FIVE CASES
OF
TRACHEOTOMY IN CROUP,
WITH REMARKS ON CERTAIN POINTS CONNECTED
WITH THE OPERATION.

(With a Postscript containing two additional Cases.)

BY
HENRY WILLIAM FULLER, M.D. CANTAB., F.R.C.P.L.
PHYSICIAN TO ST GEORGE'S HOSPITAL, ETC.

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THE propriety of performing tracheotomy in croup has been called in question by many eminent members of our profession, and much difference of opinion has been expressed in regard to several points relative thereto. I propose, therefore, to offer a few remarks on two cases in which the operation has been performed successfully at St. George's Hospital, and on three in which it failed in its object. By so doing I hope to elicit the opinions of those whose experience has been more extensive than my own on this most important practical subject, and at the same time to furnish additional grounds on which to base a just estimate as to the propriety of the operation, the proper time for performing it, and the conditions essential to its success.

The following case which fell under my own care at the hospital will furnish an appropriate text for my remarks :

CASE 1.—Elizabeth W—, æt. 8, was admitted into the Crayle Ward at 1.30 p.m. on September 24th, 1856.

She had enjoyed good health up to the 20th instant, when she complained of sore throat, which, on the following day, was accompanied by cough, and considerable distress of breathing. A medical man was sent for, who pronounced it croup, ordered some medicine, and applied a few leeches to the throat. No improvement resulted, and the next morning, therefore, the throat was blistered. Still no relief was obtained; and about 5 a.m., on the morning of the 24th, the dyspnœa became much more urgent. From this time the symptoms rapidly increased in severity, and at 1.30 p.m., when she arrived at the hospital, she was gasping for breath; her countenance was pale; the lips were rather livid; the pulse was imperceptible, and she was covered with a cold clammy perspiration. After recovering from the fatigue of the journey, she rallied slightly, but the dyspnœa continued excessive; there was frequent gasping for breath; the voice was almost inaudible; the cough was entirely suppressed; the jugular veins were turgid; and the pulse could only just be felt. It was 140 in the minute, very irregular, and intermitted frequently. The person who brought the child to the hospital stated that an emetic had not been administered, and as I was unwilling to have recourse to tracheotomy until every other means of recovery had been tried, I ordered an emetic composed of tartarized antimony and ipecacuanha to be taken immediately. It acted speedily, and resulted in the bringing up of a little thin mucus, and three small shreds of white false membrane. This, however, did not relieve the breathing, and as suffocation was imminent, I requested my colleague, Mr. Pollock, to perform tracheotomy. This he did most skilfully at a quarter past three o'clock. There was very little hæmorrhage either during or after the operation, and the relief afforded was immediate. The moment the incision was made, several plugs of white false membrane were coughed up through the wound, and the little patient fell asleep on the table even before the introduction of the tube. Subsequently a double canula was inserted through the wound, and the breathing went on calmly and regularly.

As the bowels had not been moved for two days, a brisk purge of scammony and calomel was given immediately, and two grains of calomel with six of chalk were administered every four hours. A saline draught was also ordered to be taken at the same time, containing eight minims of antimonial wine. Further, an experienced nurse was kept by the bedside day and night for the purpose of watching the patient, and removing any mucus or other matter which might chance to obstruct the canula. The child slept at intervals during the night, and was much easier the next day, but the bowels had not acted since her admission, and a senna draught was therefore administered. The remedies previously ordered were continued up to the 27th instant, when, as the chief symptoms were subsiding, the draught and powders were repeated only three times daily. On the 29th, the remedies were discontinued, as there remained no symptom requiring their administration. From the time of her admission up to the evening of the 27th, white croupy matter mixed at first with thin mucus, and afterwards with thick muco-purulent matter, was ejected in considerable quantity through the canula, but no false membrane was seen subsequently to that date. On several occasions she had suffocative paroxysms resulting from temporary obstruction of the canula, and on the night of the 26th, she had a severe attack of dyspnœa, which lasted about a quarter of an hour, and ceased on the withdrawal of the tube; but with this exception the case did not present an untoward symptom from first to last. The cough and thick muco-purulent expectoration, which remained after the 29th instant, was relieved by a little squill mixture; the wound healed kindly, and my little patient left the hospital in perfect health on the 14th of October.

I have been thus precise in narrating the details of this case, because they bear on various points to which I shall have occasion to refer, as exercising an important influence on the successful issue of croup cases requiring operative interference.

The other four cases were under the care of my colleagues at the hospital, and to their kindness I am indebted for leave to make use of them on the present occasion.

CASE 2.—Hannah C—, æt. 5, was admitted into the Holland Ward, under the care of Dr. Bence Jones, at 1.30 p.m. on the 3d of October, 1854. She had been attacked with croup nine days previously, and in spite of medical treatment the symptoms had gradually increased in severity. On admission her breathing was stridulous, and her distress considerable; but the pulse was tolerably good, and there were no very urgent symptoms of suffocation, so it was determined to apply some leeches to the throat, and to try the effect of a brisk emetic, followed by calomel, salines, and tartarized antimony. No relief, however, was thus obtained. By 8 p.m. the urgency of the symptoms had greatly increased, and it was evident the child would speedily sink if immediate relief were not afforded by tracheotomy. Already she was gasping for breath, and was cold, pale, and unconscious, and the pulse, which could scarcely be felt, intermitted frequently. Mr. Hewett was, therefore, called upon to open the trachea. Considerable hæmorrhage occurred during the operation, and some blood trickled into the windpipe, causing violent paroxysmal cough and dyspnœa. During one of these fits of coughing a mass of tough, white, albuminous concretion was seen through the lips of the incision. This was seized with the forceps and dragged out, and in this way two large pieces were removed from the trachea, one of which measured nearly three inches in length. A large tube was then introduced through the opening, and all hæmorrhage speedily ceased. The child, however, was so much exhausted that it was judged expedient to administer a small quantity of wine and water. Subsequently the calomel, salines, and antimony were continued as before.

The breathing was greatly relieved by the operation, the pulse soon improved, and the child fell into a dose. During the night she had several severe paroxysms of cough and

dyspnœa, and some hæmorrhage recurred, which was stopped by the application of a styptic. The next morning, however, the breathing was much more free; her countenance was tranquil and of a natural colour; she had a tolerable pulse, and was much improved in every respect. From this time she made steady progress; the tube was removed on the fifth day; the wound healed kindly, and she left the hospital in perfect health on the 25th of October.

CASE 3.—Maria G—, æt. 16, was admitted under the care of Dr. Bence Jones, at 6.30 p.m. on the 23d of March, 1855. She was a stout, plethoric girl, and had suffered from cough, hoarseness, and more or less shortness of the breath ever since the 19th instant. Nevertheless, she had not undergone any medical treatment prior to her admission into the hospital. She was then suffering greatly from dyspnœa and pain in the chest; the breathing being very rapid and shallow, but not accompanied by much stridulous noise. The pulse was quick and sharp. Leeches were applied to the chest, an emetic was administered, and salines with tartarized antimony were prescribed every four hours. She had two attacks of suffocative dyspnœa during the night, which subsided without the ejection of any false membrane, and the next day the face was flushed, and the pulse 130, and sharp. Leeches were, therefore, applied again to the chest, and the mixture was repeated every two hours. The dyspnœa, however, increased towards evening; the lips became blue; and the pulse much more feeble. The breathing was now unaccompanied by stridor. On the morning of the 25th, she was weaker; the dyspnœa was very great, and was aggravated in paroxysms; and the lips were excessively blue. At 8 p.m. laryngotomy was proposed, but eventually, at 10 p.m. tracheotomy was performed by Mr. Hewett. At the time of the operation the pulse was imperceptible; the lips were no longer blue, but pale; and she was bedewed with a cold perspiration. Soon after the opening was made she coughed up a considerable quantity

of blood, which had trickled into the trachea during the operation, and almost instantly expired. Artificial respiration was performed in vain. After death the trachea was found to contain about two drachms of blood partly fluid; the mucous membrane of the larynx and trachea was highly injected, and covered almost throughout by a layer of soft, yellow, albuminous exudation, and the epiglottis was similarly covered on its posterior surface. The fauces and œsophagus were in their natural condition. The lungs were very cedematous, and the lower lobes on either side were hepatized. The bronchial mucous membrane was especially vascular throughout, and was covered to a great extent by the same sort of soft albuminous matter which existed in the trachea. Many, even of the smallest bronchi, especially those leading to the inflamed and hepatized portions of the lungs, were full of this deposit.

The heart and other viscera were in a normal condition.

It is worthy of remark, in regard to this case, that neither in its history nor in its symptoms did it resemble a case of uncomplicated croup, and that although it was deemed advisable to have recourse to tracheotomy, the deep oppression and extreme shallowness of breathing, together with the cough, which had existed from the first, rendered it probable that the lungs were extensively affected, and that the operation would be unsuccessful.

CASE 4.—Henry S—, æt. 5, was admitted, at 11 a.m. on the 24th of April, 1856, under the care of Dr. Nairne.

His mother stated that he had been quite well up to the 20th instant, when he complained of sore throat. Medical aid, however, was not had recourse to until mid-day on the 23d, when he was suddenly seized with dyspnoea. Leeches were applied to the throat and medicine was administered, but the next day the breathing was much more difficult, and the child was therefore sent to St. George's Hospital.

On admission the countenance was pale and anxious, the pulse quick and feeble, the respiration stridulous, the

dyspnœa urgent. An emetic, which was given directly, took no effect, and in the course of half an hour suffocation became so imminent, that it was determined to have recourse to tracheotomy without further delay. The operation was performed by Mr. Pollock, and as soon as the trachea was opened the child became more tranquil, and appeared to breathe without much difficulty. Soon afterwards he fell into a doze. The breathing continued tranquil throughout the day, the pulse improved, the countenance assumed its natural colour, and the cough, which recurred at intervals, led to the ejection of a considerable quantity of shreddy mucus and false membrane through the tube. One or two doses of saline and antimony mixture were given after the operation; but, beyond these one or two doses, no medicine was administered. He passed a tolerably tranquil night, and next morning was very much more comfortable; but in the afternoon the tube became obstructed, and great dyspnœa ensued. With a view to the introduction of a new tube, it was thought necessary to enlarge the opening into the trachea, and during this operation a good deal of blood escaped, some of which trickled down into the air-passages and caused excessive dyspnœa, which never ceased until the child died suffocated, shortly afterwards, *i. e.*, at 5.30 p.m. The post-mortem examination revealed ulceration of the soft palate and tonsils, and a thick layer of recent lymph on the latter. The mucous lining of the epiglottis and larynx was covered throughout with a similar very thick layer of false membrane, and the aryteno-epiglottidean folds were very œdematous. The lining membrane of the trachea was covered with a very thin layer of albuminous deposit mixed with stringy tenacious mucus and blood, and the membrane was stained of a red colour. The larger bronchi presented a similar appearance, but to a much less extent. The lungs were congested, and the smaller bronchi contained a good deal of thick mucus, mixed with blood.

In connexion with this case, I would merely remark on the

great relief afforded by the operation, on the length of time (about thirty hours), during which the respiration continued tranquil, and on the unfortunate accident which led to its interruption, and (probably by re-exciting inflammation) to the speedy occurrence of suffocation. The immense relief obtained by the operation seems to countenance the belief that the extensive albuminous deposit found after death, was poured out during the few hours preceding death, which were marked by the accession and continuance of dyspnœa. If such was the case, there was nothing in the condition of the parts at the time of the operation to preclude the chance of recovery.

CASE 5.—Thomas D—, æt. 4½, was admitted, under the care of Dr. Wilson, at 6.30 p.m., the 2d of November, 1856. He had undergone an attack of scarlatina about the middle of September, and had never since regained his health. On the 31st of October he was exposed to cold, and began to cough in the evening of the same day. On the 1st of November, however, he was well enough to play about as usual, and it was not until 7 p.m. on that day that unequivocal symptoms of croup presented themselves. Early on the morning of the 2d, he was seen by a medical man, who treated the case vigorously with emetics and calomel until 6 p.m., when, as the symptoms did not yield, he recommended the removal of his patient to the hospital. As the child had been barely twelve hours under treatment, and the dyspnœa, though considerable, was not as yet accompanied by any great degree of pallor or lividity of the countenance, it was judged expedient, for a time at least, to continue the administration of calomel and salines, and to give tartar emetic in quarter-grain doses. The child slept at intervals during the night, and though he had suffered one or two attacks of urgent dyspnœa, he appeared somewhat easier the next morning. Towards noon, however, the symptoms assumed an alarming character, and in a short time the countenance became ghastly pale, the eyes became fixed, and suffocation appeared imminent. Mr.

Hewett was therefore asked to perform tracheotomy, which he did at 1 p.m., and the operation was not attended by much hæmorrhage. The child was a good deal exhausted, but at 2 p.m., after coughing up a considerable quantity of mucus through the wound (no false membrane) he was greatly relieved, and fell asleep. Beef-tea, port wine in half-ounce doses, and cinchona, were ordered. Throughout the remainder of the day and the following night he seemed comfortable in every respect; he continued at intervals to cough up through the tube a considerable quantity of mucus, and each time he did so he manifestly obtained relief. During the intervals, the breathing, though quicker than natural, was performed without difficulty. Early on the morning of the 4th, however, his face became flushed and his skin hot, and by degrees some difficulty of breathing ensued. From this time the dyspnœa gradually increased, and at half-past three in the afternoon became urgent: no mucus or discharge of any kind came through the tube, which was removed without effect, and death from suffocation speedily took place.

Dissection showed the subcutaneous tissues round the tracheal opening indurated, and infiltrated here and there with purulent fluid; the pharynx exceedingly congested; the tonsils enlarged and hardened, and presenting old cicatrices and one or two small specks of recent ulceration on their surface; the epiglottis natural, but the larynx, and the trachea almost down to its bifurcation, lined with concrete albuminous exudation, which at the upper part of the wind-pipe was exceedingly firm, and formed a distinct cast of the tube; the bronchial lining membrane congested, and covered with thick mucus, and the right lung in one part passing into the early stage of red hepatization. The other viscera were healthy.

The principal points to which I would call attention in reference to this case are—the immense relief obtained by the operation, and the presumption thereby afforded that at the time of its performance the tracheal and pulmonary

obstruction was far less extensive than that found after death ; the length of time during which the patient continued free from urgent dyspnoea ; and the chances against the ultimate success of the operation, consequent on the patient's previous attack of scarlatina, and his subsequent ill-health.

Thus, then, it would appear from the result of the cases above detailed, that, whatever the theoretical objections to tracheotomy in croup, the operation is attended with a fair proportion of success, and that, unless the recoveries obtained through its agency at St. George's Hospital are quite exceptional, it ought to be had recourse to when other remedies have failed. But the experience obtained from such a limited number of cases is not of itself sufficient to determine the propriety of the operation, and therefore I propose to discuss the question generally, and to endeavour to bring together such facts as shall enable us to decide— 1st. Whether the operation of tracheotomy is justifiable in any case of croup? 2dly. If so ; under what conditions and at what stage of the complaint? 3dly. Whether the existence of certain symptoms or other circumstances ought not to cause us to hesitate in recommending its performance? 4thly. Whether any, and what medical treatment is necessary after an opening has been made into the trachea?

The first question which arises is, as to the propriety of the operation. Are we justified in recommending the performance of an operation which is admitted on all hands to fail frequently in its object, and as to the probable success of which in any given case we can obtain very little reliable evidence?

With a view to a correct decision on this subject, it is necessary to refer for a few moments to the various forms of acute disease which have been comprised under the name of croup, and to the great difference observed in their physiological and pathological effects. Excluding the so-called spasmodic croup, known more commonly as child-crowing, which can hardly be confounded with true croup, there are two affections, differing widely in their nature, which are deserving of especial notice. The one is idiopathic inflam-

matory croup, met with sporadically in this country and elsewhere; the other a diphtheritic affection of the throat, which is sometimes accompanied by croupal symptoms, and which, though comparatively of rare occurrence in England,¹ is exceedingly common in France, and often prevails there in an epidemic form. The former commences by inflammation, more or less extended, of the mucous lining of the air-passages, and is attended, in the majority of instances, by a concrete albuminous exudation into the larynx, trachea, or bronchi, one or all of these parts being affected; the latter begins by erythematous redness of the tonsils and fauces, with a more or less plastic exudation on their surface, and, as the disease progresses, the inflammation extends down into the pharynx, and passes sometimes into the nares, sometimes into the larynx, trachea, and bronchi, where it usually produces an albuminous exudation on the surface of the mucous membrane in no way distinguishable from that which accompanies inflammatory croup. In idiopathic inflammatory croup there is no external affection of the throat, whilst the diphtheritic form of the disease, like that which follows measles, scarlatina, and other of the exanthemata, is often accompanied by considerable glandular swellings and œdematous fulness about the neck, rendering tracheotomy a difficult operation. Moreover, the symptoms which accompany the latter form of disease very rapidly assume a typhoid character, so that a fatal issue may be looked for, quite irrespective of any impediment to the respiration. If then, in spite of the difficulties which surround it, the operation of tracheotomy is often crowned with success in this diphtheritic form of croup, much more are we entitled, theoretically at least, to hope for a successful issue in inflammatory croup.

Well! how stands the case as to the diphtheritic form of

¹ Although this is strictly true, diphtheritis does sometimes prevail epidemically even in England. A very severe outbreak of the disease occurred at Haverford West in 1849-50, so severe indeed that one practitioner, Mr. J. D. Brown, had no less than 200 cases in his own practice, of which 40 proved fatal. (See 'Med. Times and Gazette,' Dec. 28th, 1850.)

the disease? In the year 1826, M. Bretonneau announced that he had operated on three cases, and that in one of them life was saved by the operation.¹ In 1835, he had operated on 17 children, and had saved the lives of 5.² As long ago as 1840, M. Trousseau reported having operated in 80 cases, which resulted in 60 deaths and 20 recoveries,³ and in a lecture recently delivered at the Hôtel Dieu,⁴ he gives the result of his operations for croup during the four years ending 1854. They were 24 in number; in 10 cases the children died, in 14 they recovered. M. Letexerant reports the details of 47 cases in which the operation was practised during the years 1850-51. Of these, 30 died and 17 recovered. And I wish to draw attention to the results of M. Trousseau's later experience, as stated above, and to the following numbers, reported from the Hôpital des Enfants Malades, at Paris, as evidence of the increasing success which attends the operation as the practice becomes more thoroughly understood, and due precautions are more carefully attended to. M. Becquerel, writing before 1842, and giving the results of tracheotomy in croup, as practised at the Hôpital des Enfants, reports: "depuis dix ans, on n'a sauvé qu'un seul cas de croup sur plus de cent opérations qui ont été pratiqués."⁵ Whereas in 1850, the official reports of the same hospital give 20 operations and 6 cures; in 1851, 31 operations, and 12 cures; in 1852, 59 operations and 11 cures; in 1853, 61 operations and 7 cures; in 1854, 44 operations and 11 cures; or, on the whole, 215 operations and 47 cures, or nearly one quarter of the whole. And when it is remembered that at the Hôpital des Enfants Malades, the children, as M. Trousseau observes, are "of the poorest class, who have been neglected

¹ 'Traité des inflammations spéciales du tissu muqueux et en particulier de Diphthérie.'

² See a Thesis 'Du croup et son traitement,' par Jules Louis Chenantais, p. 52. Paris, 1844.

³ See 'Cyclopedia of Practical Surgery;' article bronchotomy, by T. Spencer Wells.

⁴ See 'Medical Times and Gazette,' January 5th, 1851.

⁵ Thesis 'Du Croup et son traitement,' par Jules Louis Chenantais, p. 53.

or badly treated prior to their admission into the hospital," and "are surrounded by the contagion of scarlet fever, measles, smallpox, and hooping-cough, which often cause the most fearful complications," it is only surprising that the operation has been attended with so much success; and we may well believe M. Trousseau's statement, that "half the operations performed out of the hospital are successful." But, taking the numbers as they stand, and excluding the 100 cases referred to by M. Becquerel, in which, during the infancy of the operation, tracheotomy was performed at the Hôpital des Enfants, and in which it must be presumed some accidental and avoidable cause led to the uniformly fatal result, we find a grand total of 383 operations and 103 recoveries, giving a proportion of one recovery to every 3·7 operations; or, excluding the numbers reported since 1850, from the Hôpital des Enfants, where, for the reasons already stated, the chances against the success of the operation are greatly above the average, we obtain a total of 168 operations and 56 recoveries, or a proportion of one recovery to every three operations. And when it is considered that the operation is not had recourse to until the second stage of the disease has set in, or in other words, until the disorder has reached a point from which, before the introduction of tracheotomy, very few recoveries took place, the conclusion seems inevitable, that in croup cases generally, including the diphtheritic form of the disease so prevalent in France, the operation is eminently successful, and is productive of an enormous saving of life.

What then is the difference between the diphtheretic form of the disease and idiopathic inflammatory croup, which should lead us to regard the operation so successful in the one as totally inapplicable to the other? There certainly is nothing in the nature of the accompanying fever which should lead us to anticipate a more favorable result in diphtheritis; for in idiopathic inflammatory croup the vital powers are far less rapidly depressed than in the diphtheritic form of the disease. Neither is there any in the condition of the throat externally, for that again is greatly in favour

of success in idiopathic croup. Is there any then in the extent of the disease or the condition of the œsophagus? Many authorities answer in the affirmative. "In France," says Dr. West, "croupal symptoms are induced in the majority of cases by the extension to the larynx of false membrane, originally deposited on the fauces and soft palate, while the windpipe itself is comparatively seldom in a state of active inflammation often unaffected; and the bronchitis and pneumonia, which in this country so often and so seriously complicate the disease, are of less common occurrence."¹ Now I am satisfied that this reputed absence of tracheal pulmonary affection in France is not in accordance with actual facts, and has been too hastily assumed by English writers, with the view of explaining the success which has attended tracheotomy in croup, in the hands of French surgeons. Messrs. Bretonneau, Roger Collard, Guersant, and all French authorities, speak of the frequency of tracheal and pulmonary complications. M. Matice reports:² "les pneumonies lobulaires sont très communes; dans l'épidémie de 1840 à 1841, c'était la complication prédominante;" and again, "la bronchite se rencontre aussi très souvent;" and certainly during the months I was working in the wards of the French hospitals at Paris, almost all the cases of croup I saw there were accompanied by symptoms of pulmonary and tracheal affection. Indeed I am at a loss to discover the source of the erroneous doctrine so commonly promulgated in England as to the comparative rarity in France of croupal pulmonary affections. Possibly it may have arisen from the confusion created by

¹ West 'On Diseases of Children,' 3d edit., p. 304. It is right, however, to add that, at p. 307, after reviewing the various arguments which have been urged against the operation, Dr. West speaks of "the circumstances which make him hesitate in expressing a decided opinion against tracheotomy, and that prevent him from joining at present in that unqualified condemnation of the operation in cases of croup which has been pronounced by the greater number and the most weighty of English authorities."

² 'Du croup, de sa nature, de son traitement,' par C. F. Matice. Paris, 1846.

many French writers in not drawing a distinction between diphtheritis and idiopathic croup. For diphtheritis is not primarily an affection of the air-passages, and consequently if all cases of diphtheritis, whether accompanied or unaccompanied by croupal symptoms, are to be regarded as instances of true croup, there cannot be a doubt that pulmonary complications are far less common in croup, as it occurs in France, than in the idiopathic inflammatory croup of England. But the cases of diphtheritis in which the air-passages escape are not attended with croupal symptoms, and therefore are not included in the numbers from which the French statistics of tracheotomy are deduced, and all the reliable evidence we possess goes to prove that when the air-passages *do* suffer in diphtheritis, the mischief is of the same character, and extends quite as far as it does in ordinary inflammatory croup. The results of careful pathological research are quite conclusive on this point. With the view of determining the existence, seat, and extent of false membranes in the air-passages, M. Chenantais has recorded the post-mortem appearances observed in 140 cases of croup.¹ They occurred in France, and therefore the majority of them were probably examples of the diphtheritic form of the disease.

In 25 the false membrane did not extend beyond the larynx and the middle of the trachea.

In 50 the affection reached to the lower part of the trachea.

In 22 the larger bronchi were affected.

In 19 the false membrane reached the smaller bronchial ramifications.

In 7 the seat of the exudation was not precisely limited.

In 7 no false membrane was found in the air-passages.

Another series of 171 cases has been collected and reported by M. Hussenet.²

In 30 of these instances the larynx and trachea were implicated, but no mention is made of the state of the bronchi.

¹ 'Du Croup,' par Jules Louis Chenantais. Paris, 1844.

² Thèses de la Faculté de Paris, No. 63, p. 73, 1833.

In 78 false membranes occupied the trachea, but did not extend below.

In 26 the larger bronchi were affected.

In 16 the smaller bronchi were implicated.

In 21 no false membranes were found.

Now from these statistics it is obvious that, when diphtheritis attacks the air-passages, the extent of mischief is nearly, if not quite, as great as that which is met with in idiopathic inflammatory croup, so that in this point of view the former disease, when accompanied by croupy symptoms, does not, as compared with the latter form of croup, present any greater prospect of success for the operation of tracheotomy than it does in the character of its accompanying fever, or the condition of the throat externally.¹

Thus, then, it must be admitted that, in spite of the theoretical objections to the operation, the practical success which has attended its performance is sufficiently striking; for in France, where, before the introduction of tracheotomy, croup (by that term implying both forms of the disorder) proved fatal to nearly two thirds of those attacked,² and almost invariably destroyed life when it had reached its second stage, patients at the present day are not only saved as, heretofore, when the attack is mild and manageable, or when they come early under treatment, but in about one third of the more formidable or neglected cases are actually snatched from the jaws of death by the operation of opening the trachea.

What then is the practice in these cases in England?

¹ If the above statistics and the results of Dr. West's experience in London are taken as the basis for an opinion as to the relative severity of the affection of the air-passages in France and England, it would appear that as far as croupal exudation is concerned the disease is more formidable in the former country, for Dr. West says ('On Diseases of Childhood,' 3d edit. p. 307) "In the chief of the cases that have come under my notice among the poor in London, the deposit of false membrane was very limited and the larynx was the chief, sometimes the exclusive seat of the disease."

² See 'Rapport de Royer-Collard, p. 165.

It may be stated generally that if medicinal agents fail to relieve our patients who are attacked with croup, we rarely attempt to save their lives by operative interference. So notorious has this become, that in a lecture recently delivered by M. Trousseau, at the Hôtel Dieu, he asserted that, "throughout the whole extent of Great Britain, tracheotomy is not so much practised as it is in Paris alone." And such is indeed the fact. Our chief English authorities have, almost without exception, opposed the operation, principally on theoretical grounds, and those surgeons who have been most zealous in attempting to save life by its agency have been daunted by their ill success in the few cases in which they have performed it. Without wasting time by an unnecessary quotation of authorities, I may be permitted to refer briefly to a few of those whose opinions are most entitled to respect. Dr. Cheyne was strongly opposed to the operation. Dr. Mason Good states that "there is but little hope of any benefit from such an operation." Mr. Porter speaks of the satisfaction he feels at having assisted in checking the growing tendency to the performance of an operation "which cannot effect a cure, and which, therefore, there can be no reasonable motive for undertaking." Dr. Watson "would be inclined to look upon it as absolutely hopeless, but for two instances recorded in the 'Medico-Chirurgical Transactions;'" and Dr. West reports that, "in England, the result of almost every instance of the performance of tracheotomy in croup has been so unfavorable that the operation is scarcely looked upon as a justifiable proceeding." No wonder that in the face of such authorities the operation seldom has been had recourse to! It must be remembered, however, that these gentlemen do not found their opinion, as to its inefficacy, on its observed results in any large number of cases, but rather on theoretical objections arising out of the pathological effects of the disease, and of the ill success which has attended the operation in the comparatively few cases in which it had been performed in England prior to the publication of their respective works. And in estimating the value of such

opinions it must be remembered that out of the first 100 cases operated on at the Hôpital des Enfants, at Paris, before the conditions essential to success were understood, no less than 99 proved fatal, whilst by taking the precautions which an extended experience has pointed out, nearly a fourth of the cases are now saved. But putting conjecture and theory aside, enough has been done already in England to prove that tracheotomy, performed even in the very last stage of the disease, is followed not unfrequently by favorable results. In the third volume of our 'Transactions,' Dr. Farre relates the case of a boy successfully operated on by Mr. André. The child was on the very point of suffocation, when his throat was opened, and he recovered perfectly. Mr. Chevalier relates a similar case in the sixth volume of our 'Transactions;' Mr. Craig, of Ayr, in Scotland, has recorded another in the person of a child aged seven.¹ Dr. Prior, of Bedford, has reported another, the patient being a boy five years of age;² one case was successful about four years ago in University College Hospital;³ Mr. Jones, of Jersey, has put another on record, in which the sufferer was a boy five years of age, a patient at the Jersey Hospital;⁴ and I have myself witnessed two successful cases in St. George's Hospital.⁵ And these, be it observed, were, without exception, instances in which the operation was deferred until the last stage of the disease, when suffocation was imminent, and when it was morally certain that life would soon have become extinct if the breathing had not been relieved by tracheotomy. And if the details of the fatal cases are examined, there will be found even in them much ground for encouragement; for it will be seen that in a very small proportion of them were the symptoms of a nature to preclude the possibility of recovery, and further experience may enable us to distin-

¹ See 'Medical Times and Gazette,' May 21st, 1853.

² 'Association Medical Journal,' Nov. 16th, 1855.

³ 'Medical Times and Gazette,' Dec. 9th, 1854.

⁴ 'Association Medical Journal,' Oct. 4th, 1856.

⁵ A third successful case is reported in the postscript to this paper.

guish such cases during life, and so to avoid the performance of the operation. In the sixth volume of our 'Transactions,' Mr. Chevalier relates a case in which relief was obtained for a few hours. Mr. Porter¹ details one in which a girl, aged five, went on favorably until the fourth day after the operation; and another in which a girl, aged three and a half, was temporarily relieved, but was choked in the course of twelve hours, in consequence of her inability to expectorate through the wound, "any mucus which was thrown into the wound being sucked back again by the next inspiration." Dr. John Wilson² has recorded the case of a boy who was operated on whilst in a moribund state, was relieved, fell asleep, and continued to breathe tranquilly until he was suffocated ten hours afterwards by accidental obstruction of the canula. Mr. Erichsen³ has reported another case in which a child aged five years who had been subject to fits, and had also suffered hemiplegia, was going on satisfactorily in every respect, when on the day succeeding the operation she was seized with a fit and died. Mr. Henry Smith has reported three cases:⁴ the first was that of a boy, aged two, who was operated on at 11.30 a.m., whilst in a moribund state, and ceased to breathe before the completion of the operation. Artificial respiration restored him to life, and for eight hours everything went on admirably, the child "breathing with ease." At 8 p.m., however, there was a sudden accession of dyspnœa, probably from obstruction of the tube, and almost immediately the child ceased to exist. The second case was that of a girl, aged four, who underwent the operation at 2 p.m. on the 12th of August; ejected a considerable quantity of mucus and false membrane through the artificial opening, was greatly relieved, passed a fair night, and the next morning was "breathing with tranquillity." Stupor subsequently occurred, and she died at 2 a.m. on the 14th,

¹ 'On the Larynx and Trachea,' pp. 74-8.

² 'Med. Chir. Trans.,' vol. 25, p. 71.

³ 'Lancet,' May 4th, 1850.

⁴ 'Medical Times and Gazette,' March 5th, 1853.

thirty-six hours after the operation. The third was that of a child, eleven months old, who was temporarily relieved by the operation ; but expired six hours afterwards, evidently prostrated by the effects of the disease, or else asphyxiated by reason of the small quantity of air admitted through the opening, for there was no obstruction in the trachea or bronchi. Two more cases have been recorded by Mr. Smith, in which the croupal symptoms arose subsequently to scarlatina.¹ In the first of these the child was four years old, the throat was in a sloughy condition, the child was on the brink of suffocation, and the pulse was almost imperceptible. The operation afforded immediate relief, and the child lived seven days afterwards, when extensive aphthous ulceration of the mouth, and an attack of capillary bronchitis set in suddenly and carried her off. The second case occurred in the person of a girl five years of age. She was operated on at midnight, and experienced immediate relief: the air was heard entering the chest "freely and softly," and "the chest expanded well;" the child took nourishment at once, and fell into a sound sleep. Early in the morning she was nearly asphyxiated by obstruction of the canula, but was relieved by its withdrawal. Throughout the day she continued comfortable ; but towards evening she became very depressed, and died at 11 p.m. Another instance is related by Dr. West of a boy, aged twenty-one months, who was operated on by Mr. Arnott in the Middlesex Hospital, and was thus kept alive for forty hours ; and of the three fatal cases which I have witnessed, and which are recorded in this communication, one only presented symptoms which precluded a reasonable hope of recovery. The cases above referred to include all the fatal cases of which I can find records in the English journals, and in almost all of them immense relief was afforded by the operation ; in several of them no false membrane was found below the seat of the artificial opening, and death in some of them appears to have resulted from accidental and possibly

¹ 'Medical Times and Gazette,' Jan. 26th, 1856.

avoidable causes. But even supposing that death was the unavoidable result of all these cases and of many others which may not have been recorded, still if life can be saved, as I have shown it may be, in a certain number of instances, by operative interference, I apprehend that a medical practitioner, to whom is intrusted the preservation of his patient, would not be justified, except under some peculiar circumstances, in withholding the chance afforded by the operation.

But here comes a question as to the stage of the disease at which the operation should be undertaken. Ought we, following M. Trousseau's example, to open the trachea as soon as the second stage of the disease has commenced? or ought we not, rather, to wait till other remedies have failed, and suffocation appears to be the inevitable result of the non-performance of the operation? It is asserted by those who advocate an early performance of tracheotomy, that much engorgement and inflammatory mischief in the lungs is prevented by admitting a free supply of air at an early stage of the disease; and that the patient, being stronger than at a later period, is better able to undergo the fatigue of the operation, and to cough up the false membrane, or the thick tenacious mucous by which the bronchi are obstructed and the breathing is oppressed. But, however plausible these suggestions may be, they must not be allowed to influence our practice, unless it can be shown, —1st, that the pulmonary engorgement so commonly presumed to exist during life is not attributable to the irritative influence of the disease; 2dly, that if referable to obstructed breathing, it occurs as soon as the second stage of the disease has commenced; and 3dly, that when suffocation is approaching, the patient is unable to bear the operation, or has not sufficient strength to cough up and get rid of the accumulations in his air-passages. And experience seems to negative these suppositions. Not only is it not uncommon to find pulmonary engorgement in croup unconnected with any material obstruction of the upper air-passages, but in many instances, even when the larynx and

trachea have been plugged with false membrane, the amount of pulmonary engorgement observed after death has not been greater than that which occurs in the course of three minutes in cases of ordinary asphyxia. Further, the operation is usually well borne, and expectoration takes place freely and easily as soon as the trachea is opened. In four out of the five cases recorded in this communication, in which the operation was not had recourse to until collapse had set in, and death was, so to speak, commencing, none of these theoretical difficulties were observed, nor were they, in more than one or two of the cases, whether successful or unsuccessful, of which I can find records in English literature. On the contrary, it is almost invariably remarked that in a space of time varying from a few minutes to half an hour or an hour after the operation, the patient coughed up some mucus or false membrane through the artificial opening, appeared much relieved by so doing, and fell asleep, breathing easily—facts quite inconsistent with the existence of any great degree of persistent pulmonary engorgement. It is no answer to such convincing evidence to adduce the results of post-mortem investigations. Doubtless in certain instances there are found after death abundant traces of acute bronchitis or true pneumonic consolidation. But in the majority of cases there is nothing more than excessive pulmonary congestion with capillary injection of the bronchial mucous membrane, and an effusion of frothy mucus into the bronchi—appearances presented in cases of ordinary asphyxia even when death has taken place in a few minutes, and has not been preceded by affection of the lungs. Admitting, therefore, that these appearances are found after death, their presence might indicate nothing more than death from asphyxia, and would not warrant any inference as to the protracted existence of pulmonary engorgement, and the consequent necessity for the early performance of tracheotomy. Even in France it appears that the results of more extended practical experience are beginning to dissipate the fallacious opinions

generally entertained as to the necessity for an early performance of tracheotomy. For MM. Bretonneau, Trousseau, others, who were formerly most forward in recommending its adoption at an early stage of the complaint, have lately had recourse to it only towards the latter stage, and when other remedies have failed.

Various considerations of a different kind tend equally to recommend this line of practice. It is well known, for instance, that in the earlier stages of the disorder, a certain proportion of cases will recover without tracheotomy; it is probable that a certain number perish from the direct and indirect consequences of the operation quite irrespective of the existence of the disease; and it is certain that the operation, however skilfully performed, must in many ways seriously complicate the case: whereas if its performance be deferred until other remedies have failed, and asphyxia is rapidly approaching, we do not endanger life by the operation, and therefore incur very little responsibility thereby. As, then, the theoretical objections to the late performance of the operation are found to have no foundation in fact, I submit that we ought not to open the trachea until other remedies have failed. The statistics of an early performance of the operation may possibly be found hereafter to furnish more favorable returns than those derived from its performance at a later period; but judging from what I have seen, and from what I can learn from the experience of others, I believe that the difference observed would not be greater than is explicable by there being included amongst the former a certain number of cases which would have recovered without tracheotomy. As long as it appears possible to save life without operative interference, so long, I maintain, we ought to withhold the knife; but directly it becomes obvious that our remedies have failed, and that life will be sacrificed if the trachea be not opened, that moment we ought to urge upon the parents the immediate performance of tracheotomy. Each minute that is lost afterwards is so much against the patient's recovery; for with approaching suffocation, the strength fails rapidly, and passive

congestion of the lungs takes place. It is impossible to lay down precise rules as to the moment at which the operation should be undertaken; that of course must be determined in each case by the discretion and judgment of the practitioner in attendance; but it is obvious that no time should be lost in having recourse to its assistance when the third stage of the disease has set in; or in other words, when the respiration is becoming feeble, the skin cold and clammy, the eyes fixed, the voice faint and whispering, the pulse rapid, feeble, or intermittent.

But are there no signs whereby we may prognosticate the issue of the operation in any given case, or which, as indicating the impossibility of recovery, should cause us to hesitate in recommending its adoption? Assuredly this is a difficult question to answer. If it could be shown that the lungs had already passed into a state of pneumonic consolidation, and that the bronchi were obstructed by masses of albuminous exudation, it would be in strict accordance with experience in such cases to anticipate a fatal result; and this being so, it would be folly to attempt an operation which must prove unproductive of ultimate benefit, and which, besides distressing the parents, must tend by its failure to bring surgery into disrepute. But unfortunately it has been established beyond dispute, that neither by a physical examination of the chest, nor by the most careful observation of the general symptoms, can we arrive at a certain conclusion as to the condition of the lungs, or the issue of the operation. Not only is it impossible to discover the point to which false membranes have extended, but even to diagnose with certainty the very existence of false membranes.¹ The extreme restlessness of the patient in the later stages of the disease, renders percussion difficult, and useless as a means of accurate diagnosis; and the stridulous noise attendant upon croupal respiration usually deprives us of the information which otherwise might be obtainable by auscultation. In certain cases the

¹ For an example in illustration of this point see West 'On Diseases of Children,' 3d edit., p. 295.

presence of vesicular breathing may be distinguished, and may lead to the inference that inflammation has not as yet extended to the lungs: and in others the existence of bubbling sounds diffused generally over the chest may serve to indicate pulmonary congestion, and the presence of fluid secretion in the air-tubes; but stethoscopists will understand how difficult, or rather impossible, it must be when the larynx is in a state of tumefaction or ulceration, or is plugged with concrete albuminous exudation, to draw any trustworthy conclusion as to the existence of bronchial obstruction merely from the weakness or absence of respiratory murmur over any portion of the lungs. Moreover, it appears from the results of dissection that the mortality after tracheotomy in croup does not bear a constant relation to the extent of false membrane, or of pulmonary engorgement. Not only have many cases proved fatal in which there has been no tracheal or bronchial obstruction, but instances have been put on record in which recovery has taken place in spite of albuminous concretions extending even to the minute bronchial ramifications.¹ Therefore, if the physical and social condition of the patient, and the existence or non-existence of any exanthematous or other disorder be excluded from the calculation, there appear to be no sufficient grounds on which to hesitate in recommending the operation. But the conditions just alluded to, and especially the social position of the patient, as implying the ability or inability to obtain proper assistance, and the unwearied and skilled attention which is absolutely essential to the success of the operation, must be allowed full weight in determining our line of practice. If the patient has been out of health prior to his attack of croup, if his illness has been preceded by pneumonia or severe bronchitis, if he is suffering from any exanthematous or other disorder; and further, if he is in such a position of life that his parents are unable to secure for him proper skilful attendance day and night, the operation ought not

¹ See a case recorded by Dr. Barker, 'Med. Chir. Trans.' vol. xxi.

to be recommended, however promising it might otherwise appear. For under such conditions it must almost certainly prove fatal, and although, if the trachea be not opened until the last stage of the disease, we should not risk life by its performance, the parents might justly censure us for recommending it, and the operation might fall into unmerited disrepute.

An argument against the general adoption of tracheotomy has been founded on the assertion that in many instances death results from the formation of fibrinous concretions in the heart, and happens quite independently of closure of the air-passages ; and it has been stated that this condition may be recognised during life by the coldness and pallor of the body, slight blueness of the lips, distension of the jugular veins, irregularity of the pulse, intense anxiety, gasping respiration, and constant movement.¹ But I am satisfied this assertion is founded on a wrong interpretation of the phenomena observed, which are attributable to the arrest of the blood in the pulmonary capillaries consequent on the interference with the process of respiration. The symptoms described are precisely those which accompanied both the successful cases recorded in this communication, and more than one of the other cases referred to, and they closely resemble those which occur in many cases of asphyxia. Why, in certain cases of croup, just as of asphyxia, the body should be pale, and in others of a blue or leaden colour, has not as yet been determined ; but possibly the difference may be attributable to the variation in the length of time during which life is prolonged after the pulmonary circulation is nearly arrested. If asphyxia is very rapidly induced and life becomes extinct whilst as yet dark-coloured, non-oxygenated blood is being sent to the system from the left side of the heart, the superficial capillaries are congested, and the body is therefore blue or livid, whereas if it take place slowly, very little blood will have

¹ 'Medical Times and Gazette,' March 8th, 1856, "On the Diagnosis of Fibrinous Concretions in the Heart in certain cases of Inflammatory Croup," by B. W. Richardson, M.D.

been sent from the left ventricle for some time prior to its occurrence, the superficial capillaries will have emptied themselves, and the body will be found pale. Certain it is that in croup, just as in asphyxia, pallor is not the primary effect of the negation of air, but after a time succeeds to blueness and lividity. And inasmuch as extensive inflammation of the lungs would of itself throw a mechanical obstacle in the way of free pulmonary circulation, and would tend to hasten the occurrence of asphyxia, the existence of the symptoms alluded to by Dr. Richardson must be regarded as indicating the propriety of tracheotomy, rather than as contraindicating the practice; the probability being, if such symptoms are present, that asphyxia has supervened slowly, and therefore that the parenchyma of the lungs is not inflamed.

There are certain points in the treatment to be adopted subsequently to the operation to which I wish to direct attention. So little importance seems generally to be attached to the after-treatment, that in several of the recorded cases it is not even alluded to; but in the three cases of idiopathic inflammatory croup reported by Mr. Henry Smith,¹ and in most of the other fatal cases on record, wine and brandy formed the chief if not the sole medicaments. On the other hand, in the successful cases recorded in this communication, in Mr. Jones's case at Jersey, and in other cases having a similar result, calomel, antimony, and the remedies which are usually considered useful before the operation, were steadily persevered in afterwards. And if it be remembered that the operation does not arrest the disease, but merely admits air, obviates the ill effects of spasm, facilitates respiration, and so affords time for medicinal agents to exert their curative influence, it is difficult to conceive on what principle the use of such agents should be discontinued. In the fatal cases, almost without exception, the breathing was immensely relieved by the operation, the symptoms of approaching asphyxia passed off, the

¹ 'Medical Times and Gazette,' March 5th, 1853.

countenance reassumed a natural appearance, and the patient fell asleep, breathing calmly. This period of tranquillity lasted for periods varying from a few hours in some instances, to three, four, and even seven days in others, and then in many of them the difficulty of breathing again began to manifest itself, and gave rise to death in the course of a few hours. In most of such cases dissection showed the larynx, trachea, and bronchi, one or all, in a greater or less degree, the seat of active inflammation and of concrete albuminous exudation; and the conclusion has been jumped at, that the operation failed in consequence of the wide-spread mischief in the air-passages which existed at the time of its performance. But is such a conclusion consistent with the observed phenomena? Is it likely, is it possible, that an obstruction of the air-passages, such as that which produced death, and which was made manifest by the scalpel afterwards, could have existed during the period of tranquil breathing and calm repose which followed the operation? or, is it not more probable, that subsequently to the operation the previously existing mischief had extended, or else that the inflammation had recommenced. In the museum of the Middlesex Hospital is an interesting preparation, which proves that an entire cast of the trachea may be formed within a very few hours. The child from whom it was taken, after undergoing tracheotomy, ejected a tubular portion of false membrane through the artificial opening, and fell asleep. In the course of a few hours the dyspnoea returned, and in less than seven hours from the time of the operation the child perished of suffocation, consequent on the pouring out of the fresh albuminous matter exhibited in the preparation. Now it is easy to conceive such a catastrophe occurring, not only under the influence of wine and brandy, but simply from the non-exhibition of those remedies which experience proves to be most efficient in subduing croupal inflammation and arresting its progress. If the inflammatory action has been already subdued, or is rapidly subsiding at the time of the operation, the patient may possibly recover without any further administration of

medicines, provided the smouldering embers of mischief are not rekindled by the injudicious exhibition of stimulants. But if active inflammation still exists, it is vain to hope for ultimate recovery, unless means are taken to check the continuance of the morbid action and the extension of its pathological effects. As well might we expect to arrest the disease without the aid of medicine before tracheotomy has been performed, as to save the patient without its assistance afterwards. Nor does it appear to me that in idiopathic inflammatory croup the administration of stimulants is at all in keeping with the nature of the disease or the necessities of the case. The exhaustion often observed after tracheotomy in these cases, just indeed as before the operation, is the exhaustion of asphyxia, which is to be remedied by the free admission of air, and by the performance, if necessary, of artificial respiration, but not by the administration of internal stimulants. We might as well give brandy to a person half strangled, as to a child half asphyxiated by croupy obstruction of the trachea. In the diphtheritic form of the disease, and in those varieties which follow measles, scarlatina, or other of the exanthemata, in all of which the patient is prone to pass into a typhoid condition resulting from the action of the poison which excited the original disease, it may be necessary to support the system, and not only to give tonics and stimulants before the operation, but to push them even to a greater extent afterwards. These cases, however, are quite distinct from idiopathic inflammatory croup, and require from the first a different treatment. And just as bleeding proves prejudicial to a patient's safety in the former class of cases, so stimulants must do in the latter. If for the moment a little wine may be necessary to counteract the loss of blood resulting from the operation, still to persist in its administration to the exclusion of those remedies which experience has pointed out as most efficient in arresting the disease, is to risk and prejudice our patient's chance of recovery.

It may be well at this point to draw attention to two causes, which, though not referred to in any book to which

I have had access, exert, I believe, a powerful influence in producing a fatal result. I allude to the shock sustained by the nervous system in the long-continued struggle for breath, and also to the imperfect subsequent expansion of the lungs, consequent on collapse of the pulmonary tissue. These, I am satisfied, together constitute the cause of the fatal issue in many of the cases in which the patient begins to sink some hours, or even days, after the operation, without any material increase of dyspnoea, and whilst all the symptoms are progressing favorably. The sinking observed is precisely analogous to that which is sometimes met with about the same period in persons who have been submerged or otherwise partially asphyxiated, and doubtless is attributable to the same agencies. How far it may be possible to ward off the fatal issue in these cases, by the adoption of appropriate treatment, is a question worthy of careful investigation; and it may further admit of inquiry, whether the inhalation of oxygen and the adoption of other means to stimulate the full expansion of the lungs, may not have the effect of warding off the catastrophe. However this may be, the occurrence of such cases, which has been adduced as a reason for not performing tracheotomy, does not, in fact, afford any argument against the operation. The utmost that can be urged is, that in a certain proportion of otherwise favorable cases, the operation will fail in consequence of the supervention of the symptoms referred to; and the possibility of such an untoward event might be urged with equal propriety against any attempt to recover persons apparently drowned, as against tracheotomy for the relief of those who are being asphyxiated by croup.

It is not my province to discuss the mode of performing tracheotomy in these cases, neither is it my intention to do so, but I may be permitted to add a few remarks on one point connected with the operation, which I am satisfied has a material influence on its successful issue. I allude to the size and construction of the canula inserted into the opening in the trachea. If, as is commonly the case, the larynx is only partially obstructed, the tube in common use may

suffice to introduce a due *supplementary* amount of air; but if by any chance the obstruction is complete, or becomes so subsequently to the operation, the patient who has only an ordinary trachea tube to breathe through cannot fail to undergo slow suffocation. Those who witnessed the early attempts at the administration of ether in surgical operations, will not easily forget the frightful asphyxia and convulsions which resulted from the use of a breathing tube of inadequate size; and if any persons doubt whether the symptoms of asphyxia may not have been attributable to the ether, they may soon convince themselves, by closing the nostrils and breathing for a short space of time through a tube of the same calibre. And yet the tracheal tubes in common use are of far smaller size than the breathing tubes alluded to, and like them would inevitably permit the super-vention of asphyxia, if the entrance of air into the lungs through the natural channel were altogether prevented. Not only is the external or upper orifice too small, but the tube is so tapered off towards its inferior extremity, with a view to facilitate its introduction into the trachea, that its internal or inferior orifice is not capable of transmitting one half of the quantity of air required for the supply of the system. And as in croup cases the passage by which air naturally passes into the lungs is apt to become completely occluded, for a time at least, sometimes by the occurrence of spasm, sometimes by the presence of a plug of false membrane, it is especially needful to use a full-sized canula, so as to provide against all contingencies.

If I may be permitted to offer a suggestion on this, the more strictly surgical aspect of the subject, I would recommend—

1st. That the trachea tubes be made larger, shorter, and less curved than those in common use, and that in every case a tube be employed of calibre equal to the tube of the trachea.

2ndly. That the *inner* tube, longer than the outer one, and somewhat flattened from side to side, be made of uniform

diameter throughout, and be so constructed at its inferior extremity, that the direction of its internal or inferior orifice shall be at right angles to that of its external orifice.

3dly. That the *outer* canula, instead of being constructed of one piece, as heretofore, be divided vertically and longitudinally into two blades, which shall not together make up a perfect tube, but (especially towards their inferior extremity), shall consist merely of the flattened lateral portions of a tube, the upper and lower portions of which have been cut away.

4thly. That the blades of the outer canula be fastened at their superior or outer extremity by a hinge, so constructed as to admit of their inferior extremities being brought together in a wedge-like form, after the manner of a dilating bivalve vaginal speculum, and of being expanded without a moment's delay, by merely pushing in the inner tube between them.

5thly. That a small screw be placed close to the hinge of the outer canula, so as to fix the blades in their expanded position, and thus to admit of the inner tube being withdrawn for the purpose of cleansing, leaving the outer one expanded.

The peculiarities and advantages of an instrument so constructed over those in common use, are—

1st. *The uniformity in the diameter of the inner tube.*—This would not only insure uniformity in the force of the expiratory blast throughout the whole length of the tube, and thus render an accumulation of mucus, and consequent obstruction, far less probable, but it would enable us to judge, by the size of the outer orifice, whether the calibre of the tube is such as to admit a sufficient supply of air—a fact which it is impossible thus to ascertain when ordinary trachea tubes are used, inasmuch as they are tapered off to a greater or less extent, according to the fancy of the surgeon or the instrument maker.

2dly. *The direction of the internal orifice of the tube.*—

This, independently of the length or precise curvature of the tube, would obviate all possibility of obstruction arising from the internal orifice of the tube being pushed against the posterior wall of the trachea, an accident which may readily occur with many of the trachea tubes in common use.

3dly. *The construction of the outer tube.*—This would not only facilitate the introduction of the tube through the edges of the incision, and thus save time in the performance of the operation, but it would render serious obstruction well nigh impossible, inasmuch as should the inner tube become obstructed, its withdrawal would at once open a free channel for the admission of air through the expanded blades of the outer tube. Further, it would enable us to dispense, if necessary, with the use of the inner tube, a circumstance of great importance in children in whom the trachea is small, and in whom, consequently, the thickness of a double canula forms a serious obstruction to the admission of a due supply of air. Indeed, whether in children or adults, the outer tube would alone suffice for all purposes.

These circumstances, I apprehend, are all deserving of careful consideration, and appear to me to justify the opinion, that, with an instrument such as that above described, an increased measure of success would attend the operation. At all events, it is certain that in cases of tracheotomy in croup, asphyxia supervenes with great rapidity; that the suffocative paroxysms consequent on an obstruction in the canula induce frightful distress and dangerous pulmonary congestion; and that, if we fail to anticipate and guard against such difficulties, we neither do justice to our patient, nor do we give the operation a fair chance of success.

POSTSCRIPT, *September 7th*, 1857.

Since the foregoing paper was read before the Society two other patients suffering from croup have undergone

tracheotomy in the wards of St. George's Hospital. The first died, notwithstanding the operation; the last recovered perfectly. As every instance of recovery possesses special interest whilst the question as to the propriety of the operation remains *sub-judice*, I have ventured to subjoin the particulars of the two cases, together with a few remarks thereupon.

The first patient was a girl, named Amy Stewart, aged five, who was admitted, under the care of Dr. Pitman, on the 11th of March, 1857. She had been subject to colds and coughs since birth, and had been attacked with wheezing, and harsh, croupy breathing, on the 9th instant. Nothing, however, was done for her relief until 8.30 on the 11th instant, when, as the symptoms were very aggravated, a medical man was sent for, who advised her immediate removal to the hospital. She arrived at St. George's at 10.30 p.m., when tartar emetic and other remedies were given; but the dyspnœa increased, the complexion became exceedingly dusky and dark-coloured, the extremities cold, the pulse almost imperceptible, and at 3 a.m. on the morning of the 12th instant, it was found necessary to have recourse to tracheotomy. The operation was performed by Mr. Hooper, the house surgeon, and gave immediate but not complete relief to the breathing. The dyspnœa decreased, the lividity passed off, and warmth returned to the extremities. Subsequently, however, the difficulty of breathing recurred, and at 1 p.m. she died.

The post-mortem examination showed the larynx and the trachea, almost as low as its bifurcation, coated by soft, yellow fibrin, a thin film of which partially covered the inner orifice of the opening made during life; the bronchi were congested, but free from false membranes; the lungs collapsed, but not otherwise diseased.

The only remarks I would make on this case are, 1st, that, inasmuch as all treatment had been neglected prior to the child's admission into the hospital, success could hardly

have been expected from the operation ; and 2dly, that the condition of the parts discovered after death renders it doubtful whether the fatal issue may not have been attributable in some measure to obstruction of the artificial opening.

The second case was that of Frederick Smith, aged six, who was admitted into Holland ward at 9 a.m. on the 26th of July, 1857, under the care of Dr. Barclay. He had been attacked with cough and huskiness of the voice on the 17th instant, which at 1 p.m. on the 18th instant had so much increased, and was accompanied by so much dyspnœa, that recourse was had to medical advice. Medicine was then administered, and a blister was applied to the chest, but nevertheless the symptoms remained unrelieved, and at 2 p.m. on the 26th instant the breathing became markedly stridulous. From this time the severity of the symptoms rapidly increased, and at 9 p.m. on that day he was brought to St. George's Hospital.

On admission he was almost pulseless, the dyspnœa was excessive, the extremities cold, the lips livid, and the throat swollen and very puffy, with all the superficial vessels gorged. Tracheotomy was therefore determined on, and Mr. Tatum operated without loss of time. He first made a small incision below the isthmus of the thyroid, but this was followed by profuse hæmorrhage from the neighbouring plexus of veins, and a considerable quantity of blood flowed into the trachea, causing suffocative choking. Had the jugular been opened the hæmorrhage could hardly have been more profuse. Mr. Tatum, therefore, enlarged the opening immediately, passed the finger into the wound, introduced a tube, and made pressure on the veins. By this time the child was quite pallid, the respiration had ceased, and no pulse could be felt at the wrist. Indeed the child was thought to be dead, but artificial respiration was at once resorted to, and as a few convulsive inspirations soon took place it was kept up for full two hours. During this period the respiration was slowly re-established ; a quantity of blood mixed

with false membrane was ejected through the opening, and the child fell asleep. So feebly, however, was the breathing carried on, that for two hours, if the expiratory efforts were not assisted by pressure of the ribs the child ceased to respire, and instantly became pulseless. It was, therefore, found necessary to administer wine.

During the night the breathing continued tranquil, interrupted only by occasional paroxysms of cough; but early on the 27th dyspnœa recurred, accompanied by great congestion of the face and neck. The tube was, therefore, removed, and on its withdrawal nearly a table-spoonful of muco-purulent matter poured from the wound. Immense relief to the breathing resulted; the tube was again introduced, and throughout the day the child continued comfortable. The following remedies were administered:

Hydrargyri Chloridi, gr. j nocte, maneque.

Haustûs Salini, ʒij, c. Vini Ipecacuanhæ, m̄x; 4tâ quâque horâ.

Beef Tea.

He slept well throughout the night, disturbed only by occasional fits of coughing, which were usually followed by the ejection of muco-purulent matter mixed with lymph; and next day (the 28th) his countenance was quite tranquil; the skin though hot was moist; the tongue coated; the pulse 108. His bowels had acted twice. The remedies were continued as before.

Three times during the day the tube was removed and cleaned, and each time was reintroduced without much pain or difficulty. At 8 p.m. excessive dyspnœa suddenly ensued in consequence of a large plug of false membrane blocking up the tube, but this was immediately seized and drawn out of the tube, and the breathing again became tranquil. He passed another quiet night, and on the 30th was evidently better in every respect, and frequently ejected through the tube a quantity of thick muco-purulent matter mixed with shreds of lymph. Towards the afternoon it was observed that a portion of all fluids taken by the mouth

returned through the tube, so that swallowing was accompanied by considerable difficulty, and as this complication became still more troublesome on the following day (the 31st) the tube was withdrawn at 3 p.m., and was not reintroduced. In every other respect he was so much better that the draught was repeated every six hours only, and the calomel only once a day. Strong gravy was also given. From this time he made rapid progress. No food came through the wound after the 1st of August, and on the 3d the calomel, salines, and ipecacuanha were omitted, and he had some meat for his dinner. On the 14th the Ferri Ammonio Citras was ordered. The wound healed kindly, and he left the hospital in perfect health on the 19th of August.

I would only remark on this case, that it affords an admirable instance of the value of tracheotomy in cases of croup, and of the absence of any reasonable ground for despair even when the patient is "*in extremis*." It also confirms the opinion already expressed, that those who have undergone judicious treatment prior to the operation, are more likely to recover than those who have been neglected; and that although wine may be needed in some instances immediately after the operation, to counteract the ill effects of excessive loss of blood, yet that calomel and other remedies which prove useful before the performance of the operation are equally essential afterwards. Further, it illustrates the value of the trachea tube described in the body of this paper. Twice, three times, or four times daily, the trachea tube had to be removed for the purpose of cleansing, and spite of these precautions and the excessive and constant watchful care which was exercised throughout the case, the boy on two occasions nearly lost his life in consequence of obstruction of the tube. Had an instrument been employed, such as that described in this paper, obstruction to the breathing could not thus have taken place.