

the following points: First, To extend the wound out towards the acromion, by which the form of it is changed from a deep cavity to a superficial wound; next, To introduce the needle on the outer or acromial side of the artery; and, lastly, to select the most favourable part of the artery. This, on inspection, will be found to be where it has just passed through the scaleni. How necessary this selection is, will appear by a perusal of the account of Mr Ramsden's operation; for he, by attempting to secure this vessel near to the first rib, or rather, as he says, at the lower edge of the first rib, found it almost impossible to turn the needle round the artery in the very narrow space between this bone and the clavicle.

Cases in which this operation may be necessary, will not be very unfrequent. In wounds of the axillary artery, either while it runs in front of the thorax, or while it lies along the humerus, this operation will be preferable to following the course of the wound by cutting through the pectoral muscles in the one case, or entangling ourselves in the brachial plexus, when the artery is wounded in the axilla. The pain and difficulties of the operation above described are trifling, when compared to those which must occur in following the course of these wounds.

When an aneurism of the axillary artery shall require this operation, we may indulge a confident hope that the rest of the arterial system is free from disease, as it appears to have been in two of the foregoing cases, that of Levancee, and of the Rev. Mr S.; one, where the disease arose spontaneously,—the other, where it could be traced to accidental injury. Although this operation has not yet proved ultimately successful, yet I think we should not despair. The history of surgery furnishes parallel instances of operations, now generally adopted, which, in the few first trials, failed of success.

*Stephen's Green, Sept. 6, 1814.*

## II.

*Observations on the Fœtal Liver, &c. &c.* By JAMES BRYCE, F. R. S. E. Fellow of the Royal College of Surgeons Edinburgh.

**I**T is a circumstance known to all anatomists and physiologists, that the size of the liver; compared with the other vis-

cera, or with the body, is much greater before birth, than after that period; and, although the immediate cause of this be readily explained, by comparing the anatomical structure of this organ during the fœtal state, with its structure in the adult, yet, for what purpose it is intended by nature that this peculiarity should constantly take place in the fœtus, seeing less bile is secreted by the liver before than after birth, is a question which, as yet, has not been explained to the satisfaction of physiologists.

In the following pages I shall attempt to explain some important advantages which the constitution of the new-born infant obtains from the diminution which takes place in the size of the liver immediately after birth, and which, I presume, will appear to be of such consequence to the animal economy at that critical period, as to entitle me to deduce from them the final cause, or the purpose intended by nature to be effected, by the greater size of that organ during the fœtal state. For this purpose, we shall first attend to the general situation and connections of the liver, and, from a comparative view of its anatomical structure in the fœtus with that in the adult, point out those circumstances on which its great size before birth seems immediately to depend.

The liver is the largest of all the abdominal viscera, and also the largest gland in the body. It is of a very irregular figure, being convex and smooth above, concave and uneven below. It is situated in the upper part of the abdomen, having its smooth and convex surface contiguous to the arch of the diaphragm, and its concave surface in contact with the stomach and part of the intestinal canal. In the adult, its size is such as, in a healthy state, to be easily contained in the right hypochondrium and epigastric regions; but, in the fœtus, it not only fills these completely, but also the left hypochondrium and greatest part of the umbilical region. It is divided into lobes, which, from their situation in the abdominal cavity, have acquired the names of right and left, by a deep furrow on the inferior surface, and by a corresponding membranous ligament above. In the fœtus, these lobes are nearly of an equal size; but, in the adult, the right is much greater than the left. Besides this division of the liver into two great lobes, there is, situated upon the right lobe towards its back part, and near the deep furrow already mentioned, a triangular eminence, called, by anatomists, the lobe of Spigelius; and near it another smaller eminence which is anonymous, but to which and the other now mentioned the name of portæ has been applied, because

between these pass the blood-vessels of this organ before entering its substance.

The liver is connected to the surrounding parts by means of ligaments, which are formed chiefly by doublings of the peritonæum. The most conspicuous of these is that already mentioned as corresponding with the deep furrow. It is called by some, from its shape, falciform; by others, from the office it seems to perform, suspensory. By this ligament, which, in the fœtus, contains the umbilical vein in its duplicature at the lower edge, the liver is connected with the umbilicus, the anterior side of the abdomen, and with the diaphragm. By doublings of the peritonæum are formed the two lateral ligaments, connecting the lateral portions of the liver with the corresponding parts of the diaphragm. And another connection of this viscus, which has improperly obtained the name of ligament, is merely an adhesion of its substance to the tendinous part of the diaphragm.

The liver, even in the adult, is supplied with blood in a very ample manner in proportion to its bulk.

The great trunk of the aorta, having passed through the diaphragm, sends off a large vessel, called cæliac artery, which soon divides into three branches; one of which is distributed on the stomach, and another, passing to the left, goes to the spleen, while the third and largest goes to the right, and, giving off some branches to the adjacent parts, carries blood to the liver, and is then called the hepatic artery. This artery, passing between the portæ, enters the liver, and is, by innumerable ramifications, distributed throughout its whole substance, terminating in the beginnings of corresponding veins. The blood which this artery carries to the liver, as possessing all those qualities fitted for the nourishment of the animal body, is supposed to be destined solely for that purpose with respect to this organ.

Besides the blood thus carried to the liver by the hepatic artery, it also receives, in a manner peculiar to itself, a large quantity of blood by the vena portæ,—a vein apparently performing in the liver the office peculiar to an artery in other parts of the body. This vessel begins by innumerable small branches, and receives the blood from the whole of the other abdominal chylipoietic viscera. These branches unite, in their passage towards the liver, into one great trunk, which, together with the artery already mentioned, is inclosed in a membranous capsule, and, running between the portæ, enters the liver, and, like the artery, is distributed throughout its whole substance. Of the ramifications of the vena portæ, some terminate in corresponding hepatic veins, whereby the blood is conducted into the vena

cava inferior, and some in another system of vessels, called biliary ducts, through which the bile is carried from its secreting puncta into the gall-bladder and intestinal canal. The blood carried to the liver by the vena portæ is, from circumstances in the mode by which it is conducted thither, and circulated through it, and from its nature and general appearance, deemed that alone from which the bile is secreted by the peculiar action of this organ.

Besides these vessels, which are common to the fœtus and the adult, the liver receives before birth a very copious supply of blood by the umbilical vein. This vessel, conveying the blood from the placenta, passes into the body of the fœtus at the umbilicus, enters the substance of the liver at the top of the great transverse cleft or furrow which divides it into two lobes, and immediately detaches very considerable branches, by which it not only supplies the left lobe almost entirely, but affords also a very considerable supply to the right. Hence we find the umbilical canal, which is justly esteemed the termination of the umbilical vein, scarcely equal to one-fifth part of the size of that vessel before it enters the substance of the liver. Seeing, then, that the whole blood passing from the placenta to the fœtus passes through the umbilical vein, and that at least four-fifths of it must circulate through the ramifications of that vessel in the substance of the liver before it enters the inferior cava, we readily account for the greater size of that organ before birth, (viz. from the vast mass circulating through it,) than soon after that period. Hence, also, we see how the size of the fœtal liver, as depending on the increased quantity of blood which it receives by the umbilical vein during the fœtal state, must very quickly be diminished after birth, when the supply by that vessel is interrupted. And hence, also, we observe why the diminution, which takes place in the size of the liver after birth, is chiefly in the left lobe.

As another immediate cause of the greater size of the liver, during the fœtal state, may also be mentioned the presence of much mild and viscid bile in the biliary ducts, the ramifications of which extend throughout its whole substance. This is evident by anatomical inspection; and there is no doubt that, from this cause, the magnitude of the liver must be very considerably increased, compared to what it will be afterwards, when, from the action of the muscles of respiration, &c. this viscid matter comes to be completely evacuated into the intestinal canal. I would here observe, that there are many circumstances which render it probable that this mild and viscid bile, which is collected in the biliary ducts of the fœtal liver, by being propelled from thence into the intestinal canal immediately after birth, consti-

tutes the meconium of new-born infants. It seems difficult to understand how the meconium, if secreted from the glands of the intestines during the fœtal state, or if propelled from the stomach during that period, should lodge in the bowels several months without inconvenience, and should, all at once, immediately after birth, acquire such a degree of acrimony as to induce those violent symptoms we daily observe to take place in newly-born children from the retention of this matter. The voiding of the meconium is evidently intimately connected with respiration; for an infant born in the seventh month will void this viscid matter in a few hours after that important function is established; and there is no instance in which infants born at the end of the ninth month have ever suffered this evacuation previous to their birth. As the evacuation of the meconium, then, is as common to the infant born at the beginning of the seventh month as to that born in the end of the ninth month, it is evident that this matter is equally prepared for evacuation in the seventh as in the ninth month, although, perhaps, not in the same quantity; but how can we suppose this matter to be lodged in the intestinal canal with impunity, during two months before birth, seeing the retention of it for a single day after birth, whether that happens in the seventh or in the ninth month, is constantly attended with much inconvenience?

The explanation of the origin, and of the excretion from the newly-born infant, of that viscid and tenacious matter which is called meconium, seems to be this: By the peculiar action of the liver during the fœtal state, much mild and viscid bile is secreted and accumulated in the biliary ducts throughout its whole substance. By the action of the diaphragm, and other muscles of respiration, immediately after birth the liver is considerably compressed, whereby the viscid bile, accumulated in the biliary ducts, is propelled from thence into the intestinal canal, where, acting as a powerful stimulus to the tender coats of the intestines, it excites them into action, and is consequently carried downward, and evacuated from the body; or if, from accidental circumstances, it be retained in the intestinal canal, it then induces those troublesome symptoms which are known to arise from acrid matters applied to the tender coats of the intestines. Does the pure arterial blood derived from the placenta, and which circulates through the fœtal liver, by imparting oxygen to the blood in the vena portæ, render the blood in it less fit for the secretion of bile? and also, does it render what is secreted from it less acrid? If so, ought not advantage to be taken of a knowledge of this circumstance to relieve, or effectually to remove, those violent symptoms which are induced by a superabundance of

bile, or by a particular acrid state of it, by throwing in this principle of oxygen largely into the alimentary canal, whereby the blood, passing from thence to the liver in the vena portæ, may become highly impregnated with it? Is it on this principle that acids are esteemed correctors of acrid bile?

The final cause, or the purpose intended by nature to be effected by the great size of the liver in the fœtus, compared with what it is soon after birth, is a question which still remains unexplained to the satisfaction of physiologists. "Hucusque," says a late author, when treating of this subject, "nulla sufficiens assignatur ratio, ob quam vena umbilicalis ad hepar potius quam ad cavam immediate feratur, cur canalus venosus sit umbilicali angustior. Si vero insignem hepatis molem in fœtu spectemus peculiari usui hoc viscus inservire, suspicio oritur, licet nondum sit nobis manifestus."\* And in a similar manner do other physiologists express themselves on this subject, marking this peculiarity in the fœtus as a circumstance in the operations of nature highly deserving of attention. †

How far the following explanation of certain advantages which result to the newly born infant from the diminution which takes place in the size of the liver immediately after birth, may appear satisfactory to account for its greater size during the fœtal state, I must leave to the able physiologist to determine. To me it appears that such a state of that organ, and effected precisely by the means we have mentioned, is so necessary in order to complete that grand revolution which takes place in the circulating system at birth, that any deviation from it, would, in my opinion, at that critical period, be attended with certain and immediate death.

In order to illustrate this, I would observe,

1st, That during the fœtal state the lungs are completely collapsed, are of a firm and compact texture, having very little if any ‡ blood circulating through them in the pulmonary ar-

\* Vide Scassi de Fœtu, p. 93.

† Vide Monro's Lectures, MS.

‡ It appears to me extremely probable, that no blood circulates in the pulmonary artery and veins during the fœtal state, but that the whole of the blood passes directly from the right to the left side of the heart through the oval opening; that the right side of the heart and the arterial canal are not called into action until the period of birth, and that then the use of the arterial canal is only to convey a certain quantity of the blood from the pulmonary artery into the aorta, which could not be transmitted through that vessel until, by the full dilatation of the lungs, a free passage for the blood was obtained during all periods of respiration, after which this canal becomes shrivelled, and is gradually obliterated.

tery, and that there is no empty space in what is called the cavity of the breast.

2d, That in the fœtus the muscles of respiration are in a relaxed state, or in that state to which they will naturally return after every contraction, or at the end of every natural expiration.

This is strictly true with regard to the intercostal muscles; and with regard to the diaphragm, I would observe, that that muscle is not only not in a state of contraction, but that it is pressed upwards considerably beyond the state of natural relaxation, which occasioned the Baron de Haller to observe, that “the cavity of the breast is short in the fœtus, and greatly depressed by the enormous size of the liver.”

3d, That after the function of respiration is established in the newly born infant, a certain quantity of air remains in the lungs after every natural expiration.

This is proved by the simple experiment of immersing the lungs of an infant that has breathed, in water; although, before the infant breathed, the lungs were so compact as quickly to sink in that fluid, yet, after having breathed, the air can never again be so completely expelled from them by the ordinary efforts of respiration, as to render them again heavier than water, and they, therefore, now swim in that fluid. From experiments it is known, that a considerable quantity of air remains in the lungs of an adult after the most complete natural expiration, and that a quantity proportionally great is constantly in the lungs of the newly born infant, after the function of respiration and the great revolution in the circulating system have been fully established, there seems little room to doubt.

4th, This quantity of air remaining in the lungs after every complete natural expiration, and occasioning what I would term *the permanent dilatation of the lungs*, is absolutely necessary to admit of the free circulation of the blood through the pulmonary artery, during that period of respiration which takes place between expiration and inspiration.

This must appear evident, when we recollect that very little if any blood passes through the pulmonary artery in the fœtus, and also when we attend to that train of symptoms which clearly mark a disturbed, or entirely interrupted circulation in the pulmonary vessels, which takes place from diminishing this permanent dilatation, either by compressing the lungs themselves, as in hydrothorax, and in wounds of the breast, when air is admitted between the lungs and the pleura lining the ribs, or by diminishing the natural capacity of the chest, as happens by fits

of coughing, or laughing, or from an increased size of the liver itself, as in many cases of hepatitis.

On an attentive consideration of these circumstances, the following question will naturally suggest itself: Whence proceeds, in the newly born infant, such a space in the chest, as to allow of that degree of permanent dilatation of the lungs, which is necessary for the free circulation of the blood throughout the pulmonary vessels during all periods of respiration, more particularly during that period which takes place between expiration and inspiration? This question can only, I apprehend, be properly explained by carefully attending to the changes which take place in the liver immediately after birth.

From the situation and connections of the liver, formerly explained, we readily understand how any change in its magnitude will occasion a change in the capacity of the chest; and we know that a chief cause of the great size of this organ, in the fœtus, is the great quantity of blood which it receives by the umbilical vein; and it is evident that when this supply is cut off, as happens at birth, the size of the liver must necessarily be much and quickly diminished. But this diminution in the size of the liver will necessarily remove that degree of pressure from the diaphragm, which occasioned it, in the fœtus, to protrude into, and greatly diminish the capacity of the chest. From this circumstance, the lungs will admit of a greater degree of expansion, from the air which is taken in by inspiration, and a certain degree of permanent dilatation of them, in proportion to the diminution of the liver, will be established, independent of the muscles of respiration. Thus, by the action of the muscles of respiration, by whatever means this may be excited, a quantity of air is taken into the lungs immediately after birth, which, if the circulation in the umbilical cord remains entire, will be completely expelled again at the end of every expiration; but as the force of the circulation in the cord, and consequently the size of the liver, quickly diminishes, the function of respiration becomes more strong; the capacity of the thorax, and the permanent dilatation of the lungs, increase; and as, in a short time, the circulation in the cord becomes entirely interrupted, the size of the liver, as depending on this circumstance, must be greatly diminished, the capacity of the chest increased, and the permanent dilatation of the lungs so far established, as to allow the blood to flow more or less freely through the pulmonary vessels at all periods of respiration; and, in proportion as the inspirations become more deep, and the muscles of the thorax and abdomen act more strongly, the size of the liver will be still farther diminished, by being more fully emptied of the remaining

blood which it had received by the umbilical vein, and also of that viscid bile which was collected in the biliary ducts in the fœtal state: thus still farther increasing the capacity of the chest, and establishing such a degree of permanent dilatation of the lungs as freely to allow the passage of the whole mass of blood through the pulmonary vessels, even after the deepest natural expiration; at which time the arterial canal will become flaccid, and begin to be obliterated, and the revolution in the circulation of the blood may be reckoned complete.

The great advantages which the animal constitution obtains from this diminution which takes place in the size of the liver after birth, and consequent establishment of a considerable permanent dilatation of the lungs, are evident throughout life. By this means, the important function of respiration is rendered far less liable to be impeded, or entirely interrupted, by those accidents to which we are daily exposed. Thus, the smallest degree of diminution of the cavity of the thorax, or pressure on the lungs, as from coughing, laughing, from hydrothorax, empyema, &c. must, but from the circumstance mentioned, have been attended with very great inconvenience, or even immediate death; whereas, by the permanent dilatation of the lungs being established, we find, from experience, that a very considerable degree of diminution of the cavity of the chest may take place, or that the above diseases may be present to a considerable extent with little inconvenience.

The Baron de Haller, when treating of the peculiarities of the fœtus, more particularly of the great size of the liver, and of the diminution which it undergoes after birth, says—"Diminutio hepatis est ex naturæ finibus, locum enim pulmone parat in quem se distendat, et obstaculum minuit quod diaphragmatis per inspirationem descensui se opponebat."

Here it is evident that there is a very great difference between the advantage supposed by the Baron de Haller to arise from the diminution of the fœtal liver after birth, and that which I have now explained; because, although we agree that the cavity of the chest is thereby increased, yet the opinion of that celebrated author was, that, by this diminution in the size of the liver, the lungs were merely allowed to be dilated more freely at each inspiration than they could otherwise have been: but he certainly does not state, that, from this circumstance, such a degree of permanent dilatation of them is established as to allow the blood to flow freely through the pulmonary vessels during all the periods of respiration. Nay, it appears very clearly, that of this permanent dilatation of the lungs, and of the free circulation of the blood through them in the pulmonary vessels, during all the

periods of respiration, he was entirely ignorant, as may be collected from the following passage, contained in his celebrated work: "In inspiratione summa facilitas nascitur sanguini de corde dextro exeunti. In expiratione vero pulmo undique urgetur et in multo minorem molem comprimitur: vasa ergo sanguinea breviora quidem fiunt cum retractis bronchiis eademque angustiora nunc sunt, siquidem pectus secundum tres suas dimensiones arctatur. Sanguis ergo quidem in pulmones undique comprimitur; et venosus æqua vi pressus, partim versus arteriosum quidem reprimatur eumque moratur aliquantum, partim versus cor sinistrum promovetur. Quare in expiratione quam ponimus stabilem superesse, pulmonis pro sanguine immeabilitas oritur, quam neque absque palpitatione et vitioso conatu, demum omnino ullis suis viribus cor vincere queat." Lib. viii. sect. 4.

Besides the permanent dilatation of the lungs, there is also another advantage which the animal constitution derives from the diminution which takes place in the size of the liver immediately after birth, which is perhaps not less important. Since, during the fœtal state, very little if any blood circulates in the pulmonary artery and veins, and as, after birth, a very considerable quantity is constantly present there, it must be evident, that, unless some supply was added to the circulating mass, at the critical period when the revolution in the circulation takes place, such a quantity of blood must necessarily pass from the aortic into the pulmonic circle as to induce, in the former, such a loss of tension and tone as would be attended with the very worst consequences. In order, therefore, to prevent this, it is wisely ordained by nature that the liver should, in the fœtal state, receive, in the manner we have formerly pointed out, a much greater quantity of blood than is necessary for it to retain after birth. From this circumstance, when, at birth, the circulation in the cord comes to be interrupted, the great quantity of blood which is at that time contained in the vessels of the liver is propelled into the vena cava, whereby such a supply of that fluid is given to the general circulating mass as is necessary to prevent those bad consequences which would otherwise have arisen from the passage of so considerable a portion of blood from the aortic into the pulmonic circle: so that, in proportion as the liver is, by the action of the muscles of respiration, &c. gradually diminished in size, will not only the permanent dilatation of the lungs be increased, but also will the quantity of blood which is, after birth, constantly found in the pulmonary vessels of the lungs, be supplied by that which is propelled from the liver; and by this transmission, as it were, of a certain quantity

of blood from the liver into the newly-dilated lungs, will that due balance be supported throughout the whole circulating system, which is so necessary for health, and that loss of tone and dangerous debility prevented which would, at such a critical period, have been attended with faintings, or the immediate death of the tender infant.

From these observations, I conclude,

1st, That the immediate cause of the great size of the liver, in the fœtal state, is chiefly owing to a greater quantity of blood circulating through it before birth than after birth.

2d, That the diminution which takes place in the size of the liver, after birth, is effected by the change which takes place in the circulation of the blood at that period.

3d, That from this diminution in the size of the liver, after birth, arises *that degree of permanent dilatation of the lungs* which is necessary to admit of a free circulation of the blood through the pulmonary vessels, during that period of respiration which takes place between expiration and inspiration.

4th, That, *by the transmission of a quantity of blood from the liver into the newly-dilated lungs, at the period of birth*, that loss of tone and debility is prevented which would often be attended with fatal consequences.

5th, That these circumstances are of such important advantage to the animal constitution as to ensure the constant formation of the greater size of the liver before birth than after that period, and are consequently to be considered as the purposes intended by nature to be effected by that peculiarity in the fœtus.

### III.

*Reply to the Review of Mr Baynton's Essay on the Cure of Crooked Spine, in No. 39. of this Journal.* By HENRY EARLE. Surgeon to the Foundling Hospital, and to the Central National School.

HAVING been educated in a school where the beneficial effect of counter-irritation is inculcated, and having enjoyed ample opportunities of witnessing the most happy results from the judicious application of issues in counteracting and arresting the progress of the most formidable diseases, I was not a little