THE ENTRANCE OF AIR BY THE OPEN MOUTHS OF THE UTERINE VEINS, CONSIDERED AS A CAUSE OF DANGER AND DEATH AFTER PARTURITION.¹

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IN connexion with the subject specially indicated by the title of this paper, it will be necessary to consider with attention, though briefly, the phenomena which follow the Introduction of Air into the Veins; and especially to call attention to the fact, that these phenomena vary exceedingly in character and degree according to certain circumstances, most of which seem to be explained by cases and experiments. The errors of opinion which have arisen as to some published cases, from inattention to the fact, that air may be generated within the blood-vessels during life, and after death, want of space will prevent me from considering upon this occasion.

The following remarks are divided into sections, so that the different topics may, as much as possible, be considered separately. The cases and experiments are introduced in the most convenient places, but of course they will often aptly illustrate particular points in all the sections.

- I. The various Effects caused by the Entrance of Air into the Veins, and the Appearances found on Dissection. Detail of Experiments and Cases.
- II. Statement of facts, proving that the Entrance of Air by the open mouths of the Uterine Veins may cause Dangerous Symptoms, and even Death. History and Critical Examination of some of the alleged Cases.
- III. Prevention and Treatment of such accidents, after Parturition.

I. THE VARIOUS EFFECTS CAUSED BY THE ENTRANCE OF AIR INTO THE VEINS, AND THE APPEARANCES FOUND ON DISSECTION. DETAIL OF EXPERIMENTS AND CASES.

Till very recently, the opinions which have been entertained regarding the effects produced by the entrance of air into the organs of circulation, have been vague and contradictory. Even now, perhaps, they are not quite settled. There are several ways in which hazard arises, or death ensues, from the entrance of air into the veins. The phenomena and the issue are materially influenced by a variety of circumstances; but especially by the quantity of air introduced, the rapidity and force with which it enters, and the relation which the aperture, through which it gains admission, bears to the calibre of the vein in which is the aperture.

Bichat, Sir Charles Bell, and others, have maintained that extremely small quantities of air introduced into the veins prove fatal: but this

¹ This paper was read before the Westminster Medical Society on the 23rd of March, 1850; and a short abstract of it appeared at p. 589 of this Journal for June 1850. It was likewise shortly reported in the *Lancet*, *Medical Times*, *Medical Gazette*, *Edinburgh Monthly Journal*, *Provincial Medical and Surgical Journal*, *Dublin Medical Press*, as well as in several foreign medical periodicals.

notion has been completely disproved. The entrance of air, even in considerable quantity, into the circulation, is by no means necessarily fatal. Experiments on animals, and cases which have occurred in the human subject, alike testify to the accuracy of this statement.

The following is an exact account of an experiment which I performed on a rabbit:—

EXPERIMENT. A large quantity of air, was injected into the jugular vein. Very violent effects were produced; so violent, indeed, that the animal seemed for twenty minutes to be in a moribund, or at least in a very critical state. To our astonishment, however, it gradually came round; and, in about an hour, the respiration, which was at first very laboured, became tolerably natural, and the rabbit was soon little out of sorts. In a few hours afterwards, the breathing, as far as I could judge, was quite natural, and the animal ate food with avidity. I kept it for sixteen days, and never observed anything wrong, except an abscess which formed in the seat of the operation. Upon dissection, immediately after killing it, the lungs were found to be perfectly healthy, and there was no air in any of the blood-vessels.¹

I believe it often happens that air enters the veins during operations; sometimes the quantity is so small, as to produce no notable manifestations; and at other times, after the characteristic symptoms of the accident have been produced in an alarming degree, the case has, without any special treatment, terminated favourably.

A very apt illustration of this remark has been kindly communicated to me in the following letter from Sir B. C. Brodie.

“21 *March*, 1850.

“MY DEAR SIR,—I send you the case, which is quite at your service.

“**CASE.** A young lady consulted me in the year 1842, on account of a large tumour occupying one side of the neck. The tumour was fully covered by the sterno-cleido-mastoideus muscle; but it was quite moveable on the parts below. In the operation for the removal of the tumour, I found it necessary to divide the muscle, which lay over it. In the course of the dissection, it was discovered that the internal jugular vein was so intimately connected with the under surface of the tumour, as to be inseparable from it; the tumour itself lying in contact with the carotid artery and pneumogastric nerve. Under these circumstances, I was led to apply a ligature to the vein above, and another to the vein below the tumour, and then remove about three inches of that vessel with the tumour. Towards the conclusion of the operation, on dividing some parts near the clavicle, a branch of the principal vein was wounded, and immediately a hissing sound was heard, which I concluded to have been produced by air entering the wounded vessel. The patient became faint, so that the pulse at the wrist could scarcely be felt, and she was at the same time insensible. I caused her to be laid on the floor, where she remained insensible and faint for half an hour, and then gradually recovered, so that she could be removed to bed. On the following day she was apparently well, but wholly unconscious of what had occurred, from the time of her becoming faint, until the expiration of several hours. The tumour was of a fibrous

¹ Author's Inaugural Dissertation on the Presence of Air in the Organs of Circulation. Edinburgh, 1837, pp. 28-29.

structure, not apparently malignant; and two or three years afterwards, there had been no return of the disease. No inconvenience had ever arisen from the removal of the internal jugular vein.

"Mr. Kennedy, of Tavistock Square, attended the patient with me.

"Yours truly,

B. C. BRODIE."

Another interesting illustration of the good hope which there is of recovery, when the quantity of air admitted is small, occurred in 1848, in the practice of Mr. Gay; and has been detailed and commented upon in an instructive manner by Mr. G. F. Lane, in the *Medical Gazette* for May 31, 1850, p. 926. The following is a slightly abridged account of the case.

CASE. *Admission of Air by a Wound in a Branch of the Axillary Vein. Alarming Symptoms. Complete Recovery.*

Mrs. Simkiss, æt. 46, a married woman, of light complexion, usually of good health, and the mother of eight children, had a painful tumour in the axilla, which had first appeared on weaning her youngest child six years ago. On the 7th of February, 1848, it was removed by Mr. Gay, the patient being under the influence of chloroform. In dissecting out the tumour, a tributary branch of the axillary vein was wounded near the chest; the opening was small. Air was seen, both by Mr. Gay and myself, to enter the orifice, accompanied with a peculiar noise, sufficiently loud to be audible to all present: the sound being quite characteristic of the entrance of air and fluid through a contracted opening, or of air drawn through fluid,—something between gurgling and hissing, and resembling the sound heard when, in drawing the last portion of a fluid from a vessel into a syringe, some air accompanies it. A great change was immediately noticed in the condition of the patient: the powers of the circulation sank; the woman, who had nearly recovered from the effects of chloroform, became exceedingly faint, and sank down in the chair. Mr. Gay instantly detached the portion of gland he was engaged in removing, and applied pressure above the opening in the wounded vein. The pulse was now imperceptible; the face deadly pale. Brandy was freely given, the wound closed as speedily as possible, the arm brought to the side, and the woman placed in the recumbent position. The surface of the body became cold, and the patient seemed scarcely to breathe. Ammonia was held to the nostrils; bottles of hot water were applied to the feet; the legs and arms were rubbed continuously; the feet and hands immersed in hot water; hot brandy and water poured down the throat in considerable quantities, and subsequently some sulphuric ether. After the lapse of an hour and a half, during which these measures were continued, the pulse at the wrist could be detected beating regularly, and the woman began to regain her consciousness, which she had lost immediately after the entrance of air into the vein. After this, she fell into hysterical fits, which soon passed off again, and after two hours she was placed on the bed, so far recovered as to admit of a compress being applied, and the arm bandaged to the side; the pulse beating 80 in a minute, regular, but feeble. She was ordered spiritus ammoniæ aromaticus, in mistura camphoræ, every four hours. She recovered without any bad symptoms. There has been no return of the disease; and her general health has been better since than before the operation.

Regarding the circumstances which modify the effects produced by the entrance of air into the veins, I entertain, substantially, the same opinions which I expressed in 1837, and which have been largely noticed by numerous subsequent writers, and likewise pretty fully adopted by the two authors who have most elaborately discussed the subject, viz., Professor Wattmann of Vienna, and the late Professor John Reid of St. Andrew's. As my Thesis has been long out of print, I give the following passage at length.

"Very considerable quantities of air may be introduced into the circulation without producing death. The concurrent testimony of a variety of experimenters establishes this beyond the possibility of doubt. Sometimes the patient to whom the accident happens, or the animal experimented on, suffers only transient inconvenience, or makes a complete recovery; and, in other instances, death ensues so late as some days after the admission of the air. Two very interesting subjects of investigation are thus presented to our notice. In the first place, what are those circumstances which thus modify the result? And, then, what is the nature of the modifications which occur under these varying circumstances?

"The different modifying causes are:—

1. The *quantity* of air admitted:
2. The *rapidity* of its admission: and
3. The *situation of the orifice* through which it enters.

"That the result is modified, to a very great extent, by the quantity of air admitted, it is unnecessary to insist upon at any length. The experiments of Nysten, Magendie, Wing, and others, clearly shew that it is only when introduced in considerable quantity that there is a fatal issue. This I have satisfied myself of by repeated experiments. The same fact has also been stated by Dr. Blundell, in his memoir on the transfusion of blood. It is probable, that when slowly introduced, the oxygen is either in whole or in part absorbed, and the volume of the elastic fluid thus materially diminished. That such absorption does really take place, there can be no doubt; for the experiments of Dr. Christison distinctly prove that the oxygenation of the blood is a purely chemical process, and that even out of the body venous blood absorbs a large quantity of oxygen, and changes its purple for a florid hue. Nysten infers from various experiments, that some of the injected gas may be thrown off by the lungs."¹

To shew the truth of these remarks, I will now relate three of the many analogous experiments which I have performed on animals.

EXPERIMENT. *Sudden Introduction of Air into the jugular vein of a horse: convulsions: death in three minutes. Enormous distension of the right auricle with frothy blood: air in every visible vein.*

The subject of this experiment was a horse about seventeen hands high, and in pretty good condition, but which was condemned to death on account of an incurable cancer of the foot. A tube, a quarter of an inch in diameter, was introduced into the left jugular vein. The man who blew filled his chest twice, and continued to blow for a minute. He then stopped, on account of the symptoms of uneasiness which the

¹ Op. cit., pp. 22-23.

animal exhibited. In a few seconds, the horse staggered and fell; and in three minutes, from the commencement of the introduction of air, he was quite dead. During the period he survived after falling, he made great and violent efforts to respire, and during that time was strongly convulsed, the convulsions commencing soon after he fell. It was computed that he lost about eight quarts of blood, which is the quantity usually taken at an ordinary venesection.

Section. Air was found in every visible vein over the whole body. The chest was opened an hour and a half after death, when the lungs were seen to be collapsed, and in no degree emphysematous. All the cavities of the heart, but particularly the right auricle, were distended, and had a tense elastic feel. The right side was first examined. The auricle was enormously distended; and, upon a small opening being made with the scalpel, frothy blood, with which the cavity seemed to be entirely filled, instantly rushed out. The greater part of the ventricle was filled with fluid and coagulated blood, but there was also some in a frothed state. The left auricle contained frothy blood, and some coagulated masses. In the left ventricle, the quantity of air was just sufficient to make its existence appreciable; but there was a great quantity of blood, both fluid and coagulated, in this cavity.¹

EXPERIMENT. Introduction of Air into the jugular vein of a rabbit: convulsions: death in two minutes. Right side of heart distended with air unmixed with blood, as well as frothy blood: fluid blood in left side. Irritability of heart nearly lost. Bubbles of air in vena cava and larger abdominal veins.

A tube, almost equal in diameter to a crow-quill, was inserted into the right jugular vein of a rabbit. In the course of two minutes, I introduced three or four full expirations. During this time the animal lay quite tranquil, and did not struggle in the least, but the breathing was difficult, and the heart's action feeble and fluttering. Just as I desisted from blowing, I observed some slight convulsive movements of the limbs, and in a few seconds more they recurred. Respiration now ceased, and there were no more convulsions. The thorax was immediately laid open. Great venous congestion everywhere presented itself. The heart was enormously distended. Upon puncturing the right auricle and ventricle, air unmixed with blood issued forth; and in the auricle there was a good deal of frothy blood. The froth was not nearly of so light a consistence as in the former experiment, owing, probably, to the blood and air not having had sufficient time to be thoroughly agitated together. The left side of the heart contained fluid blood. It is worthy of remark, that the irritability of the heart was almost extinct. Even though rapidly relieved of its load of blood and air, the contractions, excited by pricking it with the knife, were unusually trifling. In the horse, again, the contractions of the heart continued very forcible, long after it had been cut out of the body. The lungs were next examined, and were found to be quite healthy. They were collapsed, and in no degree emphysematous. In the vena cava, and some of the larger abdominal veins, bubbles of air were observed; but in most of the other vessels examined, none could be detected.¹

¹ Op. cit. pp. 10-11.

EXPERIMENT. *Injection of Air into mesenteric vein of a rabbit. Air found in the veins of the liver: none in any other part of the body.*

I threw a quantity of air into one of the mesenteric veins of a rabbit, and in eight minutes afterwards killed the animal. The liver was in a state of almost complete anæmia; and, upon slicing it, minute bubbles of air appeared at every point on the incised surfaces. There was no air apparent in the heart, nor in any part of the body, except the liver.

I will now detail the case of a man whom I had the opportunity of watching for some hours after the entrance of air into a vein of the neck, and whose body I inspected after death. The leading facts are already well known to the profession; the case having been noticed, with more or less particularity, in all the medical journals, at the time of its occurrence. The various phenomena which presented themselves in this case were watched with intense interest; for if the accident had been an intentional experiment, it could not have been more suited to illustrate the physiology, pathology, and treatment of this class of cases.

CASE. *Entrance of Air by a rigid Vein in the Neck, opened accidentally by a seton-needle. Asphyxia, and convulsions: death in seven hours. Congestion of the right side of the heart found on dissection.* [This case was described in the daily newspapers, in the *Lancet*, and other journals, at the time of its occurrence. References to these imperfect reports have been made by scientific writers.]

William Richards, aged 39, labouring under chronic laryngitis, applied to Dr. R. Willis, of Barnes, for advice, in the spring of 1848. He was first treated by leeches, then by blisters; and lastly it was resolved to introduce a seton, as Dr. Willis had found this, in other cases, a completely successful method. On the 25th March, the deceased came to Dr. Willis about 9 A.M. Dr. Willis set him in a chair, instructing him as to the proper attitude. He threw back his head, which, by keeping the parts tense, he being much emaciated, was inconvenient. Dr. Willis having desired him not to do this, pinched up the skin with the finger and thumb of the left-hand, and immediately thrust in a seton-needle, about the size of a common bleeding-lancet, armed with a strip of lint. It entered horizontally, about two inches and a half above the breast-bone, and not at all near any important blood-vessel. What followed was thus related by Dr. Willis to the coroner. "At the instant of its entrance, I heard a slight momentary hissing sound. At first I thought I had opened into a subcutaneous abscess communicating with the windpipe; but, almost at the same moment, I looked in the poor man's face, and saw that another, and far more serious event had occurred; that the rushing of the air was not from the windpipe, but into some small vein which had been implicated in the operation. The man was deadly pale; his features were set; he fainted; and subsequently became rigid and convulsed. I kept my fingers on the openings, to arrest the farther entrance of air during inspiration: I caught the man, and laid him down on the floor." It was in these circumstances that Dr. Willis sent for me; and in half an hour I was with him. The muscles were then rigid, and momentarily convulsed. The man seemed as if in an agony for breath: the

¹ Op. cit. pp. 11-12.

muscles of respiration were in a state of frightfully violent, and somewhat spasmodic and intermitting action. The sound of air and fluid being, as it were, churned in the heart, was heard with, and also without the stethoscope. Dr. Willis and I entirely agreed as to the nature of the accident; and we were also of opinion that it was our first duty to relieve the oppressed lungs, and over-distended heart, by blood-letting, and then to use such stimuli, internally and externally, as the progress of the case might warrant or suggest. We hoped that in this way the rapidly increasing congestion of the lungs, and therefore impending asphyxia, might be averted. We judged it dangerous to open the jugular vein, because we feared that, during the deep and violent inspirations, more air might be drawn down into the heart, as, from the rigid state of the fascia of the neck, it was evident that the tube might be kept gaping and patulous. If we had had any one to aid us, we would have freely opened the jugular vein, and, by mouth-suction at the wound, relieved the right side of the heart. In the circumstances, it was determined to open a vein at the elbow: and, in three or four minutes after my arrival, I performed this operation. Before the bleeding, he was almost pulseless; but after it the pulse immediately revived, and the ammonia and brandy, which had previously produced no benefit, caused, when now repeated, a manifest improvement in the pulse and respiration; and the action of the diaphragm became less convulsive. Death, which before the bleeding had seemed to be momentarily impending, was certainly delayed, for a time, by the measures which we adopted. We now sent to London for Mr. Syme, who was with us about noon. He found us applying, at intervals, warmth to the feet, dashing cold water on the face, and giving stimulants. The patient was in a more hopeful state, just as Mr. Syme entered, than he had yet been. Mr. Syme entirely concurred in the view we had taken of the nature of the case, and of its treatment. Shortly after Mr. Syme's arrival, I was obliged to leave the patient for an hour and a half. I returned at 2 P.M.; and, to my great surprise, found that the man was not only alive, but apparently better. The pulse was good, and the breathing was quieter, and more regular; but the locked-jaw, and opisthotonic arch of the back, proclaimed that the case was still desperate. Violent convulsions came on at three o'clock; the features were distorted, and the bleeding tongue was pushed up against the teeth, so as partly to protrude through their crevices. The last time he swallowed, was about a quarter past two o'clock. After several violent fits of convulsions, he expired a few minutes before 4 P.M., the body having previously become colder and colder, and the surface more and more livid. He died in a state of asphyxia. Up to a very short time before death, the churning sound was distinctly heard through the stethoscope; but it was much feebler, and more confused than in the early part of the day.

In reply to a question by the coroner, Mr. Syme said that a post-mortem examination was "not necessary to explain the cause of death; but that, for the sake of science, it was important that there should be one made." Immediately after the inquest, at the request of Dr. Willis, in his presence, and with the concurrence of the relatives, I made an anatomical inspection of the body.

General Appearance. The body was much emaciated. Some very slight indications of incipient putrefaction were present.

Neck. The great vessels of the neck were uninjured. The skin was carefully dissected away from the parts through which the needle had passed, when it was found that a vein, running almost exactly in the mesial line upwards and downwards, was the vessel which had been injured.¹ Its coats were thickened and rigid. Its calibre was such as readily to admit a bougie, of the size of a crow-quill. It had been transfixed by the seton-needle, which had made a gap in the anterior wall, leaving posteriorly about two-thirds of the rigid tube uninjured.

The diseased vein which had been wounded, came down nearly in a straight line from the under surface of the chin; about the lower third of the neck, it began to diverge to the right, till it joined the external jugular immediately above where that vessel dipped to join the internal jugular vein, under the sternal origin of the sterno-cleido-mastoid muscle.

Chest. The lungs were considerably gorged, and entirely filled the cavity of the thorax. There were strong pleural adhesions posteriorly, but none anteriorly, on both sides. Before proceeding with the examination, double ligatures were applied to the venæ cavæ. The heart occupied a large space. The right auricle had an elastic feel, and before it was opened it was evident that it was distended with air: the left auricle was flaccid. On pushing a scalpel into the right auricle, a small quantity of blood bubbled out, with at first a slight hissing noise. On fully opening up this chamber of the heart, the contents were found to be partially congealed blood, intimately mixed with bubbles of air. They were very numerous, notwithstanding the air which had escaped by the opening made by the scalpel. Most of these bubbles of air were about the size of a millet-seed; but a few of them were as large as small shot. There was also, in the right auricle, one small, pale, consistent, fibrinous clot. The pulmonary artery was likewise filled with blood and air intimately commingled: it did not contain any clots. Saving the presence of a minute quantity of fluid blood, the ventricles were empty. If permitted, I would have examined the veins over the whole body, and also the brain and liver. Unfortunately, the length of time occupied in exploring what has been described, rendered the relatives impatient, and made it necessary to close the inspection.

I am not aware of any recorded case of death from the entrance of air into a vein, so full of instruction as that now detailed; and probably this is because in no other instance was the opportunity for observation so long, and so ample. If an experiment had been deliberately planned, and skilfully performed, it could not have shed more light upon the subject. The characteristic and immediate effects were strikingly exhibited: they subsided; and then the secondary or asphyxial phenomena became equally well manifested. The first shock which the vital functions sustained, was caused by the rapid distension of the right auricle and its inability to contract upon its elastic contents. Had the dis-

¹ This vessel was the anterior jugular vein. In place of a single vein, there are generally two. Professor Schuh of Vienna, in his paper from which I am about to quote, incidentally states, that upon one occasion, in performing the operation of tracheotomy, he opened the middle jugular vein, and that some air was drawn into the circulation. The effects produced are not stated.

tension been a little more complete and rapid, instant death would have been the result. As it was, the heart partially regained its power; and although the condition of the heart, and frothy blood in the auricle, pulmonary artery, and its branches, produced an obstruction to the passage of the blood through the lungs, adequate ultimately to induce fatal asphyxia, the obstruction was yet sufficiently moderate to enable us to analyse all the phenomena as they presented themselves, and to point out to us, that had this obstruction been still more moderate, the difficulty might have been surmounted, and recovery from the accident might have occurred.

The history of this case clearly shows, that in such accidents, after the first danger is over, the patient may perish from asphyxia, induced by a gradually augmenting pulmonary obstruction. What I saw in this case, along with a careful reperusal of Mr. Erichsen's experiments (*Edin. Med. and Surg. Journ.* Jan. 1844,) has fully satisfied me that, in a large number of the deaths which occur from the entrance of air into the veins, asphyxia is the principal and immediate cause of death. It may be stated as a conclusion from this case, from numerous other cases, and also from experiments on animals, that if the first shock of the accident be got over, *the degree of subsequent immediate danger is in proportion to the amount of obstruction to the passage of the blood through the lungs.*

More remote subsequent danger may arise from inflammation of the lungs. Some of the animals which I experimented upon, recovered from the immediate effects of the introduction of air, but ultimately died from pneumonia.

On the other hand, when death takes place after the lapse of a week or ten days, the fatal result may be wholly independent of the entrance of air, and may depend upon purulent matter entering the circulation at the seat of the operation. In a case recorded by Professor Schuh, of Vienna, in a paper on Steatomatous Tumours, published in the *Deutsche Klinik* for 6th April, 1850, this actually happened. During the removal of a steatomatous tumour from the neck, a sound was heard resembling that known to be caused by the entrance of air into a vein. A finger was immediately placed upon the spot at which the air was supposed to have entered, when the sound ceased. No remarkable symptoms were witnessed in the patient. After a pause, the operation was resumed, when, a second time, air was heard to enter, and was in a similar manner a second time as promptly arrested. The effects were slight, but characteristic. I subjoin the history of this interesting case, as it has not yet appeared in any of the English or French medical journals.

CASE. *Entrance of Air into the Subclavian Vein, during an Operation: Survival for ten days: Purulent Deposits.*

A tanner, aged 50 years, had been three times operated on for a swelling in the region of the right pectoralis major muscle. The last operation had been performed three months ago, but the disease had returned. He had a tumour of the size of two fists: it was painless, had a very uneven surface, and was firmly connected with the pectoral muscle; it extended very nearly to the clavicle, and could not be moved

by drawing aside and raising the arm. The skin over it presented cicatrices, (the result of former operations); extending as far as the axilla, and inseparably united with the substance of the tumour. The consistence was generally hard; but two of the most projecting lumps were soft, very elastic, and apparently fluctuating: the skin over them was healthy, and moveable. An examination from the axilla shewed an unevenness and hardness on the posterior surface of the pectoral muscle. As the patient persisted in his resolution to have the tumour removed, Dr. S. loosened the mass, and removed the greater part of the pectoral muscle, which was inseparably united with it. While Dr. S. was endeavouring to divide the last remaining attachments of the growth, at the lower edge of the clavicle, and for that purpose was pushing it upwards, and somewhat dragging on it, he suddenly heard *the sound of the entrance of air into an opening in the subclavian vein, without hæmorrhage*. He immediately placed his finger on the spot where he had last cut, and watched the patient. He was already recovered from the insensibility produced by chloroform, and shewed no signs of the entrance of air. There was not even any change in his countenance. There was, indeed, some inclination to vomit; which, however, as well as the slow pulse, Dr. S. ascribed to the chloroform. The operation was concluded, and an assistant was directed to keep up pressure with his finger. Dr. S. endeavoured to apply a ligature; but, as soon as the finger was removed, the blood gushed out in such quantity as to render it impossible to see the wound. A small compress was then laid above the clavicle, another pushed under it, and the two were held together by Hesselbach's compressorium. In two hours, being summoned on account of hæmorrhage, Dr. S. removed the compressorium, and was about to introduce his finger under the clavicle. Before he could do this, air was again distinctly heard to enter the vein. He felt the pulse immediately, and found it *much accelerated, very weak, and extremely irregular; but this continued only a few seconds. At the same time, the patient felt slight nausea, and inclination to vomit*: but these symptoms passed away with the acceleration of the pulse. Hæmorrhage was restrained by the application of Dupuytren's intestine forceps, which were left on for forty-eight hours.

On the first days after the operation, the patient felt well, with the exception of unquenchable thirst; the pulse was normal. *Fourth day.* Slight sopor; delirium at night; pain in the chest; and difficulty of breathing. *Fifth day.* The wound was dirty, and moderately inflamed; heat of skin normal; the right arm was much warmer; and the pulse, on this side, not accelerated, but stronger. The muscles of the right forearm exhibited involuntary contractions. There was great thirst, and the head was warm: the urine was normal. *Sixth day.* Wound cleaner; pulse normal; thirst great; tongue covered with a white fur. The patient had a feeling of exhaustion, and of great heat, although the skin was only of normal warmth. Right arm hot; muscular contractions fewer. Pain in the left axilla; head warmer; sleep interrupted by dreams; urine very thick. *Seventh day.* Night restless, from severe pain in right knee, increased by the least motion, or pressure: wound clean; head and right arm warmer, the other parts of normal warmth: pulse normal; thirst great; urine thicker; frequent complaints of cold.

Eighth day. Delirium in the night. The left knee very tender, and swollen about the patella; the right knee had also begun to be painful, without exhibiting any swelling. Wound clean; eye coloured yellow; pulse slightly accelerated; heat of skin, normal, except in head and right arm, in which last frequent subsultus was observed. The patient suddenly lost his power of speech, and had a grinding motion of the lower jaw; the movements of the sound hand were unsteady, and there was a red painful swelling on the left fore-arm. There could be no doubt now of the presence of purulent deposits. Speech returned in the afternoon. The patient was very loquacious, and laughed at his own figure, during his delirium. **Ninth day:** Pulse somewhat accelerated; heat of skin increased over whole body. The patient was bathed in sweat; did not speak; and had a sunken countenance, with yellowness of the face. There was œdema at the inner side of the right upper arm; respiration accelerated; urine suppressed. No pain was produced by pressure in the region of the wounded vein. **Tenth day.** The patient died.

Post-mortem Appearances. The subclavian vein was plugged with a clot of blood, commencing at the wound, and extending two and a half inches towards the axilla. The coagulum had already undergone purulent softening in the centre. The length of the wound in the vein, which was plugged by coagulum, was two or three lines. The fibrous coagula in the heart were of a yellow colour. At the apex of one of the lungs, there was a metastatic deposit of the size of a nut. The left knee-joint contained pus, which was also found in the cellular tissue of the left fore-arm. There were two ounces of clear serum in the lateral ventricles of the brain. (*Deutsche Klinik*, 6 April, 1850.)

CONCLUSIONS. From the preceding cases, experiments, and arguments, some important pathological facts and practical lessons clearly flow. The subject becomes simple both in theory and practice. In the three following paragraphs, an attempt is made to give the essence of the previous pages.

1. The entrance of air into the veins does not necessarily give rise to exactly the same symptoms; the intensity of the effects depending upon the degree in which the action of the right side of the heart is arrested or impeded by its over-distension, and upon the degree of asphyxia induced by the impediment to the passage of the blood through the lungs.
2. The indications of treatment are threefold; *first*, to relieve the distended right auricle; *secondly*, to treat the impending or actually present asphyxia; and *lastly*, to prolong life by every possible means, in the hope that the air may be all absorbed, and the passage of the blood through the small vessels of the lungs again be made easy.
3. In the most rapid class of cases, in which death is suddenly threatened from paralysis of the heart from over-distension, we must first strive to relieve the organ from that condition; when the phenomena are chiefly those of asphyxia from more gradually increasing obstruction in the lungs, the various means for treating asphyxia must be resorted to, and among these, in many cases, I believe the alternate use of the hot and cold douches will be found to be very valuable, especially if com-

bined with stimulants judiciously varied and skilfully administered externally and internally. In many cases, repose, dashing cold water in the face, keeping the surface warm, and TIME may be the only means which ought to be used. The case furnished to me by Sir B. C. Brodie clearly establishes this latter position.

Being now disembarassed of much matter, which might (had this section not been prefixed) have inconveniently obtruded itself upon our notice, we are prepared to enter upon the discussion of the topics more immediately referred to in the title of this paper.

II. STATEMENT OF FACTS PROVING THAT THE ENTRANCE OF AIR BY THE OPEN MOUTHS OF THE UTERINE VEINS MAY CAUSE DANGEROUS SYMPTOMS, AND EVEN DEATH. HISTORY AND CRITICAL EXAMINATION OF SOME OF THE ALLEGED CASES.

Legallois, in 1829, when experimenting upon animals, with a view to elucidate the effects of loss of blood, and abstinence, during gestation, observed, in three different cases, that air penetrated into the vena cava inferior and uterine veins; and that this was followed by instantaneous death. He was naturally much struck with the coincidence; and properly connecting the two circumstances as cause and effect, he has asked, in the memoir which contains the experiments referred to, whether, in some of those sudden and unexpected deaths which have occurred after delivery, and in which no explanatory lesions have been found on dissection, the entrance of air into the veins has not been the cause of death?¹ Ollivier has also suggested a similar explanation of certain cases of sudden death after parturition.² In my Graduation Thesis, published at Edinburgh in 1837, in noticing these opinions of Legallois and Ollivier, I made the following remarks: "There are various circumstances which render it possible, that in some instances in which women die unexpectedly after parturition, when all seems to be going on well, death is owing to air entering the circulation by means of the open mouths of the veins communicating with the uterine sinuses. These orifices, immediately after the separation of the decidua, are very large. They have been made the subject of investigation by many modern as well as old anatomists and obstetricians; and, upon the whole, the various descriptions correspond. Burton (writing in 1751) says, that the uterine sinuses in the ninth month of gravitation are so large as to admit the end of the biggest finger; and their orifices that open into the cavity of the womb will at the same time admit the end of the little finger. (*New System of Midwifery*, p. 19, Ed. 1751.) Now, the uterus not unfrequently contracts and expands alternately with considerable energy after the expulsion of the fœtus; and it is quite reasonable to suppose, that air may sometimes be sucked into the gaping mouths of the uterine vessels, in sufficient quantity to prove fatal to a woman exhausted with the fatigues of labour."³

Thirteen years have elapsed since the Thesis now quoted from was published: but, though during that period numerous systematic treat-

¹ LEGALLOIS. *Ann. Hebdom. de Méd.* t. iii, p. 183. Paris: 1829.

² OLLIVIER. *Dictionnaire de Méd. Art. Air.* 2nd Ed. Paris.

³ *Op. cit.* p. 18.

tises on Obstetrics have appeared, I am not aware that in any one of them even a single line has been devoted to this subject. Being convinced that, notwithstanding this remarkable neglect, the subject is one of great practical importance, as well as of deep scientific interest, I again bring it before the notice of the profession, trusting that the meagreness of the information to be communicated may be largely supplemented by others, of ampler experience, to whom the following considerations are respectfully addressed.

Many authors refer to this sucking in of air by the uterus, without however in any way connecting it with the immediate subject of this paper; but it may be sufficient to give a single quotation from a recent work. The following passage is from Dr. Charles Meigs' *Letters to his Class, on Females and their Diseases*. "I have," he says, "often been present at the discharge of large quantities of gas from the genitalia. A woman shall be seized with her first labour-pains, and, bearing down with great violence, thrust not the child only, but the placenta also forth upon the bed; and in bearing down with the violent force of the labour-tenesmus, she pushes the very womb itself to the bottom of the pelvis, shortening the vagina in so doing, wrinkling and crushing it down to the os magnum. As soon as the tenesmus is over, the resiliency or elasticity of the tissues recovering its power, the womb rises again to a certain height within the excavation of the pelvis; but, as it is a cul-de-sac that rises, it is natural for air to follow it, and the vagina and the womb itself may thus contain air that has been drawn up within them, upon the same principle as that which makes it follow the movement of a piston in a cylinder. Then comes a new pain—an after-pain; or else I may apply my hand to the hypogastrium, and make sure of a good contraction of the womb. If I compress the womb with my hand, and particularly if I push it downwards in the pelvis, I am very apt to cause a quantity of air to rush out at the ostium vaginæ, with considerable noise. This I have heard a great many times. So, in making the examination *per vaginam*, when the uterus is very low down, or when, in making use of the speculum, I push the os tincæ far away from the os magnum, air enters the passage, and follows the retreating womb. If it be left there, and the woman be seized with a fit of coughing, or if she move quickly, or change her position, the air is pressed out with the sound of the *pet-vaginal*. There is no other way to account for it that is reasonable. So, also, a woman has a heavy womb, with a large loose vagina; she lies on the couch or bed; and the uterus retreats, as La Motte says, drawing air after it; but she rises, or coughs, or turns, and the air is expelled" (p. 289).

If it be admitted, that air is drawn into the uterus in the way described, what ground is there for supposing that it may thence pass by the uterine veins into the vena cava, and so on to the right auricle of the heart? The uterine veins, it must be remembered, are large canals, some of them with open mouths, sufficient to admit the little finger. Nature generally closes them firmly by a coagulum; but an accession of hæmorrhage may dislodge this; or the coagulum may contract and fall out, and thus leave the orifices of the veins patent. This accident may occur hours, days, or, in some exceptional cases, even weeks after delivery.

Of the freedom of the communication between the cavity of the womb after delivery, and the vena cava inferior, any one may be informed by the most cursory examination of the parts on the dead body of a puerperal woman. Dance says, in his *Essay on Phlebitis*; "If even a thick injection be thrown into the vena cava inferior below the emulgent veins, it is immediately poured forth in abundance into the cavity of the womb, and overflows from the vulva; thus proving, that after delivery, the large uterine veins are open in the uterine cavity, and communicate freely with the large abdominal veins."¹

It might, therefore, be anticipated, *a priori*, that air might get into the vena cava, and so onward to the heart of a woman recently delivered, by being sucked into the uterus by the sudden dilatation of that organ, and by thence passing into the orifices of the uterine veins. When the uterus is relaxed, these large openings are gaping, the structure of the parts effectually preventing apposition of their parietes. Unless closed by a plug of coagulum, they are (as I have satisfied myself by examination) perfectly patent. If any obstacle exist,—such as a large clot, or contraction of the circular fibres of the cervix, or of the sphincter of the os uteri, after the air has rushed into the relaxed uterus,—it must, of necessity, be propelled into these openings, should the body of the uterus contract without being able to force the air through the os. I have repeatedly seen the womb, after delivery, become inflated with air; and when the organ has contracted, I have heard the air hissing through the vulva. I have, therefore, not only no difficulty in believing, but am constrained to admit, that, should any impediment be offered, in such cases, to the free exit of the air by the os uteri, it must be forced into the uterine veins, were their mouths not protected by coagula; and thence it would rapidly pass, by the current of the circulation, up the vena cava into the right auricle.

But, that cases of this kind *may* occur, is not all. They have occurred; though, from attention not having been sufficiently drawn to the possibility of such accidents, fewer may have been recognized than have actually occurred. At the same time, it seems probable that the accident is a very rare one.

Dr. Collins of Dublin, Dr. Murphy of London, and others, long in extensive practice, inform me that they have never seen such an occurrence as the death of a woman from the entrance of air into the uterine veins. Dr. Lever, however, who views the matter in a different light, has addressed to me the following letter.

"12, Wellington Street, London Bridge, March 16, 1850.

"MY DEAR SIR,—When in Ireland, my library was cleaned; and, in consequence, my papers became so disarranged that I am unable to lay my hand on the rough notes of the cases about which we were conversing, and have therefore to trust entirely to memory. All the women were multiparæ; the labours had not been over-tedious; the placentæ were thrown off without assistance; and an inert state of uterus, with hæmorrhage, ensued. This viscus seemed like a softened India-rubber bottle: and the period at which the air was *supposed* to have entered it, was when the hand was withdrawn from the abdomen, after employing

¹ DANCE. De la Phlébite. Arch. Gén. de Méd., t. xviii, p. 481. Paris: 1823.

forcible compression. There was an accompanying noise, very similar to that heard when a caoutchouc enema bottle is squeezed, and then allowed to fill with air; in fine, I may describe it as a rushing sound. All three patients died speedily; the quantity of blood lost not being, in my opinion, sufficient to account for death. Two were examined; one in cold weather, the other in the very height of summer. The latter presented signs of commencing putrefaction. In neither was there any large quantity of blood in the uterus; but in the sinuses, uterine veins, spermatic veins, and left renal vein, there was indubitable proof of air. This, in the former case, emitted no offensive smell when liberated. All these women had been exposed to marsh malaria; and all had enlarged spleen. I am grieved to furnish you with so meagre a report: but I cannot do more from memory.

“Believe me, dear Sir, yours very truly, JOHN C. W. LEVER.”

I have now to mention cases, which have been minutely described.

CASE. Sudden Death following injection into the vagina of chloruretted water in a case of uterine hæmorrhage. On dissection, discovery of the appearances which are characteristic of death from sudden Entrance of Air into the Veins. The following case is detailed by Dr. J. Bessems, of Antwerp; and his explanation of the cause of death is similar to that which I adopt.

On the 14th October, 1841, a woman, aged 35, suffering from uterine hæmorrhage, was admitted into the hospital of St. Elizabeth, under the care of Dr. Bessems. She was the mother of three children. When at the fifth month of her fourth pregnancy, she had some flooding, in consequence of strong mental excitement; medical assistance was called in, but abortion took place on the 10th of October, between three or four days before her admission into the hospital. Being alone, she pulled the cord, and broke it. A midwife afterwards arrived, who introduced the hand to complete the delivery; but, being baffled in her attempts, she withdrew. The patient remained in this state, without hæmorrhage, till the 14th; when, in consequence of a great loss of blood, she was taken to the hospital. On admission, her general condition was tolerably satisfactory: the face was slightly pallid; and the pulse, though of adequate strength, was a little too rapid. On examining the abdomen, no marked symptom presented itself, except the large bulk of the uterus, which was very appreciable in the hypogastrium. The cervix, which was very soft, was still open; two fingers were easily passed up to the placenta, but, although the attempt was assisted by the contractions of the uterus, it was not found possible to drag out the mass, which had perhaps formed adhesions with the internal surface of the organ. By means of Levret's forceps, some very small portions of the placenta were got away. The hæmorrhage had at this time almost ceased. Dreading to irritate the womb too much by prolonged manipulations, Dr. Bessems injected into its cavity slightly tepid water, and prescribed other measures, which are merely alluded to as being those ordinarily employed in such cases. On the 15th, the following day, the state of the patient seemed to be better. She had lost no more blood; and the pulse was firm and tranquil. The gentleman in attendance (M. Stevens) having tried in vain to ex-

tract the remainder of the placenta, prescribed chloruretted injections, which were administered in the morning, at noon, and in the evening, by the surgeon in attendance, by means of a gum-elastic catheter placed within the womb, and adapted at its other end to the pipe of a syringe filled with the fluid to be thrown in, all bubbles of air being carefully excluded. On the 16th, little change took place, and the treatment was continued. In the night between the 16th and 17th, the patient had (about 4 A.M.) considerable hæmorrhage; at 8 A.M., the hour of visit, it had ceased; but the countenance was perceptibly paler, and more yellowish, and the pulse was smaller, and more rapid. By digital examination, the cervix was found dilated as formerly, and the placenta was somewhat engaged in it. Some fragments were removed, and the chloruretted injection was repeated, with the same precautions as had been adopted on the two previous days. In an instant, the patient, who had been lying in bed; sprang into the sitting position, with her arms extended, crying out that she was being suffocated. The head was thrown backwards; the face became livid; the eyes were convulsively turned upwards; and the expression became fixed. From some convulsive movements of the throat, it was for a moment believed that she was in an hysterical condition. But respiration became jerking, and slower and slower; the body fell backwards; the pulse fled; and, in spite of aspersion with cold water, and the putting in force of the usual means of restoring from syncope, she was dead in three minutes from the time when the injection had been thrown into the uterus.

Dissection, twenty-eight hours after death. The body was stiff, and presented no trace of putrefaction. Nothing morbid was found upon examining the peritonæum, and the abdominal viscera. The womb was as large as a good sized fist; and in its texture there was no trace of inflammation or suppuration. Its cavity still contained a portion of placenta of the size of a hen's egg, partly detached, and partly strongly adherent. The inferior vena cava was distended, and contained in its abdominal portion several bubbles of gas of considerable size, which could be distinctly seen through the parietes of the vessel. The pleura, lungs, and pericardium, were healthy. The heart appeared large; but, on examining it more carefully, it was seen that the increased size principally depended upon the *distension of the right cavities, which exhibited an elasticity of a peculiar character.* The vessels leading to and from the heart having been tied, that organ was opened under water, when there escaped a large quantity of gas mixed with blood. The encephalon presented no morbid appearances.

Dr. Bessems, from the state of the right side of the heart and of the great vessels leading thereto, does not hesitate to ascribe the sudden death to the entrance of air into the circulation, by the uterine veins. It may be asked, If no injection had been practised, and no possibility had existed of air entering the circulation in the way conjectured, might not an anæmic woman have died as suddenly, and in precisely the same circumstances, from syncope? The anæmic condition of the woman was, we cannot doubt, a predisposing or accessory cause of the fatal issue, inasmuch as anæmia is of itself sufficient to induce irregular action of the heart, and adequate to render disturbing agencies, which

would be harmless in a normal condition of the blood, suddenly fatal. When, along with the anæmia induced by loss of blood after parturition, there is a diseased heart—softening of the tissue, or some structural change in the valves—it is easy to conceive slight causes, mental emotions for instance, which have not been disclosed by words or outward acts, all at once bringing the action of the heart to a stand, and perplexing the attendants by the abrupt termination of apparent convalescence in sudden death. Numerous instances of sudden death after parturition, and when all seems to be going on well, certainly depend upon the facility with which trifling causes may disturb the circulation in women with diseased heart, and suffering from recent loss of blood. In the case of Dr. Bessems, a similar explanation might have been sustained, had the narrative been less circumstantial, and had there been no record of the appearances found on dissection; but, with the facts before us, we must believe that, however much other causes may have been accessory or predisposing, the injection of air into the uterine veins was the immediate cause of death. This is established by the distended condition of the right auricle, and by the large quantity of air found in the vena cava inferior.

M. Lionet, of Corbeil, has published a case, which claims attention in this place.

CASE. *Sudden Death after Natural Delivery, without known cause: Air in the Veins.* A lady, aged 27, of ordinary height, stout, fresh, and well-looking, but very excitable and subject to attacks of hysteria, in the eighth month of her pregnancy, while looking at her husband who was getting into a carriage, saw the horse fall down; she uttered a cry of terror, became very pale, and lost, at the instant, the power of speech. The midwife first made her use a pediluvium, then an entire bath. The aphonia persisting, M. Lionet was summoned three or four hours after the accident. The power of motion and the intellect were unimpaired; the patient made herself understood by signs or by writing. A copious bleeding, and several cups of infusion, having failed in restoring the voice, at the end of five or six hours, a large sinapism was applied to the cervico-dorsal region. The pain was so acute, as to cause convulsive movements; but speech was this time restored. The pregnancy continued its natural course, and the movements of the foetus were felt until the appearance of labour-pains, twenty-three days after. The midwife only observed that the patient was paler and more feeble than usual: she had to be carried to bed. The os being very slightly dilated, the midwife left the patient for some time; on returning in about half-an-hour, she found the head in the vulva, and the child, although well-formed, was born dead. The placenta soon followed; the uterus contracted properly, but the patient's strength did not return; she remained extremely pale, and the midwife, having exhausted her resources, sent for M. Lionet.

He did not see the patient till three hours after her delivery; she was extremely pale, was making efforts to vomit every minute, and breathed with difficulty. The circumstances attendant on the delivery were related to him; he was assured that there had been no hæmorrhage, and, on examining the linens, they did not seem to have imbibed an unusual quantity of blood. The uterus formed an ovoid mass, which

raised the abdominal walls; a little serous exudation escaped from the vulva. On introducing the hand into the cavity of the uterus, M. Lionet found a few clots; and, fearing that a rupture had occurred, he used a cold injection. He removed the pillows, so as to place the patient in a horizontal position; and he compressed the aorta, not only with the view of arresting the hæmorrhage, supposing that a rupture had taken place, but also to favour the flow of blood to the head, and to the heart, the pulsation of which was irregular. The hands were plunged into a warm mustard bath, and cordial drinks and an ether draught were administered: ammonia and hot friction were applied externally. The patient constantly complained of being suffocated, calling for air, or she should die. In an hour, M. Lionet sent for Dr. Petit, sen., who again examined the uterus. The patient expired under their hands, after two hours of constant attendance, five hours after being delivered, without having experienced any relief, beyond the grateful impression of the currents of air which were directed in her face.

The child was of average strength, and well formed; its limbs were contracted and rigid, as if they had just been convulsed; and this contraction lasted for eight or ten hours after its expulsion.

The Post-mortem Examination was made about thirty hours after death, at a temperature of 12-14 R., by MM. Petit, sen. and jun., Surbled, and myself. The body was of a yellowish white, like wax. The stomach and intestines were distended by a large quantity of gas; the mucous membrane was pale, and perfectly healthy. The uterus was slightly ecchymosed at the sides; it presented no trace of laceration, and contained no clots; when water was introduced, it did not escape by any aperture, although the organ was strongly compressed. The surface where the placenta had been attached had a velvety appearance, and exhibited a large number of venous sinuses, without any appearance of rupture.

The vena cava seemed to be enormous, and of a slaty appearance; but as it had been wounded by the scalpel in removing the uterus, the nature of its contents could not be determined. In the supposition that it might contain air introduced from the uterine sinuses, the investigations were directed to ascertain this fact. Having found nothing of importance in the chest, the heart was carefully examined: some bubbles of air mixed with a small quantity of blood were found in the ventricles, especially in the right. On lifting the calvarium, the arachnoid appeared raised by small transparent patches, which were recognised as bubbles of air; they were easily removed by pressure. The membranes and vessels were but slightly covered; and, in several of the veins ramifying among the cerebral convolutions, small columns of air separated by columns of red blood were seen: on pushing these with the finger, they could be united, so as to give to the veins the appearance of fragments of vermicelli, several centimètres in length. The same appearance was observed in the veins at the base of the brain. The veins in the limbs were not examined. The following then is a summary of the appearances observed:—No appreciable lesions in the uterus or other viscera; air in the heart, perhaps in the vena cava, and certainly in several of the cerebral veins.

M. Lionet, after various remarks, puts this question; can it be ad-

mitted that, in the anæmic state of the patient, the uterine sinuses being empty of blood and not plugged with clots, the introduction of the hand favoured the admission of air during uterine inertia? He replies—I do not know whether this be possible: it is for physiologists to determine. (*Journal de Chirurgie*, 1845, p. 234.)

CASE. Rapid Death after Parturition. Death attributed to the Entrance of Air into the Uterine Veins. Dr. Wintrich, in 1848, communicated to the Medical Society of Erlangen a case of rapid death after parturition, which he attributed to the introduction of air into the uterine veins. Death was preceded by some convulsive movements and suffocation, which symptoms followed the expulsion of the infant and the partial separation of the placenta. Dissection, we are told, satisfactorily demonstrated that air had penetrated into the venous system by the uterine veins.¹ I regret that I have failed in obtaining the original record of this case, and that I am only able to give this very meagre abstract from a French journal.

Professor Simpson has communicated the following remarks, as an appendix to Dr. John Reid's *Essay on Death from the Entrance of Air into the Veins*:—

“Several years ago I saw”, says Professor Simpson, “a case of death a few hours after delivery, which first gave me the idea that death may sometimes occur from the introduction of air into the uterine veins. The patient was an inmate of the Lying-in Hospital, and was delivered of twins. Dr. Ziegler was called to see her, in consequence of some difficulty connected with the birth of the second child. Post-partum hæmorrhage, with alternate contractions and relaxations of the uterus, supervened; and she seemed to rally very imperfectly from the effects of the flooding. I saw her in an hour or two afterwards. She had then a very weak and rapid, almost imperceptible pulse; an extremely anxious countenance; and here and there was an evanescent scarlatinoid rash over the surface of the body. The body was opened a few hours after death, as we were anxious to know if there was air in the veins; and we were, of course, desirous not to incur the fallacy of air arising from decomposition. The abdominal contents were exposed under water. The uterine and hypogastric veins, and lower vena cava, were full of frothy blood, and the air bubbled up. The large veins of the extremities were in the same state.”

Nothing is said of the condition of the heart and lungs; the only organs in which the characteristic and certain evidence of the accident having caused death is to be found. The mere presence of air is no proof that it has caused death.

Dr. Simpson has the following remarks upon the mechanism of the introduction of air in such cases. “I think we can understand it, when we remember that the interior of the uterus after delivery, especially opposite the late seat of the placenta, is studded with venous orifices; and that, if air does once become introduced into the uterine cavity, from relaxation of the walls of the organ, it will be liable to be *forced* into these orifices, and hence into the general venous circulation, pro-

¹ *Journal de Médecine et de Chir. Prat.*, Nov. 1848, p. 609.

vided the uterus, in again contracting, is unable to expel its contents through the os uteri."¹

The cases and comments of Professor Simpson are chiefly valuable as an intimation from so eminent an authority that the ideas of Legallois, as to the reality of this accident, deserve credit. The cases may or may not have been, though they probably were, examples of the accident. It must be felt that the descriptions are not absolutely convincing; for the symptoms, during life, are not sufficiently detailed, and the frothy blood in the uterine veins, hypogastric veins, and vena cava inferior, can with difficulty be understood, except by supposing that, notwithstanding the short time which had elapsed since death, when the body was examined, some decomposition of the blood, and evolution of gases, had commenced. In experiments on animals, and in cases in the human subject, in which rapid death has followed the introduction of air into the veins, frothy blood has only been found in the right side of the heart and pulmonary artery: in other parts of the body, the air, if found at all, has not been intimately mixed with the blood, but has existed in distinct bubbles. This is easily understood; for it is the churning of the struggling heart, unable to propel its elastic contents along the pulmonary artery, which causes the frothing of the blood.

It would be endless to relate all the cases, which might be cited as furnishing a strong probability that air had entered the uterine veins after delivery, inducing, in some instances, transient, but alarming symptoms; in others, occasioning almost mortal effects, and in others, causing, or, along with uterine hæmorrhage, contributing to cause sudden and unexpected death. Such cases would not furnish data of sufficient accuracy to support, far less on which to found conclusions. Some of them, however, have seemed to be entitled to the consideration which they have received in this paper.

This seems to be the most convenient place to notice the *red appearance of the skin*, which is described as having occurred suddenly in some cases of the entrance of air into the veins. Dr. Warren of Boston relates two cases which occurred in his own surgical practice. The first patient recovered, after being insensible for a considerable time. While still comatose, "the leaden colour in the cheeks", says Dr. Warren, "assumed a *reddish* tinge, and the alarming character of the symptoms was evidently diminished." In the second case, during the period elapsing between the entrance of the air, and the death of the patient, says Dr. Warren, the "livid colour of the cheeks gave place to a suffusion of *vermillion red*, and no glow in the cheek of a youthful beauty ever gave one so much pleasure as that flush. But the flush soon passed off:" and the patient died.²

In several cases of death occurring two or three days after delivery, (some of which had been considered as malignant scarlet fever, by the medical attendant), Dr. Simpson states, that "a red or scarlatinoid eruption was seen upon the cutaneous surface of the patient." In the

¹ REID (Dr. JOHN). *Physiological, Anatomical, and Pathological Researches*, pp. 579-80. Edinburgh: 1849; also in *Edinburgh Monthly Journal*, April 1849, p. 707.

² WARREN, Dr., in *American Cyclopaedia of Practical Medicine*, as quoted by Dr. J. Y. SIMPSON in *Edinburgh Monthly Journal* for April 1849, p. 707.

case quoted from Dr. Simpson, at p. 946, which is the only one of the kind fully detailed, there was post-partum hæmorrhage, and "an evanescent red scarlatinoid rash over the body." Dr. Simpson asks the following question: *If the red or scarlatinoid rash, which appeared in the preceding obstetric case upon the surface of the skin, were owing to the entrance of air into the uterine veins, might this symptom be accounted for on the idea, that the introduced air directly mixed with, and oxygenated, the blood in the capillary vessels?*

The "rash" described by Dr. Simpson, and the "reddish tinge" and "suffusion of vermilion red", mentioned by Dr. Warren, may or may not refer to the same phenomenon, but it seems reasonable to infer that they do; and such is evidently the opinion of Dr. Simpson. Granting that the red appearance was in all the cases of the same nature, granting likewise that air had entered the veins, granting even that it had caused death, I am not prepared to admit that, necessarily, the red appearance was the result of the entrance of air.

My difficulty in connecting the two phenomena, as cause and effect, does not arise exclusively from *a priori* reasoning on the subject, but from what I have recently seen in three cases, in none of which, I believe, air existed in the veins; and in one of which, at least, the entrance of air was impossible. I now notice these cases, in the hope that others will, when opportunities occur, make and record their observations, with the object of elucidating this point. In the mean time, the elements on which to found a positive or exclusive opinion are wanting; and as a contribution towards the facts required, and as my reason for not answering Dr. Simpson's question in the affirmative, the following particulars of the cases referred to are here subjoined.

About twelve months ago, I was entering one of the quadrangles of St. Thomas's Hospital with Mr. Solly, when he was suddenly hurried into one of his wards where a man, (labouring under syphilitic disease of the larynx), was urgently suffering from want of breath. Tracheotomy, being imperatively called for, was quickly resolved on and performed; and the patient was, for the time, at once relieved from the distress and jeopardy of his position. This relief, however, was of short duration, for in two or three minutes after the tube had been introduced, the man gave a sudden movement, which dislodged the tube from its position in the windpipe. From the tube being plugged up with clotted blood, and from other unavoidable causes, several minutes elapsed before air could again be made to enter the lungs through it. The visage became leaden-coloured, the tongue protruded, the teeth were clenched upon it, the face was convulsed, the pulse disappeared from the extremities, and at last the whole body became pulseless and cold. The man lay for some time cold, with bloated visage, protruded tongue, and in a state of suspended animation from asphyxia. By Mr. Solly's well-directed, and persevering efforts, life was made to return. Sinapisms to the legs, the mechanical assistance of the diaphragm in expiration, etc., were the means used; and it was beautiful to observe that, when the respirations commenced, and especially as they became fuller and more numerous, warmth gradually returned to the previously ice-cold limbs, and the pulse again beat in the arteries. A more interesting and instructive spectacle could not have been witnessed. Re-

covery was complete. Now, as life was returning to this man, I witnessed exactly what Dr. Warren saw in one of his cases of air in the veins—"the livid colour of the cheeks giving place" (not steadily, but in sudden fits) "to a suffusion of vermillion red." The phenomenon in both cases was probably analogous to blushing, or was indeed mechanical blushing caused by the enlargement of the capillaries of the surface, and their sudden distension with *oxygenated* blood, in consequence of the asphyxia tending to cease, from the return of respiration and the freer passage of the blood through the lungs.

Some months ago, I had to treat a case of uterine hæmorrhage in which, immediately after delivery, an enormous quantity of blood was poured out within a few minutes, drenching the bed and flowing in streams upon the floor. There was prolonged syncope, alternating with short fits of catching and stertorous respiration, during which the countenance was for one moment ghastly pale, at another, purple, and then at intervals suffused for an instant with a deep vermillion red, which was not confined to the face, but several times appeared in transient patches upon the neck and upper part of the thorax, which happened to be exposed. The uterus was ultimately made to contract, and the patient made a tolerable recovery, and is now well and nursing her infant. I think it likely, that in this case air entered by the uterine sinuses: but, though at the moment I had the red cases of Drs. Warren and Simpson vividly in my mind, I was so impressed with what I had seen at St. Thomas's, and in another case of an entirely different character (which I then had and still have under treatment), that I adopted at the time the explanation which I now give of the rapidly-changing colours of the surface. The ghastly countenance depended on spasmodic constriction of the capillaries—the purple and vermillion replaced the pallid hue when the spasm ceased, and the capillaries suddenly became relaxed, the patches depending upon the whole exposed surface of capillary net-work not being equally and simultaneously affected with spasm, and the purple or red hue being determined by the goodness or badness of respiration at the moment. It is not improbable, as I have already admitted, that the impediment to the passage of the blood through the lungs in this case depended on the entrance of air by the uterine veins, and presence of frothy blood in the branches of the pulmonary artery; but still I think the vermillion patches cannot be explained by an affirmative answer to Dr. Simpson's question, *because a dangerous quantity of air introduced into the venous system, in place of oxygenating the blood, tends to cause a more or less complete state of asphyxia, by rendering the passage of the blood through the lungs difficult or impossible.* The tendency of the accident, even in its mildest forms, is to impede the exit of the blood from the right ventricle.

I have at present a patient, the subject of ovarian and uterine disease, who on slight emotional causes, and sometimes without any obvious cause, falls into a state of trance or unconsciousness, the duration of the seizures lasting for minutes, or sometimes for many hours. The countenance is generally placid, though, on two or three occasions, there have been spasmodic affections of the muscles of the mouth and neck, and twice violent convulsions of the extremities. However, on various occasions when I have been present, and on many more described to me, the

eyes have become suddenly fixed, the visage overspread with a deep blush, and a state of entire unconsciousness has commenced, from which no pinching could rouse her. I have watched this condition often, and have seen red patches appear suddenly on the surface, and have observed the face to become fitfully suffused with a delicate blush, superseded quickly by an extreme pallor; and these changes have generally been indicative of the fit being likely soon to terminate. Dr. Henry Bennet once saw this case with me, and witnessed such an attack as I have described. In this patient, I have seen the evanescent red on the surface so precisely similar to what I saw in the lady with uterine hæmorrhage that I adopt in both cases the same explanation, and connect it with the condition of the capillary vessels.

The idea of the red hue, in the cases of Dr. Warren and Dr. Simpson, depending upon super-oxygenation of the blood, seems at all events to be untenable; for *the effect of introducing air into the circulation in sufficient quantity to cause inconvenience, is, beyond question, to prevent the adequate aëration of the blood.* The red hue is therefore no evidence in any obstetric case, that air has entered the veins. The red appearance may possibly be often seen in cases in which air has entered the veins; but it is a phenomenon depending upon a particular state of the nervous system induced by various causes, and giving rise to a capillary relaxation, identical with the condition of the small vessels in blushing from emotional causes. It can have nothing to do with oxygenation of the blood by the air which has entered the veins.

III. DEDUCTIONS AS TO THE PREVENTION AND TREATMENT OF ACCIDENTS ARISING FROM THE ENTRANCE OF AIR BY THE UTERINE VEINS AFTER PARTURITION.

From the facts already stated, it is plain that the Treatment, both preventive and curative, is to obtain natural and permanent contraction of the uterus after delivery. As it is extremely probable that loss of blood, and the entrance of air, in many cases conjointly cause death, it is satisfactory to feel assured that the proper treatment for the one is the best also for the other, so far as the one thing primarily essential is to strive to get the uterus to contract. Plugging will also be specially proper when there is convulsive contraction and expansion of the uterus, with or without much hæmorrhage; for then there exists the greatest aptitude for the atmospheric air to enter, or be forced into the uterine veins.

If a large quantity of air have entered the circulation, unequivocal evidence of this will be found by listening to the heart, when the churning sound will be heard. If death does not almost at once close the scene, the phenomena of asphyxia will set in; their rapidity and violence depending upon the quantity of air which has entered, on its passing up to the heart in one large volume, or in divided quantities, on the presence or absence of hæmorrhage, and on the strength of the patient. The distension of the right side of the heart, and the present, or impending asphyxia, must be met by an application of the general rules given at the close of the first section of this paper, so far as they are consistent with the special circumstances of each case. In fact, there is no uniform routine practice which can be rationally recommended in this formidable class of cases. If the practitioner under-

stand the nature of the accident, he will be able to adapt his remedial measures to the emergency. The special means adopted may infinitely vary, (as in uterine hæmorrhage); but the general principles of treatment are immutable, and simple, and ought to be engraven in the mind of every accoucheur. The amount of success attending their application must depend upon the promptness, nerve, and sagacity of the practitioner.

Essex House, Putney, September 1, 1850.

ON THE GALACTAGOGUE AND EMMENAGOGUE EFFECTS OF THE LEAVES OF THE BOFAREIRA (RICINUS COMMUNIS, OR PALMA CHRISTI).

By TYLER SMITH, M.D., Licentiate of the Royal College of Physicians; one of the Physicians to Queen Adelaide's Lying-in Hospital, etc.

DR. W. O. M'WILLIAM has often mentioned to me, that he had become aware of the galactagogue properties of a plant common in the Cape de Verde islands, and expressed his intention of publishing an account of a phenomenon so novel and important. In August, just passed, Dr. M'William submitted to me a paper which he proposed to read at the Edinburgh meeting of the British Association for the Advancement of Science. Struck by the facts related in Dr. M'William's paper, and learning for the first time that the plant is no other than the *ricinus communis*, which grows as an annual plant in this country, I determined, according to Dr. M'William's wish, to ascertain whether the plant, when growing in our latitudes, preserves its remarkable properties of stimulating the mammary glands.

In Dr. M'William's interesting paper, read before the Physiological sub-section of the British Association, and subsequently published in the *Lancet* (Sept. 7th, 1850), the following description of the mode of using the Bofareira or Ricinus, the plant referred to, is given:

"In cases of childbirth, when the appearance of the milk is delayed (a circumstance of not unfrequent occurrence in those islands), a decoction is made by boiling well a handful of the *white* Bofareira in six or eight pints of spring water. The breasts are bathed with this decoction for fifteen or twenty minutes. Part of the boiled leaves are then thinly spread over the breasts, and allowed to remain until all moisture has been removed from them by evaporation, and probably, in some measure, by absorption. This operation of fomenting with the decoction and applying the leaves, is repeated at short intervals until the milk flows upon suction by the child, which it usually does in the course of a few hours.

"On occasions where milk is required to be produced in the breasts of women, who have not given birth to or suckled a child for years, the mode of treatment adopted is as follows:

"Two or three handfuls of the leaves of the Ricinus are taken and treated as before. The decoction is poured, while yet boiling, into a large vessel, over which the woman sits so as to receive the vapour