

representing monstrosities, but it is rarely one is found for which an individual with a definite disease has been chosen for a model. Dwarfs with achondroplasia are sometimes found. The additional interest in this one is that it is one of the very rare specimens carved out of ivory. A better known piece of carving representing a monster is the Lincoln Imp, the main point of interest to be mentioned here being the well-defined hare-lip. It is a grotesque, to be seen below one of the corbels in the "Angel Choir" of Lincoln Cathedral.

FIG. 8.



Antique Statuette of a Dwarf. (British Museum.)

SOME MODERN PICTURES.

At the Tate Gallery, amongst the modern pictures dealing with this subject, one of the most striking is "The Death of Chatterton," by Mr. Henry Wallis, with whose kind permission I am enabled to show you this photograph. The young poet, who has just taken poison, is seen lying on a bed under the window through which the grey light of early dawn is coming in, giving a weird appearance to the scene. The position is quite a natural one. The body is turned over on to the side and the head has rolled off the pillow to the very edge of the bed. The hands are closed, and the right one, which hangs down on the floor, still grasps a handkerchief. Close to it on the floor is seen the empty poison flask. Rigor mortis has already commenced and is conspicuous in the neck and hands. I was particularly struck by the forcible rendering of the pallor of the face and neck, with its shadows of a leaden hue and the waxy and transparent look of the skin.

"The Death of Amy Robsart," by Yeames, is another picture in which I have admired the very correct rendering of the appearance of the skin after death. The body is lying at the foot of the staircase like a snowdrift, to use Walter Scott's words, and the artist has produced a wonderful study in white.

Millais's picture of "Ophelia" calls for a few remarks. A mistake that strikes me is that she has far too healthy a look, with her plump cheeks and rosy lips. I remember that at Bethlem Hospital Dr. G. H. Savage frequently pointed out to the students the patients of what he called "the Ophelia type." They were generally girls with sallow complexion, feeble circulation, who had been refusing their food, and, in consequence, were emaciated. A remark often made about the picture is that Ophelia is floating too high on the water. Millais here wanted to give the importance to the lines:—

"Her clothes spread wide,
And mermaid-like, awhile they bore her up."

If I were asked which is the most popular picture to-day in all our galleries, I should at once say it is "The Doctor" by Sir Luke Fildes, at the Tate Gallery. I think there is scarcely any other picture which touches, with such ability of execution, the emotional chord of old and young, educated and uneducated. I have thought that it would be interesting to take a record with a phonograph of the remarks which it calls forth from visitors to the gallery. The most frequent of all is: "How sad!" The child's complaint is said to be a puzzle for every new house surgeon who sees the picture hanging in the wards of a hospital, where it so often finds a place. The little which one can see of the child, with its flushed face, well-nourished limbs, and extended arm, suggests some acute chest complaint, probably pneumonia. A Sherlock Holmes might help one to form a diagnosis by pointing out the bowl and spoon on the stool, which have just been used to make a poultice, the soothing effect of which the doctor is now watching. In this picture morbid details are conspicuous by their absence. The whole interest of the subject, the critical condition of the child, is conveyed to the observer by the distress depicted in the face of the father, by the mother's attitude of despair, and by the kindly look of the doctor, which is expressive of deep concern for the recovery of his little patient.

CONCLUSION.

The conclusion which we are led to by contemplating these pictures is that any place which medicine can have in art must be but a subordinate one and that it is often the better taste for the artist to hide some morbid detail. The true artist has to judge which details he had best make use of, just as he has to choose that particular moment of a scene which is the most interesting, the most pathetic, or the most stirring. When he has to deal with a subject with a morbid side it is essential for him to cultivate some of that *reserve* so noticeable in Greek art. He should "use all gently he must acquire and beget a temperance that may give it smoothness." He must use his art not only to hide art but to hide unpleasant details. What we require of him is to stir up our finer feelings and to rouse our admiration. For it is the very joy of our heart to admire where we can and nothing so lifts us from all our "mean imprisonments, were it but for moments, as true admiration."

"We live by admiration, hope and love,
And, even as these are well and widely fixed,
In dignity of being we ascend."

HEART MASSAGE AS A MEANS OF RESTORATION IN CASES OF APPARENT SUDDEN DEATH,

WITH A SYNOPSIS OF 40 CASES.¹

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MASSAGE of the heart as a practical means of treatment in cases of sudden failure of the pulse and respirations, especially when such an accident follows the induction of chloroform anaesthesia, is based upon a series of physiological experiments which commenced with those of Schiff in 1874.² First of all he showed, in the case of a number of dogs that had been subjected to chloroform inhalation until the heart had ceased to beat and was distended with blood, that artificial respiration and stimulation by electricity were of no avail for restoring its action; but he was able to prove that "if the thorax is opened and at the same time air is insufflated into the lungs, by rhythmical compression of the heart with the hand (care being taken in doing so not to interfere with the coronary circulation) and continuous pressure of the abdominal aorta so as to bring the blood in greater quantity towards the head, it was possible to re-establish the heart beat even up to a period of 11½ minutes after the stoppage of that organ." Most of the dogs, however, died at the end of some hours, without any return of voluntary movements and after developing convulsive attacks.

No record of further experiments is forthcoming until in 1898 Tuffier and Hallion communicated a similar series

¹ A paper read before the Bristol Medico-Chirurgical Society on Nov. 14th, 1906.

² Recueil des Mémoires Physiologiques, vol. iii., 1874.

along with notes of a case in man.³ In this series, having definitely ascertained by a registering apparatus that the circulation had been arrested, they were able to restore the heart beat to animals in which it had been suspended for a period of time varying from one to five minutes.

In 1900 Prus⁴ published the results of experiments performed by him on 100 dogs. Of these, 21 were killed by chloroform, 44 were asphyxiated, and 35 were electrocuted. Of the dogs which were chloroformed the heart stopped in times varying from 50 seconds to 20 minutes after the commencement of the anæsthesia. Heart massage and artificial respiration were started in periods varying from 55 seconds to one hour after the arrest of the heart. In 16 cases—i.e., 76 per cent.—the results were successful, natural pulsation returning in periods varying from 30 seconds to 20 minutes. All the animals thus restored to life were killed at the end of the experiment save one, which was alive and well eight months later. In this particular case massage was commenced four minutes after arrest of the heart, and pulsation returned after it had been persisted in for five minutes. Of the 44 dogs which were asphyxiated 31 recovered, but of the 35 which were killed by electricity only five were restored to life.

In the same year Batelli⁵ at Geneva confirmed the results of Prus, but in addition was able to show that in many of the unsuccessful cases massage caused fibrillary twitchings of the heart muscle instead of true contractions. These twitchings are very difficult to overcome and when once they appear make it almost certain that failure will result. He was, however, successful in overcoming them by the direct application to the heart of an alternating current of 240 volts.

Later, along with Prévost,⁶ he showed that the fibrillary twitchings developed more frequently in animals that were experimented upon in a fasting state than in those which had had a few hours previously a feed of albuminoids and carbohydrates.

In 1902 Kuliabko⁷ performed a remarkable series of experiments in which he used the hearts of rabbits killed for the purpose. He removed the hearts from the bodies and put them in an ice chest for 44 hours. At the end of this time he succeeded in restoring pulsation to them for several hours by injecting Locke's fluid (a solution of chlorides of sodium, potassium and calcium and bicarbonate of sodium in the proportions in which they exist in blood serum to which has been added a small quantity of dextrose) into the coronary arteries. Later, in a similar manner he restored the hearts of rabbits that had died from disease, even three or four days after death, and in August, 1902, he succeeded 20 hours after death in restoring pulsation to the heart of a boy aged three months, who had died from double pneumonia, which pulsation continued for over an hour.

Velich⁸ repeated Kuliabko's experiments successfully and states that Spina of Prague injected into an artery in a direction towards the heart, a large quantity of normal saline solution (200 cubic centimetres in a dog) at from 35° to 40° C.; before this reaches the heart it closes the aortic valves and passes into the coronary arteries, and in thus doing he found that it stimulated the heart muscle. In this manner along with artificial respiration he revived animals in which the brain and cord had been destroyed, or which had been poisoned with alcohol, nicotine, &c., even when ten minutes had elapsed since the heart's action had been arrested.

Bourcart in 1903⁹ in a series of experiments on dogs used the subdiaphragmatic method for massaging the heart and also had successful results. In one case the heart stopped five minutes after chloroform began to be administered. Massage was continued for three minutes. The dog was alive and well six weeks later.

Finally, D'Halluin in 1904 and 1905¹⁰ describes a series of experiments and arrives at a number of important physiological conclusions. He considers that the massage acts mechanically by emptying the distended heart of blood and so causing an artificial circulation through the coronary

arteries which is sufficient to restore its rhythmical beating, and that this in turn is able to excite the nerve centres and restore respiratory movements, muscular action, and corneal and pupillary reflexes. He also confirms the experiences of Prévost and Batelli that fibrillary twitchings of the heart muscle are the greatest bar to successful massage and shows that the longer the time which elapses between the stoppage of the heart and the beginning of the massage the greater is the probability of these twitchings appearing. For their treatment he finds in experiments that the intravenous injection of a solution of chloride of potassium (one-fifth of a grain for every kilogramme of the animal's weight) is the most useful and considers that it acts by first arresting the heart and so stopping the twitchings; then if massage is immediately commenced the salt solution is distributed through the general mass of blood and dilutes its tonic properties.

Such is in outline the experimental evidence which has led up to the adoption of this method of treatment in human beings. I will now give notes of two cases in which I have attempted to restore life by its means and then discuss some of the important points which arise from a study of the recorded cases.

CASE 1.—A boy, aged nine years, was admitted to the Bristol Royal Hospital for Sick Children and Women on August 28th, 1906, suffering from a congenital umbilical fistula. Beyond measles and whooping-cough at three years of age, he had had no other illness, and apart from the fistula he was in normal health.

I decided to operate on Sept. 7th and chloroform anæsthesia was commenced about 12.20 P.M. At 12.30 the skin incision was started, but as there was some movement on the part of the patient it was not proceeded with. A little more chloroform was given when the boy gave three rather deep inspirations and suddenly the breathing became difficult. After a few seconds it improved, but almost immediately fell off again. The lips became cyanosed, the skin pale, and the pupils of the eyes widely dilated and insensitive. No pulse could be felt at the wrist and on auscultation over the præcordial region no heart sounds could be heard. The respiration continued spasmodically at intervals but finally stopped about five minutes later. Meanwhile the head had been lowered and artificial respiration had been commenced, along with rhythmical traction on the tongue: $\frac{1}{10}$ th of a grain of sulphate of strychnine was injected subcutaneously and also 20 minims of ether. Towels wrung out of boiling water were constantly applied to the præcordium, the limbs were tightly bandaged, and hot bottles were applied to the feet. About 15 minutes later another $\frac{1}{10}$ th of a grain of strychnine, and 20 minims of ether were injected, the above measures being still persevered with but without success. At 12.55 P.M., 25 minutes after the heart had stopped, I decided to apply direct compression to the heart. Accordingly, standing on the right side of the patient, I quickly opened the abdomen through an incision beginning about one inch below and to the left of the tip of the ensiform cartilage and passing downwards and outwards along the left costal margin until it was large enough to admit the right hand. This I passed up towards the heart, the diaphragm only intervening between the two. The heart itself was felt to be quite immobile and flaccid. I then commenced rhythmical compression of the organ with my right hand pressing, through the relaxed diaphragm, against its lower and posterior surface, and my left hand outside over the præcordial region, the rate of compression being about 70 per minute. This method was continued for about two minutes without any appreciable effect and then I grasped the apex of the heart without any difficulty with my right hand, my thumb being over the right ventricle and my fingers surrounding the left ventricle. In this manner I went on with the intermittent compression and very soon I felt a slight fluttering of the organ and at the same time noticed that the pupils contracted slightly. Within a few seconds the heart began to beat forcibly with more than normal vigour at a rate of about from 90 to 100 beats per minute. Meanwhile the artificial respiration had been continued all the time, except when I was actually making my abdominal incision, and within a very short time of the restoration of the pulse spontaneous breathing asserted itself and gradually became regular; the skin and lips resumed their normal healthy appearance and at 1.5 P.M. the heart and lungs were performing their functions normally, although the patient had not recovered consciousness. The abdominal wound was

³ Bulletin de la Société de Chirurgie, Nov. 2nd, 1898, p. 937.

⁴ Wiener Klinische Wochenschrift, vol. xiii., pp. 451 and 483.

⁵ Journal de Physiologie et Pathologie Générale, 1900, p. 443.

⁶ Revue Médicale de la Suisse Romande, 1901, vol. xxi., p. 489.

⁷ Centralblatt für Physiologie, 1902, vol. xvi., p. 330.

⁸ Münchener Medicinische Wochenschrift, August 19th, 1903, p. 1421.

⁹ Revue Médicale de la Suisse Romande, vol. xxiii., 1903, p. 637.

¹⁰ Thèse de Lille, 1904, No. 22; Le Massage du Cœur, Presse Médicale, June 1st, 1904, No. 44, p. 345; and Contributions à l'Étude du Massage du Cœur, &c., Paris and Lille, 1905.

closed and the abdomen was bandaged tightly. The patient was taken back to bed and a rectal injection consisting of four ounces of normal saline solution and half an ounce of brandy was given. Nutrient enemata consisting of two ounces of peptonised milk, one egg, and two drachms of brandy were ordered every four hours.

The subsequent history of the case was unfortunately not so satisfactory. Sensibility never returned. During the afternoon the patient developed tonic spasms with rigidity of the muscles of the limbs and trunk. He broke out into severe perspirations, the temperature rose and the pulse and respirations increased in frequency. At 4.45 P.M., as the spasmodic attacks were severe, one-twelfth of a grain of morphine was given hypodermically. I saw the patient again about 6 P.M. and found the temperature to be 103.4° F., the pulse 168, and the respirations 40. The spasms still continued and I gave him a few whiffs of chloroform. This had the effect of relieving them and was a method employed occasionally during the evening, especially when he had a nutrient enema, as the slightest disturbance precipitated an attack. At 8 P.M. a saline enema (four ounces) containing ten grains of chloral hydrate was administered. This seemed to be effective as the rigidity of the muscles gradually wore off and there were no spasms after 10 P.M. At eight o'clock next morning the temperature was 102.4°, the pulse was 160, and the respirations were 52. The patient was obviously sinking and the heart-beat was getting very feeble. $\frac{2}{10}$ th of a grain of digitalin was injected subcutaneously but death took place at 9 A.M., 20 hours after the heart-beat and respiration had been re-established.

CASE 2.—The second case was that of a boy, aged three years, who was admitted to the hospital on Oct. 14th, 1906, under the care of Dr. B. M. H. Rogers, suffering from diphtheria and as likely to require tracheotomy. Under antitoxic treatment, however, the difficulty of breathing passed off. On the 16th he was seen by Dr. Rogers at about 11 A.M. and seemed to be going on very well, but at about 11.30 A.M. he had a sudden attack of syncope and our senior house surgeon, Dr. C. C. Lavington, was just in time to see him give a few final gasping breaths. He at once commenced artificial respiration and the administration of oxygen through a glass funnel held in front of the mouth. I saw the child at about 11.45 A.M., and as both heart-beat and respiration had entirely ceased I at once opened the abdomen and commenced compression of the heart as in the last case. Artificial respiration was continued but the administration of oxygen was stopped. Compresses wrung out of boiling water were kept applied to the chest. All the limbs and abdomen were tightly bandaged and five minims of a 1 in 1000 solution of adrenalin and one-fortieth of a grain of strychnine were injected subcutaneously. As I was doubtful as to whether air was entering the lungs Dr. Lavington quickly performed tracheotomy, and after clearing the trachea of a large mass of membrane and frothy mucus by means of a feather, a cannula was introduced. The effect of this was good, as we were now able to get a free interchange of air through the cannula by means of our artificial respiration. About this time five ounces of normal saline solution were injected subcutaneously into the pectoral region and five minims of adrenalin solution were administered. No results having been arrived at by the use of these measures, and as I could not feel the heart definitely through the diaphragm I decided to open the pericardium by incising the diaphragm. This I did at about 12.30 P.M., when half an ounce of clear serous fluid escaped. Having enlarged the opening so as to admit three fingers, I was able to grasp the ventricular portion of the heart and compress it rhythmically. After continuing this for about five minutes I felt a slow wave of contraction pass over the organ, followed by others. At the end of another five minutes it was beating slowly at the rate of 48 beats per minute; the ears and lips, which had previously been quite livid, resumed their normal ruddy appearance and the tracheal and abdominal wounds bled slightly, thus showing that some oxygenation of the blood was going on. By elevating the costal margin with the left hand and pressing down the abdominal contents with the right hand it was quite easy to see the cardiac pulsation through the wound in the diaphragm. We were quite unable, however, to restore spontaneous breathing, and though in addition to the above measures we injected $\frac{1}{20}$ th of a grain of sulphate of atropine directly into the heart muscle the heart itself stopped pulsating half an hour after it had recommenced to do so. Further massage made it contract again a few times, but it again stopped and

after a few more attempts we reluctantly gave up our efforts at 1.20 P.M., one and a half hours after the massage had been commenced and one and three-quarter hours after the child had died.

I was led to try these measures through having seen them adopted by Mr. C. B. Keetley in a case at the West London Hospital in the summer of 1903. His case, which has not been published, was that of a man well advanced in middle life who was about to be operated upon for the radical cure of hernia. Chloroform was the anæsthetic employed and before the patient was completely under and in a fit of violent struggling his breathing and pulse stopped. The usual methods for restoration were adopted along with tracheotomy and faradisation of the phrenic nerves without avail and at the end of three-quarters of an hour Mr. Keetley opened the abdomen by the incision which I adopted and compressed the heart in the manner which I have described in my first case. The results, however, were negative. In giving me permission to make use of this case Mr. Keetley writes: "I have had another case rather like it since, in which we endeavoured to restore circulation by opening the abdomen and pressing the heart, through the diaphragm, but unsuccessfully."

From a clinical point of view the literature of this subject consists of reports of cases in various medical journals along with two papers, one by Keen of Philadelphia¹¹ and the other by Ch. Lenormant of Paris.¹² In preparing this article I have endeavoured as far as possible to trace the experiments and cases to their original sources, but where this was impossible I have gladly availed myself of the accounts of them given by these two authors. To their records of cases I am able to add several more and after careful investigation to append a list of 40 cases, 36 of which have been previously reported and four of which are now brought forward for the first time. The figures in parentheses which occur hereafter refer to the numbers of the cases which will be found at the end of the article. I am sure, however, that they do not comprise the total number, as probably heart massage has been done by other surgeons who have not thought it necessary to communicate their results to the medical press. Six out of the 40 cases communicated to Keen by Crile (*vide* Keen's paper), along with a similar case reported by Cheevers, in the opinion of some may not come quite within the scope of this paper; no actual cutting measures were undertaken by him in any of them, but his methods have such an important bearing on the practical question that I do not hesitate to include them. The first reported case was that of Tuffier and Hallion in 1898, but the credit of trying the method for the first time would seem to belong to Niehaus of Berne, who used it, without success however, so long ago as 1880. The first partial success was obtained by Maag in October, 1900, when he restored the pulse and spontaneous respiration for a period of 11 hours, but to Stirling and Lane we owe the report of the first complete success in 1902, though Igelsrud's successful case was performed in 1901 but was not reported until 1904. There are a few important points in connexion with the subject to which it seems worth while to refer.

The class of cases in which heart massage has been employed.—On 30 occasions the method was used for sudden cardiac syncope under anæsthetics, and in 24 of these cases the anæsthetic was certainly chloroform (1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18, 19, 20, 21, 23, 32, 33, 34, 36, 37, and 38). In nine of these instances (1, 3, 8, 11, 12, 13, 18, 19, and 38) the syncope occurred in the early stage of the anæsthesia before the operation was commenced; and in 13 instances (5, 7, 9, 10, 15, 17, 20, 21, 23, 32, 33, 34, and 36) it came on during the course of the operation, and twice (2 and 37) the time is not specified. Struggling of the patient and the giving of more chloroform are mentioned six times (7, 10, 15, 19, 32, and 38) and in five cases (10, 15, 20, 21, and 32) it is noted that the heart stopped before the breathing. In three cases (14, 29, and 35) the anæsthetic was ether; in one (40) it was chloroform and ether mixed and in two cases (16 and 26) the nature of the anæsthetic is not mentioned.

In addition to the anæsthetic cases, the method has been tried once in a case of pulmonary embolism (4); once in a case of hanging (6); twice in cases of tracheal asphyxia (22 and 31); once after opening a post-pharyngeal abscess

¹¹ Therapeutic Gazette, April 15th, 1904.

¹² Revue de Chirurgie, March, 1906.

without an anæsthetic (30); once in a case of diphtheria (39); twice in cases of severe injury to the brain and skull (24 and 25); and twice for electric shock (27 and 28).

Four methods of operation have been utilised to gain access to the heart. They are particularised as follows:—

1. *The thoracic method.*—In this method a somewhat rectangular flap is cut over the left side of the thorax, which may have its base outwards or inwards. When the base is outwards the upper border of the flap (i.e., the one opposite the base) is made along the left sternal border and the sides of the flap are carried along the line of the ribs and their cartilages adjacent to which they are made. Two or three costal cartilages, selected from the third to the sixth, are thus laid bare and cut through at their junction to the sternum and the corresponding ribs are divided with bone forceps near the base of the flap in the nipple line. The pericardium is now exposed and may or may not be opened according to the desire of the surgeon. If the flap is cut with its base inwards (Wehr) this is made along the right border of the sternum and the upper border lies about the left mammary line. The left ribs are divided near this line and the whole width of the sternum is cut through with saw and chisel. This route, the first that was used to gain access to the heart with a view to massaging it, has been employed in 17 of the recorded cases (1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 15, 21, 22, 23, 34, and 35). Of these, the pericardium was opened in eight cases (1, 5, 6, 8, 9, 15, 21, and 34); was left intact in five cases (4, 7, 12, 13, and 22); while in the other four cases (2, 3, 23, and 35) no statement is made on this point. That it is necessary in ordinary circumstances to open it is doubtful. Good compression has been made without doing so and if it is left intact the need of subsequent suturing will not arise and the danger of septic infection of its cavity will be avoided. There are two great objections to this method of procedure. The first is that the operation is in itself a slow and severe one, requiring special instruments which may not always be at hand. The second is that in resecting the ribs there is great danger of injuring the pleura and causing a left pneumothorax, an event which would make restoration of the heart beat and spontaneous breathing much more difficult to accomplish. This accident has certainly happened in four cases (5, 7, 22, and 34) and possibly in others. By this method one successful (9) and three partially successful results (7, 15, and 34) have been obtained.

2. *The transdiaphragmatic abdominal route.*—This was the second method to be employed. It was suggested by Mauclaire, because in his first case (5) he was unfortunate enough to get a pneumothorax. In April, 1902, he had occasion to drain the pericardium in a case of severe injury to the chest,¹³ and did so by opening the abdomen in the middle line between the xiphisternum and the umbilicus, and incising the diaphragm from its under surface. Having found the heart easy of access by this method he used it in his second case of heart massage (11). After opening the abdomen an assistant presses down the left lobe of the liver, the stomach is held down by compresses, and the diaphragm is exposed. His incision through it passes obliquely from right to left and from before backwards, starting slightly in front of the summit of its concavity and passing towards the apex of the heart but not involving it. As soon as the diaphragm is penetrated the remainder of the incision is made with scissors on the finger as a guide. The incision can be made large enough to admit two or three fingers and the heart is easily compressed between them. This method has been used on four occasions (9, 10, 18, and 39) but without success.

3. *The subdiaphragmatic route.*—This is the method most frequently adopted at the present time. It was first used by Lane in 1902 and altogether has been employed in 12 cases (14, 16, 17, 19, 20, 31, 32, 33, 36, 37, 38, and 40). The technique I have already described in the report of my first case. It is a method which would naturally suggest itself in cases (e.g., 14, 16, 20, 32, and 33) where the abdomen is already opened, though in these circumstances Igelsrud chose the thoracic route in his successful case (9). All that the surgeon has to do, after enlarging his incision if necessary, is to push his hand up to the under surface of the diaphragm, through which it is usually quite easy to define the heart and press it up against the posterior surface of the thoracic wall, counter pressure being made at the same time with the other hand on the exterior of the chest.

In those instances where the abdomen has not already been opened (17, 19, 31, 36, 37, 38, and 40) a median incision is usually made between the ensiform cartilage and the umbilicus, but Mr. Keetley in his first case opened it along the left costal margin and I followed his example. This latter incision seems to have certain advantages. The left lobe of the liver does not interfere so much with the manipulations, and in incising the diaphragm (as I did in my second case) a very clear view is obtained of the point for incision by simply raising the costal margin and holding down the stomach and intestines with a flat sponge, the liver not being in the way at all. This method has given the best results so far, with six complete successes (14, 16, 20, 32, 36, and 40) and three partial recoveries (31, 33, and 38).

4. *Crile's method.*—The fourth method of procedure is that of Crile, of Cleveland, U.S.A. In his work on "Blood Pressure in Surgery" he points out that in cases of shock and syncope, and especially in cases of accident during chloroform anæsthesia, there is a great fall of blood pressure and venous engorgement of the splanchnic area; in order therefore to revive people under these conditions it is not only necessary to start the heart again, but above all the blood pressure must be raised and spontaneous respiration re-established. His method, then, consists of making rhythmical pressure on the chest wall over the heart and the use of Fell O'Dwyer's apparatus for producing artificial respiration. To raise the blood pressure he infuses solutions of adrenalin of strengths varying from 1 in 25,000 to 1 in 50,000 directly into a vein and as the effects of this drug, which causes contraction of the muscular tissues in the vessel's walls, are somewhat evanescent, he continues the infusion at the rate of three cubic centimetres per minute if necessary. In addition to this he applies a rubber suit to the patients, which by inflation can produce an even pressure over the whole surface of the body and in this way he mechanically increases the blood pressure. This suit is kept on after the pulse and the breathing are restored and then can be gradually deflated while the patient is in bed. Although the rubber suit is not available for everybody similar results, in a less degree, can be obtained by firmly bandaging the limbs and applying a tight binder to the abdomen. This method has been employed in seven recorded cases (24, 25, 26, 27, 28, 29, and 30), one of which (29) was successful and two (25 and 26) were partially so.

In looking at the results that have been achieved we find that out of the 40 cases nine are reported as being entirely successful (viz., 9, 14, 16, 20, 29, 32, 35, 36, and 40), and eight as being partially so—i.e., cases in which the pulse and respiration were definitely restored, but which ultimately ended fatally (7, 15, 25, 26, 31, 33, 34, and 38). The remainder were fatal. An examination of the successful cases, however, shows that the value of heart massage is more forcibly brought out in some than in others. In all of them (except in Crile's) the usual means of restoration (viz., artificial respiration, tongue traction, &c.) were first of all tried, but in many only for a very short time and in these latter, when heart massage was adopted, pulsation was restored very quickly. The following list of them brings out the points I am referring to now. A fuller account is appended.

TABLE I.—Giving Particulars of Nine Successful Cases of Heart Massage.

Case.	Time of ordinary methods.	Time of restoration of heart from commencement of massage.	Time of restoration of breathing from commencement of massage.
Igelsrud (9) ...	3-4 minutes.	1 minute.	—
Lane (14)... ...	Uncertain.	1 or 2 squeezes.	12 minutes.
Gray (16)... ...	Uncertain.	2 or 3 squeezes.	—
Cohen (20) ...	2 minutes.	1 minute.	—
Crile (29)... ...	His special methods commenced immediately.	5 or 6 minutes.	5 or 6 minutes.
Sencert (32) ...	7-8 minutes.	5 minutes.	7 minutes.
Conkling (35)...	2 minutes.	1 minute.	—
Smith (36) ...	3 minutes.	1 minute.	A few seconds after heart beat had been restored.
Ransay (40)...	4 minutes.	1 minute.	Soon after heart beat had been restored.

¹³ Gazette des Hôpitaux, June 24th, 1902, p. 701.

One cannot help thinking that although in these cases the heart was found to be flaccid the continuance of the ordinary methods for a rather longer time might have been sufficient in some of them to restore its beating. In fact Igelsrud states (*vide* Keen's paper) that so far as his own experience is concerned "the case is not convincing because the ordinary methods of restoration were only tried for three or four minutes and traction of the tongue was continued during the whole time of the heart massage." In the cases of Crile and Sencert, however, not only had the heart stopped from five to eight minutes before the massage was commenced but it had to be continued for five or six minutes before pulsation had been restored, and spontaneous breathing did not reappear until artificial respiration had been proceeded with for a further period of from five to seven minutes. When, however, we come to look at the partially successful cases the evidence, to my mind, is of a much more decided character. In all of them the pulse and respiration were definitely re-established and so far the method completely justified itself.

TABLE II.—*Giving Particulars of Eight Cases in which Heart Massage was Partially Successful.*

Case.	Time of ordinary methods.	Time of restoration of heart from commencement of massage.	Time of restoration of breathing from commencement of massage.	Survival.
Maag (7)	10-15 minutes.	A few compressions.	3 hours.	*
Sick (15)	45 minutes.	30 minutes.	30 minutes	24 hours.
Crile (26)	<i>Nil.</i>	9 minutes (Crile's special methods).	12 minutes.	2 hours.
Crile (25)	<i>Nil.</i> , but at least 8 minutes elapsed without any attempts.	16 minutes (Crile's special methods).	16 minutes.	34 minutes.
Gray (31)	4-5 minutes.	4 minutes.	4 minutes.	2 hours.
Depage (33)	15 minutes.	A few instants.	1 hour.	16 hours.
Lenormant (34)	<i>Nil.</i>	6-8 minutes.	$\frac{3}{4}$ hour.	5 hours.
Green (38)	25 minutes.	5 minutes.	5 minutes.	20 hours.

* Breathing stopped at end of half an hour. Heart continued to beat for eight hours.

Fuller details of the above cases are appended, but it ought to be stated here that in two of them (25 and 34) the condition of the patient was one which necessarily proved fatal.

To summarise the information derived from the facts we find: 1. That it has been possible in human beings to restore the heart beat by massage when ordinary measures of resuscitation have failed, even when the massage has not been commenced until the heart had been stopped for 45 minutes, but a definite and complete cure has never yet been effected when this interval has been longer than from seven to eight minutes. 2. In many of the cases the adoption of massage for a period of from 30 seconds to five minutes has been sufficient to restore the heart beat but it has sometimes been necessary to go on with it for 15 minutes or even longer. 3. Artificial respiration and its adjuncts must also continuously be applied, and sometimes it is necessary to persevere with it long after pulsation is restored in order to re-establish the respirations.

Of the unsuccessful cases very little need be said. In two of them (4 and 23) a few pulsations and respirations were obtained, and in six of them (6, 8, 22, 24, 30, and 39) heart contractions occurred but no spontaneous breathing. In two or three cases (1, 12, and 13 (?)) it is stated that the fibrillary twitchings appeared, a condition of things which, according to Batelli, D'Halluin, and others (*vide ante*) is an almost certain hindrance to the restoration of the heart's action. It seems to me that there may be some similar cause which gives rise to the fibrillary contractions of the heart muscle and the spasms of the voluntary muscles, which along with the absence of return of consciousness, appeared in the dogs on which Schiff originally experimented and in the cases in man recorded by Lenormant and myself.

It has been frequently shown by Leonard Hill and others that sudden occlusion of the cerebral vessels, whether from ligature or spasm, gives rise to definite convulsive attacks

and sudden occlusion of the coronary arteries has also been shown to cause fibrillary contractions of the myocardium. Whether then the onset of muscular spasms some time after the pulse and respiration have been restored (in Lenormant's case the interval was one and a quarter hours and in my own one hour) can be accounted for by a sudden and sustained cerebral anæmia, or whether, as has been suggested by Walker Hall, they are due to the accumulation of metabolic, or even autolytic products, further investigation into the condition of the urine and tissues in similar cases may determine. At all events we cannot exclude the possibility that in these cases the re-establishment of the circulation does not necessarily indicate the immediate reconstitution of metabolism in the chief metabolic tissues, or even in the cerebral and spinal cells; and as regards the latter, it is well known that when the circulation is arrested, actual autolytic changes soon appear in the ganglionic nerve cells concerned in the mechanism of voluntary movement though those of the heart and respiratory centre retain their vitality for a longer period. The practical point is that if either of these views is correct the commencement of massage must not be delayed too long, not only for fear that fibrillary contractions of the myocardium may supervene, but also to avoid permanent loss of consciousness and the development of spasms of the voluntary muscles.

Is heart massage then a method of treatment which should commend itself to the practical surgeon? In suitable circumstances, and in view of the accumulation of evidence in its favour, it seems to me that the answer must be in the affirmative. It remains to consider the circumstances in which it should be employed and its proper place in the series of efforts for resuscitation which ought to be undertaken when the necessity arises. The kinds of cases in which it may be used with a fair prospect of success are: (1) cases of primary arrest of the heart in a condition of acute dilatation from poisoning by an overdose of a powerful volatile drug, such as chloroform; (2) cases where the gradual accumulation of volatile poisons, such as chloroform, leads to primary paralysis of the respiratory and vaso motor centres followed by stoppage of the heart; (3) cases of asphyxia; and (4) cases of suspension of the functions of the vital centres from simple exhaustion or injury, and consequent stoppage of the heart. In all these cases the restoration of the breathing and the raising of the blood pressure must be obtained by their own particular measures, and where a gradual weakening of the respiratory and vaso-motor centres is perceived before the arrest of the heart has come about the removal of the cause and the commencement of artificial respiration and its adjuncts may, and probably in most cases will, be sufficient to restore them to their normal conditions and prevent paralysis of the heart; but when the heart has once stopped for a definitely appreciable time it is very doubtful whether artificial respiration has any influence whatever upon it. In these circumstances direct mechanical stimulation of the organ in the form of massage has been proved both by experiments and in practice to have the power of reviving its beating. As D'Halluin states, it probably does this by creating afresh the circulation through the coronary vessels. In Crile's method I should think that the rubber suit and adrenalin injections by emptying the abdominal vessels fulfil this same mechanical function of starting a coronary circulation, for I do not think that the rhythmical pressure over the fairly rigid chest wall of an adult, at any rate, can have any direct compressing effect upon the underlying heart. Having started the heart beating, artificial respiration, by obtaining a free ventilation in the lungs, encourages a pulmonary circulation, oxygenation of the blood, and the withdrawal of poisonous vapours from the vital centres *via* the lungs, until in successful cases their functions in turn again become active and spontaneous breathing is restored.

In conclusion, it seems to me that the order of procedure in these cases of sudden heart and respiratory failure should be as follows. 1. Immediate lowering of the head and the commencement of artificial respiration and tongue traction, taking care that a free access of air to the lungs is possible and therefore implying tracheotomy if necessary. 2. If the abdomen is open, pressure on the abdominal aorta to confine the circulation to the upper part of the body. If it is not open the intravenous injection of adrenalin solution and the application of Crile's rubber suit or, failing this, tight bandaging of the limbs and abdomen. 3. The subcutaneous or intravenous injection of normal saline

solution, partly to raise the blood pressure and partly to dilute any poisons which may be in the blood and tissues. 4. If the above methods have not been successful after being applied for from eight to ten minutes heart massage by the subdiaphragmatic method. This route should always be adopted, unless the chest is already opened or to be operated upon, as being the easiest way of access, the one fraught with least danger to the patient and the one which has given the greatest percentages of success. The time is fixed at from eight to ten minutes because eight minutes is the limit of the interval at which up to the present time a complete success has been obtained in man, and if it is exceeded the danger of the production of fibrillary twitchings, inability to restore consciousness, and the development of spasms in the voluntary muscles with consequent failure of the manipulations have to be taken into consideration. The unavoidable extension of this limit should, however, be no bar to the adoption of the method, as very hopeful results have been obtained, even when 45 minutes have elapsed from the onset of the syncope before it has been tried. 5. After normal pulsation has returned to the heart, artificial respiration must be continued until spontaneous breathing has been restored or until circumstances make it improbable that such restoration will be obtained.

SYNOPSIS OF RECORDED CASES OF HEART MASSAGE.

Keen quotes Cases 1 to 15, 17, 23 to 29; Lenormant quotes Cases 1 to 15, 17, 18, 20 to 23, and 32 to 34.

1. Niehaus, 1880 (*Zesas: Centralblatt für Chirurgie*, 1903, p. 588).—A man, aged 40 years. Operation for goitre which was causing dyspnoea and dysphagia. Chloroform anaesthesia was being induced without excitement when the breathing and pulse stopped and the patient became cyanotic. Artificial respiration was tried for some time without effect. Then the ribs were resected, the heart was laid bare, and rhythmical compression was commenced. The artificial respiration was continued. The heart, which was at first soft, became somewhat firmer and fibrillary twitchings appeared, but no normal contractions. The patient died.

2. 1892 (Bazy: *Bulletin et Mémoire de la Société de Chirurgie*, 1898, p. 939).—Bazy saw a colleague perform heart massage, in a case of chloroform syncope, by the thoracic route. The effects were nil and the patient died.

3. Michaux (*Bulletin et Mémoire de la Société de Chirurgie*, 1898, p. 976).—Chloroform syncope came on in the early stages of anaesthesia. Ordinary means of restoration failed and massage of the heart was performed by the thoracic route. The result was nil and the patient died.

4. Tuffier and Hallion (*Bulletin et Mémoire de la Société de Chirurgie*, 1898, p. 937).—A man, aged 24 years. A pericæcal abscess with gangrenous appendix had been opened and drained. On the fifth day after the operation the heart and pulse suddenly stopped. Artificial respiration and traction on the tongue were tried for two or three minutes without effect, and then Tuffier made an incision in the third intercostal space (left) and made rhythmical compression on the heart, through the unopened pericardium, for one or two minutes. The heart fluttered and then contracted properly and the pulse and respiration returned. After a few respirations the pulse again failed and rhythmical compression again started it for a few minutes when it finally stopped. The cause of death was pulmonary embolism.

5. Mauclaire, 1899 (*Gazette des Hôpitaux*, Dec. 5th, 1901, pp. 1347-48).—Chloroform syncope came on at the end of the operation and the heart and respiration stopped. The fourth and fifth left costal cartilages were resected, in doing which a pneumothorax was produced. The pericardium was opened and the heart was compressed. The results were nil and the patient died.

6. Prus, January, 1900 (*Wiener Klinische Wochenschrift*, No. 21, 1900, p. 486).—A man, aged 48 years, who had hanged himself. The usual methods of restoration failed and at the end of two hours Wehr, after performing a tracheotomy and blowing air into the lungs, exposed the heart by the thoracic route and Prus compressed it. Saline solution was also injected into a vein. At the end of 15 minutes rhythmical contraction of the auricles was observed but this stopped when the massage was stopped and began again when the massage was restarted. The contractions gradually got weaker and weaker and the man died.

7. Maag, October, 1900 (*Centralblatt für Chirurgie*, 1901, p. 20).—A man, aged 27 years, who had healthy organs, but who some years previously had been a heavy drinker, though he was then a total abstainer. An operation of nerve-stretching for sciatica was undertaken. Early in the operation he struggled and more chloroform was given, when he became asphyxiated, but was brought round by ordinary means. At the end of the operation he again became asphyxiated and this time ordinary measures were tried for from 10 to 15 minutes without avail. The heart was then laid bare by the thoracic route, the third and fourth ribs being divided. During this operation a pneumothorax was produced. The heart was grasped through the unopened pericardium and was rhythmically compressed. Tracheotomy was also performed and air blown into the lungs. After a few compressions the heart began to beat, at first feebly, then gradually more firmly. At the end of half an hour the first natural respiration was taken, but it was not until the end of three hours that these were deep and regular, so that it was safe to stop the blowing in of air through the tracheal tube. The patient was put to bed but he never recovered consciousness. Half an hour later the breathing suddenly became worse and stopped. Oil of camphor and saline solution were infused and faradism was applied to the phrenic nerve but breathing never returned. The heart, however, continued to beat for eight hours longer when it finally stopped, 11 hours after its action had been re-established.

8. Depage (*Annales de la Société Belge de Chirurgie*, 1901, p. 52).—A man, aged 47 years, who was to undergo radical cure of an irreducible inguinal hernia. He also suffered from dilatation of the right side of the heart and albuminuria. Chloroform anaesthesia was commenced but very soon respiration and pulse failed. Artificial respiration and

tongue traction were tried for 15 minutes and the actual cautery was applied to the præcordium without producing any effect. The heart was then laid bare through a large flap, extending from the second to the fifth left ribs and the pericardium was opened. Heart massage, artificial respiration, and tongue traction were then employed and a few slight spontaneous contractions followed, but these gradually failed and ceased at the end of 20 or 30 minutes. The patient died.

9. Igelsrud, 1901 (Keen: *Therapeutic Gazette*, April 15th, 1904).—A woman, aged 43 years. Abdominal hysterectomy for cancer of the uterus. The patient collapsed near the end of the operation. Artificial respiration and faradisation of the phrenic nerve were tried for three or four minutes without success and then the third and fourth left ribs were resected and the pericardium was opened. The heart was compressed and at the end of one minute pulsation returned, but getting feeble again the compression was repeated for another minute when the heart beat became firm and regular. The patient made a good recovery.

10. Poirier, Dec. 5th, 1901 (*Bulletin et Mémoire de la Société de Chirurgie*, 1902, p. 43).—A woman, aged 58 years, was operated on for cancer of the stomach. During the operation the patient struggled, more chloroform was given, and the pulse and respirations suddenly stopped. Artificial respiration, tongue traction, tracheotomy, and insufflation of oxygen and faradisation of the phrenic nerve caused slight movement of the chest only. The diaphragm was split and the heart was seized and compressed. There was no response though the manipulations were continued for some time and the patient died.

11. Mauclaire (*Gazette des Hôpitaux*, 1902).—Early chloroform syncope. Artificial respiration, tongue traction, and tracheotomy were of no avail. The heart was compressed through an incision in the diaphragm, but without avail, and the patient died.

12. Gallet (*Journal de Chirurgie et Annales de la Société Belge*, 1902, p. 165).—A man, aged 28 years. Radical cure of inguinal hernia. The patient also had tuberculous peritonitis. Cardiac syncope came on after a few inhalations of chloroform. The usual methods were adopted for 20 minutes without avail, and then the chest was opened, but not the pericardium. Rhythmical massage and artificial respiration were continued for some time, but only fibrillary twitchings of the heart muscle were obtained, and the patient died.

13. Gallet, 1902 (*ibid.*).—A woman, aged 30 years, suffering from pelvic abscess. Syncope occurred in the early stages of chloroform anaesthesia. The usual methods were tried for 30 minutes and then massage was done by the thoracic route without opening the pericardium. The results were similar to those in the preceding case and the patient died.

14. Starling and Lane (*THE LANCET*, Nov. 22nd, 1902, p. 1397).—A man, aged 65 years. Abdominal section for adhesions around the colon. Anaesthesia was produced by gas and ether. The appendix had been removed when the pulse began to flag and then both pulse and respiration stopped. Artificial respiration was of no avail and the heart was massaged by the subdiaphragmatic method. After one or two squeezes it recommenced to beat but artificial respiration, &c., were continued for 12 minutes before spontaneous breathing was restored. The operation was completed and the patient made a good recovery.

15. Sick, Dec. 18th, 1902 (*Centralblatt für Chirurgie*, Sept. 5th, 1903, p. 981).—A youth, aged 15 years. Laparotomy for tuberculous ascites. Near the end of the operation the patient struggled and more chloroform was given. Syncope came on. Artificial respiration and compression of the chest wall over the heart were tried and a slight respiration and pulse beat were elicited but these soon passed off. 45 minutes after the onset of the syncope heart massage by the thoracic route was undertaken with a result that in 15 minutes breathing was restored and a few irregular twitchings of the heart were followed by a good contraction. After another 15 minutes the heart was beating firmly and regularly and respiration was normal. The wound was closed and two hours after the termination of the operation the patient became conscious and complained of thirst and dyspnoea. He continued in this condition for 24 hours when he suddenly died. Post mortem the heart was found to be firmly contracted; there was a right fibrinous pericarditis.

16. Gray, December, 1902 (*THE LANCET*, August 19th, 1905, p. 506).—A woman, aged 60 years. Operation for ovarian cyst. The kind of anaesthetic is not specified. During the operation the breathing and the pulse stopped. As artificial respiration proved of no avail subdiaphragmatic compression of the heart was adopted. Two or three squeezes were sufficient to start it again and the patient made a good recovery.

17. Keen, Feb. 6th, 1903 (*Therapeutic Gazette*, April 15th, 1904).—A man who was operated on for complete extirpation of the larynx. Preliminary tracheotomy was performed. Chloroform and oxygen were used to produce anaesthesia. Near the end of the operation syncope occurred. Pure oxygen and one-twentieth of a grain of strychnine were administered; artificial respiration, tongue traction, and faradisation of the phrenic nerve were employed. At the end of ten minutes the abdomen was opened in the middle line and the heart was massaged for half an hour by the subdiaphragmatic method. No recovery took place and the patient died.

18. Mauclaire, February, 1903 (*Zesas: Wiener Klinische Wochenschrift*, 1904).—A man, aged 36 years. Radical cure of inguinal hernia. Early chloroform syncope came on and artificial respiration was tried for 30 minutes without avail. Then tracheotomy was performed and afterwards heart massage by the transdiaphragmatic route for ten minutes and electricity to the phrenic nerve for two or three minutes. The effect of these measures was nil and the patient died.

19. Keetley, 1903 (*vide ante*).

20. Cohen (*Journal of the American Medical Association*, Nov. 7th, 1903).—A woman, aged 32 years. Adherent ovarian cyst; chloroform anaesthesia; 15 minutes after beginning the operation the patient became cyanotic and pulseless. The respiration stopped after the heart. Usual methods were tried for two minutes and then the heart was grasped through the intervening diaphragm and massaged. After 30 seconds a feeble beat was felt and in one minute the pulse was regular and registering 80 per minute and the respiration was partly re-established; two minutes later the respiration was normal. The operation was continued and completed in 30 minutes and the patient made a good recovery.

21. Drubert, September, 1903 (D'Halluin: "Les Tremulations Fibrillaires," 1905).—A youth, aged 19 years. Decapsulation of both kidneys for nephritis. The patient had albuminuria with general oedema, ascites, and hydrothorax. Chloroform syncope occurred at the

end of the operation, the heart stopping before the breathing. Tongue traction was tried for three minutes without success and then heart massage by the thoracic route with opening of the pericardium was commenced five or six minutes after the heart stopped and two or three minutes after arrest of the breathing. The efforts were unavailing and the patient died.

22. Le Fort, Nov. 17th, 1903 (*Echo Médicale du Nord*, 1904).—A man suffering from cancer of the œsophagus. Intercrico-thyroidean laryngotomy for tracheal contractions. Sudden asphyxia came on and a low tracheotomy being of no avail, five minutes after the accident the fourth, fifth, and sixth left ribs were resected, and the pericardium was exposed but not opened. Pneumothorax was produced. Rhythmical compression produced a few spontaneous contractions which soon stopped and the patient died.

23. Djemil Pacha (*New York Medical Record*, Jan. 23rd, 1904, p. 146).—A man, aged 30 years. Operation for fistula in ano. Anæsthesia by chloroform. During the operation cardiac syncope occurred. After two minutes' trial of ordinary measures without success the thorax was opened and compression of the heart was carried out. The heart movements were re-established and some respirations were secured but ultimately the patient died.

24. Crile (Keen: *Therapeutic Gazette*, April 15th, 1904).—A man who had sustained compound fracture of the base of the skull. The patient died as he was brought into hospital. Nine minutes later, rhythmical compression over the heart, artificial respiration by Fell-O'Dwyer apparatus, infusion of 1 in 50,000 solution of adrenalin chloride into the median basilic vein, and the application of the rubber suit were undertaken. Directly following this treatment the heart resumed its beating with more than normal vigour. This continued for 28 minutes and then it stopped. Neither consciousness nor spontaneous breathing was restored.

25. Crile (*ibid.*).—A man (a companion of above last patient) suffering from injury to the base of the brain. At least eight minutes, and probably more after the pulse and the respiration stopped the same treatment as in the last case was adopted. In 16 minutes the heart suddenly began to beat regularly and more strongly than normal, and this was followed by spontaneous respiration. A depressed fracture of the skull was raised and the wound was closed. The patient lived for 34 minutes when the breathing and the pulse both failed and could not be restarted.

26. Crile (*ibid.*).—A man, aged 38 years. Operation for tumour of the brain which was found under the occipital lobe; while trying to remove it syncope came on and the patient died. The same measures were adopted as in the last two cases and in nine minutes from beginning the resuscitation the heart began to beat and in 12 minutes spontaneous respiration was re-established. The infusion of adrenalin (strength 1 in 25,000) into the vein was continued at the rate of three cubic centimetres per minute, but the patient died two hours afterwards.

27. Crile (*ibid.*).—A male, aged 40 years, who was killed by an electric shock. Two and a half hours afterwards the above measures were undertaken by Dr. Ford, Dr. Heath, and Dr. Dickinson but without avail as rigor mortis was coming on.

28. Crile (*ibid.*).—A male, aged 26 years, who was killed by an electric shock. Four hours later the above method was attempted by Dr. Lower and Dr. Ford without success.

29. Crile (*ibid.*).—A woman, aged 23 years. Operation for exophthalmic goitre under ether anæsthesia. Near the end of the operation the patient collapsed and first the heart and then the respiration stopped. The rubber suit (which had been loosely applied before the operation) was inflated and pressure over the heart was made. In five or six minutes the heart slowly recovered its beat and spontaneous respiration was re-established. The operation was completed and the patient was sent to bed in the rubber suit which was gradually deflated during a period of one and a half hours. The patient made a good recovery.

30. Cheevers (*Boston Medical and Surgical Journal*, Jan. 5th, 1905, p. 10).—A female child, aged three years. Opening a post-pharyngeal abscess without an anæsthetic. During the preliminary manipulations the pulse and respirations failed. The abscess was evacuated and then a No. 28 soft rubber catheter was introduced into the trachea and air was blown into the lungs. Compression of the heart over the third, fourth, and fifth left costal cartilages was undertaken at the rate of 60 per minute. Brandy and strychnine were injected directly into the heart, the legs were firmly bandaged, the abdomen was compressed, and hot blankets were applied. While these means were being applied feeble pulsation of the radial and femoral arteries could be felt but they stopped when the compression was stopped. At the end of two hours a pint of saline solution was infused into the median cephalic vein and ten minims of solution of chloride of adrenalin were injected into the pectoral region and repeated without effect. Later tracheotomy was performed and air was blown into the lungs. The efforts were continued for four and a half hours without any success until rigor mortis was established.

31. Gray (*THE LANCET*, August 19th, 1905, p. 506).—A female, aged 55 years. Laryngeal obstruction from cancer and dyspnoea for three months. Sudden asphyxia came on and tracheotomy was immediately performed, as well as artificial respiration, by which a few spontaneous respirations were taken which soon ceased. After four or five minutes the abdomen was opened in the middle line above the umbilicus and the heart was compressed through the intervening diaphragm at the rate of from 70 to 90 compressions per minute. At the end of four minutes the heart began to beat, slowly at first but gradually increasing in rate and strength until 90 beats per minute were registered. Artificial respiration was still continued and gradually natural breathing was restored. The wound was dressed but the patient died three hours later, having never regained consciousness.

32. Sencert, April 17th, 1905 (*Réunion Biologique de Nancy*, 1905).—A man, aged 51 years. Gall stones. Very cachectic and wasted. Chloroform anæsthesia was induced. During the operation the patient struggled and immediately the respiration and the pulse stopped. Artificial respiration, tongue traction, flagellation, and the injection of ether were tried without success for seven or eight minutes. Then the right hand was pushed up through the abdominal wound and passed up to the diaphragm; the heart was easily seized at its apex between the fingers and thumb and was rhythmically compressed. After five minutes it hardened and soon contracted spontaneously and two minutes later the first spontaneous respiration took place. The abdominal wound was closed. The patient recovered consciousness and made a good recovery.

33. Depage (*Journal de Chirurgie et Annales de la Société Belge de Chirurgie*, 1905, p. 238).—A woman, aged 44 years. Abdominal hysterectomy for fibroid. The patient had mitral disease. Chloroform was administered and at the end of 20 minutes syncope had occurred. Artificial respiration and tongue traction were tried for 15 minutes without success and then heart massage was done by the subdiaphragmatic route. The heart beat was restored after a few instants; it was feeble at first but soon became stronger. Spontaneous respiration did not return until one hour had elapsed. The patient did not recover consciousness and died at the end of 16 hours.

34. Lenormant, August 16th, 1905 (*Revue de Chirurgie*, March 10th, 1906).—A man, aged 18 years. Bullet wound of the heart. Operation under chloroform. The heart was laid bare by resecting the fourth, the fifth, and the sixth left costal cartilages and ribs during which proceedings the pleura was torn. The pericardium was opened and the wound in the heart was sutured. During the manipulations the heart and the respirations suddenly stopped. Rhythmical compression was instituted and tongue traction was commenced. Ether and caffeine were injected. At the end of from six to eight minutes, and ten minutes after the heart had ceased to beat, a slight contraction was felt followed by others, which gradually got stronger and persisted, artificial respiration and tongue traction were continued and three-quarters of an hour after the syncope came on spontaneous respiration was also re-established. Half an hour later the breathing became difficult, the limbs contracted, the temperature rose, and the patient died five hours after his resuscitation had been commenced. Post mortem it was found that the bullet had also pierced the diaphragm, the stomach, the left lobe of the liver, and a loop of the small intestine.

35. Conkling (*New York and Philadelphia Medical Journal*, Sept. 2nd, 1905).—A male, suffering from a severe wound of the chest caused by a razor and extending from the outer third of the left clavicle to a point four inches below the right nipple and involving the second, the third, and the fourth left ribs. Preliminary injections of 20 ounces of saline solution as well as strychnine and nitro-glycerine were given and the wound was repaired under partial ether narcosis. Near the end of the operation the heart suddenly stopped. Artificial respiration and the subcutaneous injection of cardiac stimulants were of no avail and after two minutes the thumb and index finger were passed through the wound to grasp the heart. Compression was made for from 40 to 60 seconds when a slight thrill was felt and the pulse was gradually re-established. Stimulants and saline solution were administered and the patient made an uneventful recovery.

36. Smith and Daglish, October, 1905 (*British Medical Journal*, November, 1905, p. 1340).—A man, aged 63 years. Cancer of the rectum. Examination under chloroform. During the examination the pulse and respiration stopped. Artificial respiration was commenced and strychnine was injected, but after being tried for three minutes without effect the abdomen was opened and the flaccid heart was gently kneaded through the lax diaphragm. In 60 seconds it was again beating feebly but fairly regularly. A few seconds later voluntary respiration commenced. The patient made a good recovery.

37. Keetley (*vide ante*).

38 and 39. Green (*vide ante*).

40. Ramsay (*Intercolonial Medical Journal of Australasia*, September, 1906).—A woman, aged 27 years. Operation for prolapse of the uterus, &c. Anæsthesia by chloroform and ether. Five minutes after the anæsthetic was stopped vomiting occurred and the pulse failed. Artificial respiration was commenced immediately. At the end of four minutes respiration also ceased and heart massage was immediately commenced by the subdiaphragmatic route. Pulsation returned within a minute, at first feebly, then becoming stronger, and spontaneous breathing soon followed. Three and a half pints of normal saline solution were poured into the abdominal cavity and the wound in its walls was closed. Three hours later the pulse was 168 per minute, irregular, and intermittent. The temperature was 101.6° F. and the respirations were 28. The patient slept for four hours and was at times delirious. On the next day she was better. She made a good recovery.

Clifton.

LARGE ARTERIO-VENOUS ANEURYSM OF THE NECK TREATED BY EXCISION.¹

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THE patient a female, aged 39 years, was sent to me in March by Mr. Charles J. Heath on account of a large pulsating tumour of the neck. 20 years ago the patient first noticed a small swelling of the size of a filbert at the lower part of the right side of the neck. This gradually and very slowly increased in size but caused no serious inconvenience until the beginning of August, 1905, when she received a sharp blow upon it from a hard sweet that was accidentally thrown at her during a school treat. From that time the swelling rapidly increased in size and began to give great trouble, chiefly dyspnoea, palpitation, pain in the neck, side of the head and arm, and throbbing and noise in the tumour. Latterly her voice had become somewhat hoarse. On March 7th, 1906, she was admitted to the Royal Free Hospital and after spending ten days in a medical ward under the care of Dr. Raymond H. P. Crawford she was transferred on March 17th to my care.

¹ A paper read before the Medical Society of London on Nov. 26th, 1906.