding of the duct may very occasionally disclose an unsuspected stone, but only at the cost of serious disturbance to a number of normal ducts. Better, I think, to perform a second operation when necessary.

The Stoneless Gall-Bladder.

The following conclusions by Mackey are of value in this matter.

Removal of a stoneless gall-bladder carries a mortality of three per cent. cure of symptoms results in thirty per cent., improvement in thirty per cent., unsatisfactory in thirty-seven per cent.

The more diseased the gall-bladder the more likely is the outcome to be favourable.

Cholesterosis alone does not produce symptoms and does not justify removal of a gall-bladder.

Microscopic changes are not significant unless they are fairly gross.

Remarks on Common Duct Stone.

The longer a patient carries gall-stones, the more frequent is the incidence of common duct stone.

Duration	Incidence of common duct stone
Under 2 years	2 per cent.
2-10 years	9 per cent.
Over 10 years	11 per cent.

Frequency of common duct exploration.—This varies in surgical lists from seven to twenty per cent.

The frequency of common duct stone has been estimated as eighteen per cent. of all gall-stone cases.

Pre-operative treatment in common duct obstruction.—Delay operation one or two weeks. Water, salt, sugar, and blood are the chief needs; these can be given intravenously as glucose saline and blood transfusion. Calcium gluconate and vitamin K tend to reduce bleeding.

Operation in common duct obstruction.—Anæsthesia : icoral, spinal anæsthesia, and gas and oxygen. Limit the technique to the minimum, and in the most severe cases one should merely drain the common duct and leave the removal of the stone to a later date.

Post-operative.—Ten per cent CO_2 in oxygen during four deep breaths, repeated four times an hour during the first twenty-four hours, diminishes the tendency to lung collapse.

Follow-up.

I am much indebted to Miss Gough and her assistants for the follow-up of one's gall-bladder operations during the period 1935 to 1939.

The following results were obtained :—Good recovery 38, improved 14, still under treatment 12, dead 8, untraced 30.

Three of the dead were over 70. The untraced may have changed their address or may be dead, but of the seventy-two traced—72 per cent. show a good result, seventeen per cent. a poor result, eleven per cent. dead.

Many of the patients wrote enthusiastic letters as to the benefits of the operation, and several enclosed a one pound note as a subscription to the hospital.

REVIEW

CATECHISM SERIES.—SURGERY (Fifth Edition). Parts I to V. Author not stated. Pp. 376. With X-ray plates. Price : each part 1s. 6d. net. Complete in one vol. 7s. 6d. net. ANATOMY (Fifth Edition). Part V (Thorax). By C. R. Whittaker, F.R.C.S.E., F.R.S.E. Pp. 76. Price 1s. 6d. net.

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However, it is undeniable that a few find a catechism of real value, especially by way of revision. To these few the present series can be recommended. In the Surgery series the range of subject matter is wide, the answers adequate enough for the final examinations, the lists of contents, lay-out, and index well arranged. The reproductions of X-ray plates in parts I and II could, with ease and advantage, have been enlarged to fill the ample space available. One deplores the paucity of diagrams, but perhaps it is the intention of the author to confine himself strictly to the verbal reply.

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THE ULSTER MEDICAL SOCIETY

THE Society has now completed another most successful winter session. Fourteen meetings were held, and the presence of many members of His Majesty's Forces and of the Medical Services of the United States was gratifying to Fellows and members.

The opening meeting was held on 15th October, 1942, when the incoming president, Dr. Robert Marshall, was invested with the Whitla chain of office by Dr. George Lyttle. Dr. Marshall then delivered his presidential address on "Some Aspects of Myocardial Disease."

Two Robert Campbell Orations were given: the first, by Professor V. P. Sydenstricker of the Rockefeller Foundation, dealt with "The Clinical Aspects of Deficiency Diseases"; and the second, by Professor R. A. Q. O'Meara of Trinity College, Dublin, was entitled "Some Problems of Diphtheria in the Light of Modern Knowledge." On each occasion the president referred in appropriate terms to the late Mr. Campbell, and Sir Thomas Houston presented a bronze memorial plaque to the orator.

The other papers were as follows:—

"Amputation Sites and Artificial Limbs," by Dr. R. L. Kelham.

"Blood Regeneration in Blood Donors," by Major J. S. Alstead, R.A.M.C.

"Observations on the Scalenus Anticus Syndrome," by Captain R. L. Swank and Captain F. A. Simeone, U.S.A.M.C.

"An Introduction to the Surgery of the Gall-Bladder," by Prof. P. T. Crymble.

"Chronic Urinary Infections in Infancy and Childhood," by Colonel T. H. Lanman, U.S.A.M.C.

A Discussion on "Medical Education," opened by Professor V. M. Synge.

A Discussion on "Neo-Natal Mortality," opened by Dr. F. M. B. Allen, Mr. C. H. G. Macafee, and Professor J. H. Biggart.

Physiological Laboratory meeting was held in Queen's University, and a Clinical meeting in the Royal Victoria Hospital. The Society is grateful to all those who contributed to the success of a memorable session.

H. HILTON STEWART.