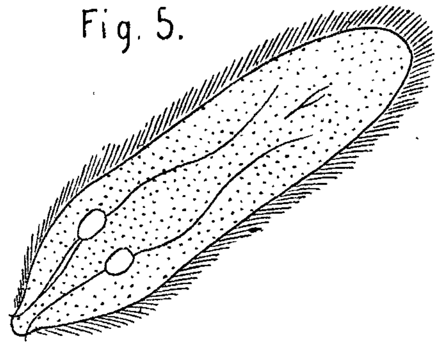
the urine be watery, or if it has previously been replaced by pure water, the escaped embryo, relieved from the confining pressure of the shell, assumes its natural conical elongated form and swims away with great rapidity (Fig. 5). If there

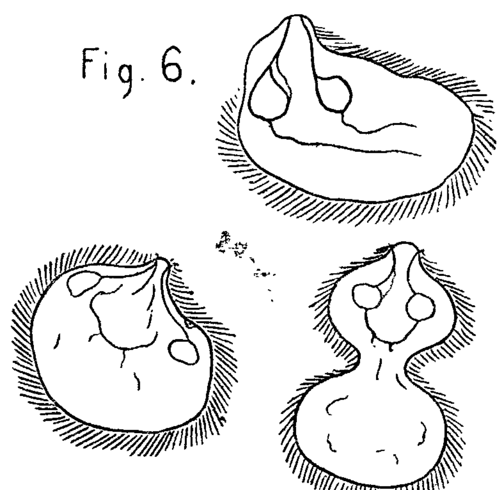
Fig. 5.



Free swimming embryo.

be much impurity in the surrounding fluid, or if the weather be cold, or if the embryo has been prematurely launched into it, strange and unnatural shapes are assumed (Fig. 6), a very

Fig. 6.



Anomalous forms of liberated embryo.

common form being that of an hour-glass. The time required for hatching varies very much according to the temperature of the air and the state of development of the embryo. As a rule, in the case of an ovum fully matured, rupture occurs within two days in warm weather, but under other circumstances it may be delayed for many days. Cobbold, Sonsino and others have made many attempts to keep alive the liberated embryo, but after a few days—and before, as a rule, any further development has taken place—the death of the embryo defeats the inquiry. One experimenter states that very soon larvæ make their appearance, by means of a sort of internal budding, in the embryo, which dies and is ruptured in order to be delivered of them. Judging by analogy, however, it is most probable that the larvæ become encysted on or in some aquatic animal, possibly passing through more than one phase and through more than one host before attaining their perfect development in the human system. They have been experimentally brought in contact with different species of fishes, mollusca, crustacea, larvæ of other insects &c., but have in no single instance been found to attack any of them. The further steps in its development, therefore, still remain a mystery.

Rustemberg, Transvaal.

LONDON AND COUNTIES MEDICAL PROTECTION SOCIETY.—On Wednesday, Aug. 23rd, at the Thames Police-court, "Dr." Blumberg, of 230A, Commercial-road, E., was brought up on a warrant and charged with obtaining money by false pretences from Mrs. Donenberg, on whom he had operated, with disastrous results, for the cure of sterility. The case was adjourned till Thursday, Aug. 31st, when "Dr." Blumberg was again brought up, and a further remand was granted until Thursday, Sept. 7th. "Dr." Blumberg was, moreover, charged with violation of the Medical Act, he not being registered in the Medical Register.

AN ANALYSIS OF THE GASES OF THE BLOOD DURING CHLOROFORM, ETHER, BICHLORIDE OF METHYLENE AND NITROUS OXIDE ANÆSTHESIA.

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AND

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THE following notes on the gases of the blood in anæsthesia must be regarded as prefatory to future papers rather than as in any way conclusive. There have been many difficulties connected with our researches and a series of interruptions over which we have had no control. There is, too, comparatively speaking, an absence of literature dealing with the subject. The investigations of Richardson, Schmiedeberg, Böhr, Paul Bert, Grehant and De Saint Martin cannot in this respect, however, be overlooked. Sudden death in chloroform anæsthesia is so appalling that any effort which is put forward to solve the problem of its causation is worthy of attention. The purely physiological side of the question has been most ably studied by Brunton, Lawrie, Gaskell and Shore, and by Horatio Wood and Hare, not to mention others. It is scarcely necessary for us to do more than to repeat these names to recall the high-class character of the work they have accomplished. Does the composition of the blood in anæsthesia throw any light upon sudden death? We have analysed the gases of the blood in chloroform, ether, bichloride of methylene and nitrous oxide anæsthesia; and, whilst there is no one feature that stands out prominently in the results we have obtained, there are certain facts that become valuable by comparison and which are not without suggestiveness. The animals which have been experimented upon were rabbits—not at all a suitable class,—but the best which we could obtain under the circumstances. Rabbits, speaking generally, are too easily killed by chloroform. Dogs are better, but we only employed one. In all our experiments narcosis was complete before the blood was removed, no pain was experienced and the animal was never allowed to regain consciousness. In the present investigation we have been satisfied simply with the production of anæsthesia without reference to the amount of the anæsthetic employed. That subject, together with a more elaborate analysis of the expired air, we hope to undertake on a future occasion. Arterial blood, unless otherwise stated, was employed for analysis. As the composition of arterial blood varies in different vessels, we generally removed it from a large branch of the abdominal aorta—e g., the external iliac artery. The blood was withdrawn through a hollow needle and rubber tubing—which had been previously filled with a weak solution of chloride of sodium—into a pipette containing mercury; the heart's beat in almost every instance being sufficient to fill the tube, aided, no doubt, by the suction influence of the mercury as it escaped from the other end of the pipette. The amount of blood which was removed was, on the average, 26 c.c. The pipette was then hermetically closed and afterwards plunged into a column of ice, in which it was removed to the chemical laboratory. Clotting never occurred. Subsequently the pipette was attached to a Pflüger's gas pump modified by Professor Bedson of the Durham College of Science, to whom we are indebted for his kindly supervision of our work, and also for many suggestions. When the gases were given off by the blood in vacuo they were analysed in Dittmar's apparatus, using the Hempel pipettes as modified by Professor Bedson. The carbonic acid was determined by absorption with caustic potash, the oxygen by absorption by means of ferrous tartrate, and the vapour of the anæsthetic by combustion with oxygen, a little electrolytic gas being employed to bring about the explosion. After the explosion the excess of oxygen was removed and the residual nitrogen measured. All the volumes given in this paper are reduced to normal temperature and pressure—(0°C. and 760 mm. Hg.) :—

Gases of arterial blood in volumes at 0° C. and 760 mm. Dog (normal).

	Handbook of Physiological Laboratory.	Meyer [from Halliburton].	Pflüger [from Halliburton].
CO_2	39·5	26 to 34	34 3
O	17 65	12 to 18	22
N	2·1	3 to 5	1·8

Dog. Arterial blood in Chloroform Anæsthesia. (Oliver and Garrett.)

CO_2	37·21
O	17 09
N	8·03
$CHCl_3$	0·92

Rabbit. Arterial blood. Chloroform Anæsthesia. (Oliver and Garrett.)

	A	B	L
CO_2	6·46	19 33	24·85
O	20·96	16·86	13·14
N } $CHCl_3$ }	54·72		
N		38·33	13 7
$CHCl_3$		4·55	2·59

Rabbit. Arterial blood. Ether Anæsthesia. (Oliver and Garrett.)

	D	E	F
CO_2	25·5	34·52	14·73
O	26 47	27·73	23 07
N	25 68	1·34	6·16
Ether	0·79	0 67	0 59

Rabbit. Arterial blood. Bichloride of Methylene. (Oliver and Garrett.)

	G	H	I	K
CO_2	38·99*	13·12	32·21	17·62
O	5·2*	21·26	13·51	14·16
N	8·92*	21·67	6·74	12·96
Combustible gas-methylene chloride	0·57*	1·31	1·20	0·99

* Removed from right heart.

Rabbit. Chloroform and Oxygen. (Oliver and Garrett.)

	M	N	O	P	U
CO_2	45·18	58·43	37·26	26·38	35·96*
O	21·02	16·06	22·95	19·03	16·83*
N	8·96	11·56	11·65	8·92	6·62*
$CHCl_3$	1·18	1·20	0·62	1·5	a trace.*

* Baird and Tatlock's oxygen used.

Rabbit. Ether and Oxygen. (Oliver and Garrett.)

	R	T
CO_2	18·85	34·02
O	15·11	21·25
N and Combustible gas	20·58	33·97

Rabbit. Nitrous Oxide. (Oliver and Garrett.)

	S
CO_2	15·66
O	3·49
N_2O	22·49
N	11·23

Rabbits took ether with greater safety than chloroform. The respirations became rapid and the temperature rose, but after death the heart would continue to beat for a variable length of time; sometimes the left side of the heart would be, comparatively speaking, empty whilst the right was full, or, as in others, the heart would be found to be over-filled in all its chambers, and relaxed. On looking over the first three tables under chloroform anæsthesia (rabbits B and L), and including the dog, it is noticed that the number of volumes of oxygen present in the blood is not large; the carbonic acid, with the exception of the dog, is not excessive. It is to be noticed, however, that a new feature has been introduced in the presence of a very large quantity of nitrogen. Chloroform exercises some influence upon the blood cells, but whether it is by direct chemical combination or by some solvent influence upon the hæmoglobin we are not at present prepared to say. It destroys the absorbing power of hæmoglobin for oxygen. Under these circumstances it is possible that the nitrogen from the atmospheric air may pass into the blood and supplant for the time being the oxygen. Rabbit's blood is said to contain always a smaller quantity of oxygen than the blood of mammals generally. In regard to the gases of the blood it has been shown by Paul Bert and De St. Martin that as the animal becomes more profoundly anæsthetised the oxygen diminishes whilst the carbonic acid increases. That is quite in keeping with our own view upon the subject. One of the examples given by Paul Bert is the following: before anæsthesia, oxygen 22 c.c. and carbonic acid 31·2 c.c.; thirty minutes after anæsthesia, oxygen 16·8 c.c. and carbonic acid 41·2 c.c.; an hour later (ten minutes before death), oxygen 14 c.c. and carbonic acid 44 c.c.[1] De St. Martin's experiments point in the same direction. At first Paul Bert's and De St. Martin's experiments seemed to be contradictory to each other. One fact must be borne in mind and that is that the removal of large quantities of blood seems to alter in a very marked manner the composition of the gases of the blood. It is a mistake therefore to remove very large samples of that fluid for successive examinations. Making allowance for this influence the fact remains that as chloroform narcosis is pushed the tendency is for the amount of oxygen in the blood to diminish and the carbonic acid to increase. In some cases of chloroform anæsthesia in the dog De St. Martin found that the amount of oxygen was not diminished. His explanation was that in this animal the early stage of anæsthesia was accompanied by deep and forcible respiration amounting to dyspnœa, and it was this rapid ventilation which he regarded as favourable to the absorption of oxygen by the blood whilst it facilitated the exhalation of the carbonic acid. His third experiment[2] is a good illustration of the remark that as anæsthesia deepens oxygen disappears and carbonic acid increases. From a healthy dog weighing 18 kilogrammes he removed from the femoral artery at 9.50 A.M. 20 c.c. of blood (α). Five minutes later the animal began to breathe air containing 10 per cent. of chloroform. At 10.7 A.M. it was asleep; 20 c.c. of blood were removed at 10.10 A.M. (β). Half an hour later, during which it had been breathing this chloroform atmosphere, another 20 c c. of blood were removed (γ). Here is the analysis of the gases in 100 c.c. of blood at 0°C. and 760 mm. Hg gases :—

	α	β	γ
CO_2	40·85	36 40	50 62
O	15 20	15 05	12·88
N	2·45	2·85	3·05
	58·50	54·30	66·55

Paul Bert carried his experiments further than De Saint Martin and proved that these results became more and more accentuated as death approached. Looking back upon the tables under the heading of "arterial blood" in ether anæsthesia it is noticed that the largest amount of oxygen was found in the blood under this anæsthetic and that, with one exception, the amount of nitrogen is smaller than in chloroform. Bichloride of methylene proved itself in our hands to be rather an unmanagable anæsthetic in the case of rabbits. Very early under its administration the breathing would suddenly cease and it could not be restored by any methods of artificial respiration that we adopted. Yet all the while the heart was felt beating and would continue to do so for more than ten minutes after its removal from the body. When death occurred the heart was always in diastole. All its cavities were filled; the right half looked as if it was painted blue whilst the left was very red. If death was not sudden it was preceded by shorter and still shorter but feebler respirations; but once this condition was reached and atmospheric air supplied death was not averted. In the rabbit G, for example, whilst attempting to remove blood from the femoral artery respiration suddenly ceased, but the heart was at once cut down upon and 26 5 c.c. of blood were without difficulty removed from the right ventricle. In G, therefore, it is an analysis of venous and not of arterial blood. This circumstance alone may explain in this particular instance the large amount of carbonic acid which was present in the blood and the deficiency of oxygen. When a mixture of chloroform and Brin's oxygen, which contains 7 per cent. of nitrogen, was being administered to a rabbit the breathing became suspended for a few seconds, especially when there was excess of oxygen, as if the animal was in a state of apnœa. This was shortly afterwards succeeded by a condition in which breathing was very active, the respirations varying from 60 to 80 in the minute. Anæsthesia was always less quickly induced

[1] Paul Bert : Étude Analytique de l'Anæsthésie, p. 444 &c.
[2] Recherches Expérimentales sur la Respiration, p. 189.

than when chloroform alone was inhaled. The blood from the artery of the animal flowed into the pipette under high pressure and had a bright scarlet colour; but in spite of that it was found on analysis to contain a larger quantity of carbonic acid than when chloroform alone was employed. Towards the end of life the breathing became very short and feeble and gradually ceased; but on opening the chest the heart in every instance continued to beat vigorously for several minutes, the left side being noticed to be practically empty compared to the right. The pupils after death were found to be semi-dilated. In the cases where oxygen was allowed to commingle with the vapour of chloroform—a condition which we accomplished by passing oxygen from a cylinder through chloroform, the latter being exposed to a slight rise of temperature—the supply of oxygen was so free that the animal, whose head was in a tight-fitting mask, could not have suffered in any way from an excess of carbonic acid. In three of the experiments we analysed the expired air, and we found that the carbonic acid in the gases escaping from the mask varied from 0·4 to 0·9 per cent. We always allowed an excess of oxygen to pass over with the chloroform. The air escaping from the exit-tube of the mask in rabbit P contained—CO_2, 0·8 per cent.; O, 64·0 per cent.; and N, 35·2 per cent., whilst in the rabbit U the escaping air contained—CO_2, 0·5 per cent.; O, 74·3 per cent.; N, 23·3 per cent.; and $CHCl_3$, 1·9 per cent. When ether and oxygen were administered the animals went quietly under the influence of the anæsthetic, the respiration and circulation were well maintained and the blood escaped from the artery under higher pressure than in any of the other experiments. Long after the respiration had ceased, when the chest was opened the heart would be seen to be beating with extreme vigour, the movements being very forcible. The pupils were the size of a large pin's head. In one or two of the rabbits it seemed to be almost impossible to check the respiration and circulation when the anæsthesia was profound. If pure chloroform was at this stage applied to the nostrils of the animal its inhalation was almost immediately followed by rapid dilatation of the pupils and the respiration would gradually but quickly cease.

It is difficult to express an opinion upon the gases of the blood in the ether and oxygen experiments. In the chloroform and oxygen experiments and also in the rabbit T (ether and oxygen) it would appear as if the excess of carbonic acid in the blood was not of itself the source of danger. The freedom with which an excess of oxygen passed into the lungs would, if it were absorbed, promote oxidation of the tissues and therefore further the production of carbonic acid. For safe anæsthesia it is rather a question of the ease or rapidity with which the blood can part with its oxygen to the tissues and at the same time good ventilation of the lungs, whereby the carbonic acid may readily escape from the blood. Nitrous oxide destroyed rabbits very quickly. The movements of the heart and respiration would suddenly cease simultaneously, or the respiration would suddenly be arrested, and on exposing the heart a few flickering impulses would be noticed in the auricles. Removal of a small quantity of blood from the heart would cause renewed and fairly vigorous movements of that organ. The pupils were dilated and the lungs were collapsed and empty of air. All the large veins were over-distended with dark blood and the arteries were empty, whilst the heart was overfilled in all its chambers. Anæsthesia by nitrous oxide seemed to be extremely rapidly induced. In the case mentioned in the table—rabbit S—only four minutes elapsed from the commencement of the administration of the anæsthetic to the pipette being filled with blood and placed in the column of ice. The analysis of the gases of the blood in nitrous oxide shows a most marked deficiency of oxygen, but no excess of carbonic acid; nitrous oxide and nitrogen are present in considerable quantity. So far as nitrous oxide anæsthesia is concerned the danger probably depends upon the great absence of oxygen, for it will be observed that the carbonic acid is present in small quantity compared with that in the other anæsthetics; but it is present in very large quantity relatively to the amount of oxygen associated with it in the blood.

Newcastle-on-Tyne.

DR. R. JULYAN GEORGE of Port Isaac, public vaccinator for the No. 1 District of the Bodmin Union, has been awarded the grant for successful vaccination in his district by the Local Government Board.

ON THE

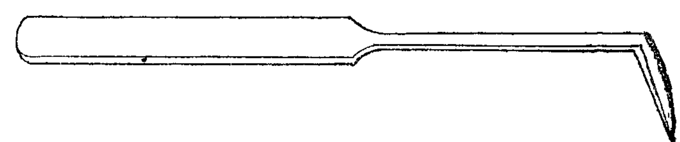
ULTIMATE CONDITION OF CLEFT PALATE CASES AFTER OPERATION;

TOGETHER WITH A NOTE ON THE CONDITION OF THE PALATE DURING THE ACT OF SNORING.

BY C. J. BOND, F.R.C.S.,
HONORARY SURGEON TO THE LEICESTER INFIRMARY AND FEVER HOUSE.

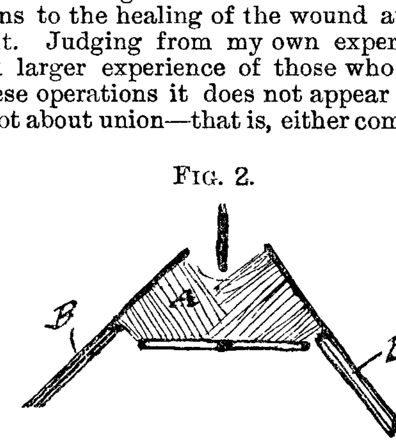
BEFORE speaking of the later results after operations for closure of cleft palate, there are one or two points in connexion with the operation itself which may, I think, prove to be of interest. Too much importance can hardly be attached to a free and thorough separation of the muco-periosteal flap, not only from the hard palate at the sides of the cleft, but also from the posterior bony edge of the hard palate; and I have found the knife represented in Fig. 1 to be useful in accomplishing this latter object. As will be seen, it has a short

FIG. 1.



blade which is set at right angles, with the cutting edge along its lower border, and after the curtain has been freed laterally and hooked forward the blade is introduced behind it on either side from within the cleft, and the fibrous connexion between the velum and the bony edge of the palate is divided directly backwards into the pharynx and to as great an extent outwards as may be desired. The position of the patient, with the head inverted over the edge of the table, is also a help at this stage of the operation. Free lateral or relaxing incisions through the whole thickness of the flaps on either side are of course equally essential, and if these two points are adequately carried out there ought, I think, to be little fear of failure of union, provided, of course, that there is a fair amount of flap material available and that the edges have been carefully pared and united without undue bruising. With regard to the uniting of the edges by suture, judging from my own experience, I must say that I find the simplest plans to be the best. I pass the sutures—wire for the hard portion and horsehair for the velum—with a single right-angled needle set on a handle in preference to the various hollow needle and reel appliances, which, however, are doubtless useful in some hands. Before considering the permanent result in these cases I should like to make a remark as regards the immediate or primary result, which pertains to the healing of the wound and the recovery of the patient. Judging from my own experience and from the recorded larger experience of those who have specially practised these operations it does not appear that there need be much doubt about union—that is, either complete, or nearly

FIG. 2.



complete—in the great majority of cases. In two cases in which temporary partial failure occurred the following causes deserve notice. In one case, although the median union was perfect, one lateral incision failed to close; and to avoid this in the future I should certainly, whenever the lateral gap is likely to be wide, also partially detach from the alveolus the portion of palate which is external to the lateral incision, as the want of closure appears to be due to the different inclination of the two membranes on either side of the lateral incision (see Fig. 2) and in the case mentioned a second plastic operation on these lines materially lessened