about an hour, but much of this time was spent in reposing, and in considering what might best be done. With better instruments and greater activity, the whole operation might most probably be completed in five minutes. In obstetrics, however, celerity is considered to be in itself a secondary merit, and the operation was conducted on obstetric principles. The general range of the pulse was between 120 and 130, a frequency common in delivery by instruments.

When the last gush of blood was observed, the pulse became imperceptible in the wrist, returning, however, in the course of ten or fifteen minutes. A few ounces of spirit were administered to the patient as the operation proceeded. Throughout the process, the forefinger of the left hand was the principal instrument, and the scalpels and hooks were employed merely as the means of arming the finger for its various operations. The professional friends who favoured me with their presence, were Dr. Elliotson, Mr. Callaway, Mr. B. Cooper, Mr. Key, and Mr. Morgan. An accident deprived me of the presence and assistance of my friend Dr. Roots. The operation was not undertaken at a venture, but in conformity with certain principles laid down in two papers read before the Medico-Chirurgical Society; the first of them in the year 1819, and the last in the year 1823. The latter, which was not published, contains the proposals for other abdominal operations. The fundamental principles of these operations, as there stated, are rested upon numerous observations made upon the human body, and a sufficient number of experiments upon brutes. Should the case here narrated come before the eyes of the public, I hope it may tend to diminish any unreasonable prejudices against experiments and experimentors. The feeling is respectable, but by the designing it may be misdirected. In Lisfranc's operation, I conceive there must be some misapprehension. I think I run no risk in saying, that by *his* method of procedure, as understood here, what the English accoucheur means by cancer of the uterus, must frequently be irremovable.

It is now five months since the parts were extirpated, and the patient is fat and well, and designs to return to her husband. The interception of the access to the ovaries, is a complete security against extra-uterine impregnation. The head of the vagina is closed by the bladder which lies upon it. The recovery was easy enough; but as the details may, perhaps, be deemed desirable, they shall be communicated at an early opportunity. The patient had been ill for eight or nine months before the operation was performed.

ON THE MECHANISM OF THE ACT OF VOMITING.

By MARSHALL HALL, M. D., F. R. S. E., &c. &c.

Two opinions have divided physiologists respecting the nature of the act of vomiting. It was originally and long thought that this act consisted simply in a sudden and forcible contraction of the stomach itself.* Afterwards Bayle, and Chirac, and more recently M. Majendie, considered that the stomach is inactive, and evacuated by being subjected to pressure by the simultaneous contraction of the diaphragm and abdominal muscles.

It appears to me that neither of these opinions is correct. M. Majendie distinctly proves by actual observation, and by the substitution of a bladder in the place of the stomach, that the contraction of this organ is not usually subservient or necessary to the act of vomiting. I refer to the interesting paper † of that eminent physiologist for the more full elucidation of this first question. I proceed to state such observations as appear to me to controvert the second, and to establish that view of this subject which I have myself been led to adopt.

It is obvious that, if vomiting were effected by a contraction of the diaphragm, it must be attended by inspiration. If this were the case, the fluids ejected from the stomach would be drawn into the larynx, and induce great irritation, events which are not observed. These events are, indeed, effectually prevented by an accurate closure of the larynx, a fact observed in an actual experiment by M. Majendie, who makes the following observation:—"Dans le vomissement, au moment où les matières vomies traversent la pharynx, la glotte se ferme très-exactement." ‡ It is astonishing that this observation did not lead its acute author to see that, under such circumstances, a contraction of the diaphragm, unless the thorax followed precisely *pari passu*, was impossible.

Complete vomiting has been observed, too, in cases in which the stomach had entirely passed through a wound of the diaphragm into the thorax, and in which it could not, consequently, be subjected to the action of

* Such was the opinion of the great Haller.

† Mémoire sur le Vomissement, par M. Majendie. A Paris, 1813.

‡ Mémoire sur l'Usage de l'Épiglotte dans la Déglutition, p. 3, note.

that muscle.* In some experiments, vomiting was observed also to take place, although the diaphragm had been paralysed by a division of the phrenic nerves, or its influence subtracted by a division of its anterior attachments. †

This view of the subject is still further confirmed by facts, which I now proceed to state, which prove that the act of vomiting is an effort, not of inspiration, but of expiration. This is obvious enough, indeed, on a mere observation of the state of the thorax and abdomen during vomiting. The larynx is evidently abruptly and forcibly closed, the thorax drawn downwards, and the abdomen inwards.

Such, indeed, appears to me to be the precise nature of the act of vomiting, in ordinary circumstances. The contents of the thorax and abdomen are subjected to the sudden and almost spasmodic contraction of all the muscles of expiration, the larynx being closed so that no air can escape from the chest, and the two cavities being made one by the floating or inert condition of the diaphragm. The mere mechanism of the act of vomiting differs little, therefore, from that of coughing, by which, indeed, the contents of the stomach are frequently expelled: the larynx, in the former, is, however, permanently,—in the latter, only momentarily closed; and there is, doubtless, a different condition of the cardiac orifice and of the œsophagus.

It appeared to me, from these views of this subject, that, if an opening were made into the trachea, or through the parieties of the thorax, the effort of expiration constituting the act of vomiting, would issue in expelling the air through these orifices respectively, and the evacuation of the stomach would be prevented; and I determined to submit the fact to the test of experiment. I took a little dog, made an ample opening into the windpipe, and gave a few grains of the sub-sulphate of mercury. The animal soon became sick. The first efforts to vomit induced a forcible expulsion of air through the orifice in the trachea. These efforts soon became very violent, however, and the stomach at length yielded a part of its contents. It was perfectly evident that the violent contractions of the abdominal muscles pressed upon the viscera of the abdomen so

as to carry the diaphragm upwards to its fullest extent, and that at this moment vomiting was effected. The act of expiration was so forcible, that a lighted candle placed near the tracheal orifice was several times extinguished. In a second experiment, a free opening was made into the thorax between the sixth and seventh ribs of the right side. The lung collapsed partially only. During the first efforts to vomit, air was forcibly expelled through this orifice, the lung was brought almost into contact with it, the stomach was not evacuated. But as the efforts to vomit became extreme, a portion of lung was driven through the thoracic opening with violence and a sort of explosion, and at the same instant the stomach yielded its contents. These experiments appear to admit only of one explanation, of one conclusion,—that the act of vomiting is a forcible expiratory effort, the larynx being firmly closed, and the diaphragm perfectly inert.

It must be regarded as singular that M. Bourdon, by whom the action of the expiratory muscles, in their various “efforts,” has been so well investigated,* should have adopted other views of the act of vomiting.

It is not intended to state that the act of vomiting is simply such as I have described. There are many facts which appear to show that the œsophagus is not without its share of influence in this act, and it is plain that the cardiac orifice must be freely opened; for mere pressure upon the viscera of the abdomen will not, in ordinary circumstances, evacuate the contents of the stomach. To effect this open state of the cardiac orifice, it is probably necessary that the diaphragm should, indeed, be in a relaxed rather than in a contracted state.

A singular and interesting fact was noticed by M. Majendie, of which he has not given any explanation. During the state of nausea which preceded the act of vomiting, in some of his experiments, air was drawn into the stomach. I am disposed to think that this effect was produced in the following manner: the larynx being closed preparatorily to the act of vomiting, an attempt at inspiration is made before the effort of expiration. In this attempt, air is drawn into the œsophagus, the larynx being impervious, and it is afterwards probably propelled along that canal into the stomach itself. It is not improbable, too, that, in some instances of vomiting, in which the action of the abdominal muscles was subtracted, † a similar

* Such a case is mentioned by Wepfer. A similar one was also recently witnessed by Dr. Webster and Mr. Hunt. The whole of the stomach was found in the thorax, having passed through a wound of the diaphragm. There was repeated vomiting of a substance resembling coffee-grounds.

† Œuvres de Car. Legallois. A Paris, 1824, tom. ii., p. 104.

* Recherches sur le Mécanisme de la Respiration, &c. Par Isid. Bourdon. A Paris, 1820.

† Œuvres de Legallois, tom. ii., p. 105.

effort of inspiration has drawn substances from the stomach into the œsophagus, which has eventually expelled them by an inverted action. Neither of these phenomena could result from any action of the diaphragm, and much less from contraction of the abdominal muscles. But it is easy, by closing the larynx and attempting to inspire, to draw air into the œsophagus. A similar act, if very forcible, might draw a portion of the contents of the stomach through the cardiac orifice.

Such, then, appears to be the nature of the act of vomiting. How different is this act from one in which the diaphragm does, indeed, contract suddenly, under similar circumstances of closure of the larynx,—viz. singultus: the action of the diaphragm being an effort of inspiration, air is apt to be drawn into the œsophagus with considerable noise; and there is occasionally pain, not only about the insertions of the diaphragm, but about the closed larynx.*

OBSERVATIONS ON THE STRUCTURE OF THE
HEART OF ANIMALS OF THE GENUS
RANA.

By JOHN DAVY, M.D. F.R.S.

It is commonly asserted by the highest authorities in comparative anatomy, and generally believed, that the animals belonging to the genus *Rana*, and indeed all the animals included in the natural order 'Batraciens' of M. Cuvier, have a single heart like fishes, composed of one auricle only and one ventricle.

Many observations which I have made on the common toad have led me to a different conclusion, and have satisfied me to demonstration that the heart of this animal has two auricles.

This structure is displayed without much difficulty by minute dissection. It is best exhibited by making a transverse incision into the ventricle, close to its base, and inflating the cavities with the blowpipe. In this way, and using fine probes, it may be demonstrated clearly that the heart has two auricles, divided by a transparent membranous septum, possessing fibres that appear to be muscular; that these auricles communicate with the ventricle by a common and very short passage, provided with three semilunar valves; and that they have no possible communication with each other, excepting through the passage above the valves common to both of them.

The same fact as to structure may also be demonstrated, by blowing air through either of the two pulmonary veins, which return the blood from the lungs to the heart. The pulmonic auricle, the smallest of the

two, is thus distended, and not the systemic; or, by blowing air into the large sinuses into which the venæ cavæ terminate, when the reverse of the preceding experiment takes place; and this, at the same time, shews that the margin of the septum acts as a valve, and must prevent the blood of one auricle passing into the other.

But, even did not the margin of the septum perform the function of a valve, the blood from one auricle could not pass into the other, the contraction of the two being synchronous, the auricles first contracting, next the body of the ventricle, and, lastly, that part of the ventricle of a conical shape, which may be considered almost as a second ventricle.*

I have observed the same kind of structure of heart in the bull-frog and the common frog. Whether it exists in all the other species of the genus, I have not ascertained, but most probably it does; and, reasoning from analogy, the probability is very strong that all the other genera of the order 'Batraciens' have a similar conformation, both of this vital organ and of the sanguiferous system in general.† Should the inference prove correct, and its truth established by observation, these animals, in their mature state, will no longer be an anomaly in the classification of reptiles, on account of their heart; and they will still continue as a link connecting the reptiles with fishes, by the peculiarities of their respiratory organs in the first stage of their existence.

* I am almost induced to consider this part as a second ventricle, from its peculiarities, which I am not aware have hitherto been noticed. It is separated from the body of the ventricle by three valves, of a semilunar form. To the side of its cavity is attached a fleshy projection, or moveable septum, above which it gives origin to four arterial trunks, viz. two aortæ and two pulmonary arteries, the former considerably larger than the latter, each provided with its own semilunar valve; and the action of this part seems to me to be as peculiar as its structure. When I have watched it, it did not appear to contract simultaneously, but first one-half and then the other; as if intended, in conjunction with the various anastomoses of the arterial system, to preserve a constant, though small, current of blood, to supply all the parts of the body according to their various demands.

† It is a mistaken notion that the pulmonary arteries in the toad and frog are derived from the aorta. When given off from the heart, and a little above it, the pulmonary arteries are closely attached to the aorta, so as not to be distinguishable till they quit their juxtaposition; and, hence, probably the error in question originated.