

I have to acknowledge gratefully the assistance of Dr Walls, the resident obstetric surgeon to St Mary's Hospital, who saw the patients in the first instance and helped me at the operations, and from whose notes the history of each case is written.

IV.—IS MEMBRANOUS CROUP ALWAYS DUE TO THE MICROBE OF DIPHTHERIA?¹

By GORDON SHARP, M.D., Leeds.

THE discovery of the specific cause of diphtheria in the shape of the organism known as the Klebs-Loeffler bacillus entitles us to the hope that this oft hotly contested question may be for ever settled. If the bacillus is found in the membrane in every case, then we shall have to answer in the affirmative; but if, on the other hand, membranes exist in which no organism answering to the specific one present in true pharyngeal diphtheria, then the contention of the Scotch School (1)² will be established as a certainty. If the discovery of Klebs and Loeffler does nothing more than enable investigators to clear up this difficulty, it will have done a great deal. But many years must elapse before the verdict is received, and meanwhile we must be content with clinical evidence.

In the discussions hitherto on this vexed point, the love of truth has often been lost, and calm reasoning has given place to national prejudice. Bretonneau (2), although he did so much to advance the knowledge of diphtheria, was the first great sinner when in the preface to his great work he wrote:—"Francis Home persuaded himself that he had just met with an affection which had hitherto escaped the attention of his predecessors; he thought he ought to give it the popular name under which he found it designated in a Scotch province. The novelty of his discovery was widely diffused, and the new denomination so fascinated all persons, that it prevented them from recognising a disease observed from the most remote antiquity, and which in our days is accompanied by all the symptoms which it has uniformly exhibited."

Bretonneau's indictment conveys a compliment to Home and the "Scotch province," and a rebuke to Home's contemporaries and successors.

Although the title of my paper defines the subject I wish to discuss, so much confusion has collected around the name "croup," that I may be allowed to state what I do *not* mean by the term. I exclude the affections known as *laryngismus stridulus* and acute

¹ Being part of a Thesis for which the writer received the degree of Doctor of Medicine in the University of Edinburgh.

² The figures within parentheses refer to the Literature at the end of this paper.

catarrhal laryngitis, in which there is no membrane present, and which latter, so far as I can gather from writings and from personal experience, is a definite affection, and when uncomplicated usually results in recovery. This I believe to be consistent with contemporary knowledge. I think one is further justified in excluding all cases of laryngeal membrane due to destroying agents such as steam, hot water, carbolic acid, ammonia, corrosive sublimate, the corrosive acids, the caustic alkalis, or any other agent which kill the epithelial covering, and so in many instances form a cast of the windpipe or other part to which they are applied. These act mechanically in reality, but in their destruction of proteid matter a certain amount of fibrin is present. Thus strong chemical or mechanical agents in their action in this particular way resemble the bacillus of diphtheria, the growth of which is attended with the production of much fibrin. We have good reason for excluding all cases of membrane due to these chemical and mechanical agencies, for when we have a history of their presence then we may expect a membrane. I have seen a membrane covering the whole of the tonsils and pillars due to corrosive sublimate poisoning, and which when stripped off left bleeding points. There was no doubt about the cause, for we had evidence of the poison being taken. If this takes place in the throat, so may it in the air-passages. This narrows us down to a membrane in the windpipe in which there is no distinct evidence of a previous diphtheria in the throat. I am not forgetful of the fact that valuable as Bretonneau's contributions are, they are to be received with caution by the man who desires to arrive at the truth, for much that he wrote was written for the purpose of proving the error of Home's observations. The same applies to his pupils and followers, among whom we may mention Trousseau, Guersant, Bouchut, Empis, and Daviot, all of whom were more or less prejudiced against the Scottish observers.

Since Bretonneau's time opinion has somewhat changed in Great Britain, and many pathologists and clinicians have adopted the views of the great physician of Tours. In 1879 a committee of the Royal Medico-Chirurgical Society of London (3) obtained the views of many of the Fellows of the Society on this vexed question, but, so far as I have been able to interpret the replies, in general they leave the query unanswered,—in fact, much as it was. I have read the works of Home, Cheyne, and others; but they are all so well known, and are so fully noted in the said report, and are so often quoted, that it is unnecessary for me to do more than mention the names, and I pass on to state shortly the views of other authorities, and to offer criticism or comments on the various points which may be raised in the quotations.

Osler (4) says—"Between diphtheritic laryngitis and croup a majority of writers now hold that there is no essential difference." But the verdict is not so unanimous as Osler would have us believe. True, it is often stated that in Scotland the rank and file

of the profession regard croup as different from diphtheria of the windpipe, while in England croup and diphtheria are looked upon as one and the same. This may or may not be true of the general practitioners of England, but amongst the writers at least in England the so-called Scotch view seems to find the largest number of supporters, as I will presently show. Seymour Taylor (5), in 1894, in discussing diphtheria, places after it, and within brackets, "membranous croup," leading us to believe that he regards them as one and the same. Hamilton (24), too, if I mistake not, in his book regards membranous croup as diphtheria affecting the air-passages. Senator (6) evidently shares Bretonneau's views, for he says Rupprius of Baden was the first to show that the pharynx generally is the first affected in croup, and Bretonneau followed. John Abercrombie (23) says, "The membrane may either spread to the larynx, or the disease may attack that part primarily, a condition to which the name croup used to be and is by some few writers still applied." William Squire (7) says, "Epidemic croup is strictly diphtheria." But then one must not forget that it is here only of epidemic croup that the writer speaks. Ziegler (8) I have misgivings in quoting, for although in the statement which follows he would appear to look upon croup and diphtheria as the same, yet we must remember he discusses the question from the standpoint of the morbid anatomist pure and simple. Further, he employs the terms croupous and diphtheritic inflammation,—terms which to-day are hardly appreciated in Great Britain. Altogether one hardly knows on which side to place Ziegler's evidence. He writes: "It will be seen that we make no pathological distinction corresponding to that implied in the clinical terms croup and diphtheria. The specific infective disease diphtheria, when it is accompanied by croupous or superficial diphtheritic inflammation of the larynx and trachea, is the same as the affection clinically described as 'membranous croup,' a term which the pathologist may well dispense with." So much for the dogmatic teaching in favour of the identity of the two so-called conditions; and when I cite the opinions on the other side, I think it will be agreed that the verdict is far from being so unanimous as Osler states.

So long ago as 1843 Watson (9) wrote,—“The croup is not contagious, although, like *cyananche tonsillaris*, and for the same reasons, it is found sometimes existing at the same time or in quick succession in more than one child of the same family.” This would rather point to its contagiousness, one would naturally imagine. A further quotation from the same authority shows that the malignancy is greater than most observers—who hold croup and diphtheria as different affections—scribe to croup. Watson says, —“It is said that four children out of five attacked by it used to die, but that now, the treatment being better understood than formerly, the number of deaths and number of recoveries are nearly equal.” Hilton Fagge (10) gives a definite opinion, saying,—

“What I regard as a non-infectious malady—namely, croup.” And he makes another statement, about which there is no uncertainty,—“To sum up, it seems clear that no fixed line can be drawn between membranous croup and the milder forms of the disease in which no false membrane is developed, except in those cases in which it occurs over and over again with sudden and alarming, but very transitory, symptoms, may be separated under a distinct designation, for which purpose the name of spurious croup seems to be the most appropriate.” Charteris (25) cautiously puts it, “Diphtheria and croup are closely allied.” Norman Moore (11) gets out of the difficulty by saying, “Croup is a clinical term, and has no precise pathological meaning, and may be due to one of three pathological conditions—(1), Laryngismus stridulus; (2), diphtheria affecting the larynx; (3), acute catarrhal inflammation of the larynx and trachea.” This is hardly likely to advance our knowledge, for I think most authorities now regard laryngismus stridulus as a distinct condition common among rickety children, and acute laryngitis is by nearly every one spoken of as false croup. On these grounds one is justified in taking exception to this author’s summing up of the disease called croup. In the days of Home and Cheyne, Moore’s definitions might have passed, but now we have made an advance, and the difficulty is reduced to a question of membranous croup and diphtheria. Coates (12), while recognising that the great majority of cases of croup are really diphtheria affecting the air-passages, goes on to say,—“Looking at the matter from a purely pathological point of view apart from clinical experience, it certainly seems possible that other irritants may produce similar results.” Payne (13), in discussing this question, writes,—“It should, however, be stated that a croupous membrane is readily produced in the air-passages of animals by irritating substances (ammonia, acetic acid, etc.), and is, though rarely, produced in man by simple irritants, possibly cold.” This point will be dealt with later on. Green (14) has the following:—“Simple mechanical or chemical injuries will produce a typical croupous membrane.” Maguire (15) believes that we have cases not due to diphtheritic poison, and writes,—“There remains still a certain proportion of cases of membranous laryngitis which are not due to the action of the diphtheritic poison.” Henoeh (16) speaks of diphtheritic croup and inflammatory croup, and the different mortality in each, so he would appear to favour the idea of two distinct diseases. But here, again, we are in a difficulty, for the Germans, with all their advances in pathology, cling to the terms catarrhal, croupous, and diphtheritic inflammations, the two latter of which we in Great Britain regard as confusing and somewhat antiquated. Goodhart (17), in writing of croup, says,—“My own opinion is that there are grounds sufficient for a belief in the existence of a non-diphtheritic as well as of diphtheritic membranous croup.” Frederick Taylor (18) gives it,—“There can be no doubt that diphtheria sometimes begins in the larynx. But there are

cases of laryngitis with the formation of membrane which are called croup, and these by some are supposed to be purely catarrhal, or at least not contagious, and not due to diphtheritic poison." Aitken (19) says boldly, "True croup—'the croup' is a different disease—a disease different from diphtheria." He describes the membrane as alkaline in reaction; if this be actually so, it differs from the membrane in true diphtheria, which, according to Sidney Martin, contains an organic acid, and one would naturally expect it to be acid in reaction. My own experience is that the throat and its secretions in diphtheria and other affections is acid. Da Costa (20) writes,—“I am still of the belief that there is such a disease as a membranous laryngitis which is not diphtheria.” Flint (21) gives his view in the following words:—“Whether diphtheria and membranous croup be distinct diseases. Regarded from a clinical point of view, it seems to me clear that this question is to be answered in the affirmative. There is, moreover, nothing in the pathology of the disease opposed to this view. It is established, both experimentally and clinically, that pseudo-membranous inflammations of the throat may be produced by a variety of causes, such as inhalations of hot vapour, the swallowing of corrosive poisons, etc.” Warburton Begbie (22) in one of his essays makes an observation with which I close this list of quotations:—“I remember, as I have observed before in this Society (the Medico-Chirurgical Society of Edinburgh), on the occasion of my first seeing cases of croup in the French hospitals, to have been struck by noting the great care exercised in the examination of the mouth and throat of the child, and when instances of the disease were described by Trousseau or Guersant I failed to recognise the distinguishing features of the disease as familiar to me in the writings of British physicians.”

As I have already said, I suggest that we bring this question within narrower limits by throwing out all cases of membranous laryngitis due to mechanical or chemical injury. Syphilis, being a chronic malady as far as the air-passages are concerned, hardly comes within the limits of consideration. This practically leaves only the simple febrile condition designated by the name of cold to be considered as a cause of membrane of the windpipe. I say practically, for measles, scarlatina, and other diseases affect the throat and larynx in many instances, and hence come within the scope of our inquiry, and will be dealt with when we have discussed the question of cold. Can cold, then (as suggested by Payne and others), or any of the simple febrile affections cause the formation of a membrane in the air-passages? Cold is denied by many authorities to be of itself a cause of disease, but cold weakens a tissue and makes it liable to attack, and when cold is suggested we suppose that this is what is often meant. Let us examine the matter more fully, and try to learn from the effect of cold on other parts. We take the throat. No part of the body is, perhaps, more liable to disease. In breathing, the soft palate, pillars, and tonsils are im-

pinged upon by air of varying degrees of temperature, and we find them red and inflamed in cold weather. The throat, so to speak, acts like a breakwater to the alimentary and respiratory tracts. The nostrils, too, are subject to the evil effects of changes of temperature and of suspended particles in the air that is breathed, and hence we find them especially liable to catarrhal affections. In the throat and nostrils cold produces almost no membrane; at the most it is a thin shimmering layer of almost no consequence. If cold, so-called, then, brings about so little membrane in the throat and nostrils, the tissues of which appear to be the most favourable to attack, I think we are entitled to be sceptical as to cold producing an extensive membrane in the larynx, otherwise that it can produce membranous croup. So much for cold; and I now turn to the consideration of some other conditions in which the throat suffers. We find it affected in gout, rheumatism, typhoid fever, measles, scarlatina, and in most diseases in which there is a rise of temperature. In many of these, too, the nostrils suffer. The fact, too, of particles of food lodging about the throat and tonsils makes the part a culture soil for maladies of another kind, such as thrush. Most of these may be rapidly passed over. Gout, rheumatism, and typhoid fever hardly concern us. Rheumatic sore throats are attended with little membrane, or so little as to cause no anxiety. Quinsy may be attended with small necrotic yellowish patches, but no continuous membrane. Measles produces very little alteration beyond redness and swelling in the great bulk of instances, and in the worst cases a necrosing of the superficial layers in small patches distinct from each other, and with no tendency to spread. Scarlatina may show nothing but redness or a collection of yellowish dots, which, when examined by the microscope, is seen to be made up of round cells, or in the worst cases a series of necrosed patches are seen, but not the continuous membrane of diphtheria. Of course, one excepts the combined cases in which diphtheria is associated with the scarlatina. Others might be enumerated, but enough has been said to pave the way for my contention. The windpipe suffers little, as a rule, in the diseases just considered, and in the severest cases I question if ever a false membrane appears.

Without being too dogmatic, as the result of my experience, I incline to the view that membrane in the larynx is (saving under the conditions already enumerated) due to the poison of diphtheria, and I pass on to answer some of the objections to this view in the following terms, drawn from observations made in my own practice. To the objection that croup (membranous) begins without any affection of the pharynx, I answer there is no reason why diphtheria should not first attack the windpipe and even never spread beyond this. We often find a catarrhal laryngitis while the parts of the tract above and below are spared, or we may have a nasal and pharyngeal catarrh accompanying a bronchial catarrh, the intervening larynx and other parts being passed over. But more, we

may have a membrane in the windpipe, and only the merest red patch in the throat, and yet this patch is diphtheria, for it is often difficult to get a good view of the throat in a refractory child. A child, as is well known, may have considerable throat trouble without making complaint, and often diphtheria is not suspected till, as a matter of routine, the mouth is examined. That membranous croup is a disease of early childhood is met with the answer that so is diphtheria to a large extent, the tender tissues of the young being apparently especially suitable for the growth of the microbe. In croup it is or was held that boys are more liable than girls. Before this could be settled one would have to eliminate all cases of laryngismus stridulus and other affections unattended with membrane, and all of which were formerly included under the one name croup. Besides, in records of cases I have gone into (in which all kinds of cases are included), boys and girls appear to be nearly equally subject. As I write, I have beside me a record of thirteen cases, by Disney Alexander of Halifax, published 100 years ago (when Home's views held sway). The list gives seven girls and six boys. A large number of cases of croup occur during the first year of life, and it is an established fact that within this period more boys die than girls, and this means that disease in general attacks baby boys more than baby girls.

It is often said that croup is not contagious, while diphtheria is highly so, and in consequence croup may be confined to one member of a large family. This can hardly be adduced as an argument in favour of croup so-called not being contagious, or to say the least it is a weak one, as I intend showing. Highly contagious diseases may be confined to one member of a large family. A short time ago I attended a girl of 16 in well-marked scarlatina. Three younger members of the family remained free, and yet complete isolation was impossible in the house. A boy of 12 contracted scarlatina during an epidemic of the disease. Four younger members of the family remained free (the boy was the only one of the family attacked), and yet this patient was at home all the time. He was confined to one room, but in a small cottage house it was impossible to keep a child from straying into the bedroom. During the same epidemic a boy in another family was the only sufferer out of a large number of members, and that, too, under the most unfavourable surroundings as to house-room. A girl of 4 contracted diphtheria, confirmed by bacteriological examination. A brother two years older and two children younger, members of the same family, remained well. A boy of 7 had diphtheria, an older brother and sister in the same house did not contract the disease, and yet they could not well be kept away from the patient. The mother, who nursed the boy, did all the household work and cooking. A girl of 4 had diphtheria in a cottage house, and six other children, members of the same family (the eldest 12 and the youngest at the breast), remained well. Instances might be multi-

plied, but I think enough have been given to show that infectious and contagious diseases like diphtheria and scarlatina may be confined to one member of a family even under circumstances favourable to their spread. Hence the necessity for caution in accepting the view of their being a non-contagious croup.

The argument sometimes adduced, namely, that membranous croup is sporadic, breaks down, for we often see diphtheria and scarlatina occurring sporadically. One hears it stated that in membranous croup there is no previous throat trouble, but malignant diphtheria may exist and yet cause little throat trouble. The following cases, taken from the practice of a fellow-practitioner, illustrates this. A child became ill with symptoms pointing to a stomach trouble. The tongue and mouth were examined, but nothing pointed to the throat. The child died suddenly, and a second child became ill, and this led to a very thorough examination of the patient, when a membrane was discovered in the throat. An examination of the body of the first child revealed a membrane in the throat. The second child died.

The following illustrate, as I take it, the relationship of pharyngeal and laryngeal diphtheria. A young man contracted diphtheria and died. The disease had often broken out in cases of two or three at a time at different periods in this neighbourhood. Six months later, next door to this case, a boy became ill on a particular Sunday afternoon, with symptoms pointing to the air-passages. The throat was reddish and catarrhal. On Monday the breathing became increasingly difficult, and symptoms of "croup" appeared. Tracheotomy was performed, and the child died on Tuesday morning. Taken by itself this latter case might have passed as non-contagious croup, but the fact of diphtheria being common in the district throws a different light on the condition. I should add that membrane was discovered in the windpipe.

The next class illustrates how diphtheria may first manifest itself (by serious symptoms) in the air-passages, and yet may have been previously present in the throat in a mild form. One child ill for some days, but so trifling as to call for no medical attendance, became suddenly worse one day, the breathing being difficult and croupy in character. This increased, and the patient died in less than forty-eight hours after having been first seen. None of the other children were affected. This might have passed as an instance of non-contagious croup, saving for the following circumstances. The throat was red, and I fancy I detected a membrane in the throat, but the child was so nervous that it was with the greatest difficulty I could get a partial view. A fortnight later a child living next door became ill in the same manner, and died in less than twenty-four hours of "croup." The throat was evidently affected with diphtheria, but *the* symptom prominent was the croupy condition. Both lived in a most insanitary district, and the two families intermixed freely although warned of the danger.

The next case is an instance of what is often observed. A man had a sore throat, but so slight as to pass almost unobserved by him. In six weeks he lost all power in his legs, being helpless in the extreme,—in short, he suffered from diphtheritic paralysis. A child may in the same manner have diphtheria of the throat so slight as to escape detection till it spreads to the windpipe, as it is more prone to do in the child than in the adult, and after all there may be much in Bretonneau's contention.

Within a narrow circle of a densely populated area three instructive cases occurred within a few weeks of one another. A boy complained of sore throat. The throat and tonsils were red, but no membrane was seen, and the condition could hardly be called diphtheria, and was looked upon as simple sore throat. In a day or two laryngeal symptoms came on, and he died. Soon after, a child in the next street but one, and within 100 yards or thereby, began with croupy symptoms and died. Taken by themselves these two cases might have been passed by as simple croup, but studied in conjunction with the next, we have to consider whether they may or may not have been diphtheria. Soon after, a man in the street between these contracted diphtheria and recovered. All may have been diphtheria.

During an epidemic of sore throat in a district in which diphtheria is often prevalent, I saw on the 20th April a woman of 36 and her boy aged 4 who complained of sore throat. In both patients the skin was dry, the pulse rapid, and the throat red, with a yellowish pellicle on the tonsils. I said both were most likely simple, but in case of their being diphtheria, it was best to avoid contact with the other members of the family. My opinion was the more cautiously expressed, because in this same block of buildings in which they lived fatal cases of diphtheria had taken place. Next day both looked better under treatment, and on the third day they had so far recovered that I did not deem it necessary to further attend them. On the 2nd of May I was hastily summoned to the boy (that is, nearly a fortnight after I had first seen him). I found him breathing rapidly and with great difficulty, and with a well-marked croupy cough. No complaint was made of the throat this time. On examining his throat I saw a thick yellow membrane extending from side to side. The history of the present illness was that he got over his former throat affection, had been to school all the week, and on the Friday evening began suddenly with symptoms of "croup," after having been paddling barefoot in a brook near at hand. The breathing was so distressing that I had under consideration the advisability of opening the windpipe, and I told the parents of this, and to apprise me at once if very urgent symptoms appeared. A terebene vapouriser was placed in the room. Ultimately the boy recovered without operation. There would appear to be little doubt as to this being diphtheria, for albumin was present in the urine abundantly, and on the seventh day the

heart-beats became intermittent. The sudden onset and recovery, on the other hand, look like what one hears described as "croup." About the throat trouble there is no doubt in this case. The boy may have suffered from diphtheria in the first illness on the 20th April, and the disease remained latent till the 2nd May, when it spread more in the throat, but only developed severe and alarming symptoms when it extended to the air-passages.

In concluding, I again add that on the whole I am disposed to count myself a convert to the view of Bretonneau and the French School,—till bacteriology has finally settled the point of dispute.

LITERATURE.

1. FRANCIS HOME.—*An Enquiry into the Nature and Cause of the Croup.*
2. BRETONNEAU and OTHERS.—*Memoirs on Diphtheria.*
3. *London Medico-Chirurgical Society's Report for Year 1879.*
4. OSLER.—*Principles and Practice of Medicine.*
5. SEYMOUR TAYLOR.—*Index of Medicine, 1894.*
6. SENATOR.—*New Sydenham Society's Publication.*
7. WILLIAM SQUIRE.—*Reynold's System of Medicine.*
8. ZIEGLER.—*Special Pathological Anatomy, 1884.*
9. SIR THOMAS WATSON.—*Practice of Physic, 1843.*
10. HILTON FAGGE.—*Principles and Practice of Medicine.*
11. NORMAN MOORE.—*Medical Anatomy.*
12. COATES.—*Manual of Pathology.*
13. PAYNE.—*Manual of General Pathology.*
14. GREEN.—*Manual of General Pathology, 1881.*
15. MAGUIRE.—*Quain's Dictionary of Medicine, Article by*
16. HENOCH.—*New Sydenham Society's Publications.*
17. GOODHART.—*Diseases of Children.*
18. FREDERICK TAYLOR.—*Manual of Practice of Medicine.*
19. AITKEN.—*The Science and Practice of Medicine.*
20. DA COSTA.—*Medical Diagnosis.*
21. FLINT.—*Treatise on Principles and Practice of Medicine.*
22. SIR DYCE DUCKWORTH.—*Warburton Begbie's Works, Edited by*
23. JOHN ABERCROMBIE.—*Fowler's Dictionary of Practical Medicine.*
24. D. J. HAMILTON.—*Text-Book of Pathology.*
25. CHARTERIS.—*Practice of Medicine.*

V.—SHORT NOTES ON THE VALUE OF THE BACTERIOLOGICAL EXAMINATION IN DIPHTHERIA.

By F. REID MACKAY, M.D., late Bacteriologist, Fever Hospital, Edinburgh.

THE criticisms against bacteriological methods of diagnosis in diphtheria can be divided into two groups :—The first, those who