passenger cars are usually at hand, as they will have brought troops and supplies to the front, and under these conditions may be used without making any changes in them. But for systematic work, as in the service of evacuation, and where sick and wounded are to be transferred over distances requiring more than three or four hours of travel, better arrangements should be provided. Under such circumstances, in the absence of specially devised and equipped hospital cars, sleeping-cars of the type described above are desirable. When these cannot be secured, such cars as may be available must be so arranged as to permit the transportation of the sick and wounded with the least discomfort. Fixed berths or supports for litters must be erected; a water-supply, water-closets, lockers for linen, seats for attendants and for patients who are able to sit up, should be provided. If box cars are converted into hospital cars, special provisions must be made for heating, lighting, and ventilation. One car will be fitted up as a kitchen and dining car, with range, cooking utensils, refrigerators, dishes, tableware, etc., sufficient for the full carrying capacity of the train. Another car will be arranged as office and dispensary and storeroom, with desk, medicines, medical and surgical chests, and medical stores.

The necessary personnel of a hospital train will depend upon the capacity of the train, the character of the patients carried, and the length of the journey.

The Manual for the Medical Department of the United States Army, edition of 1902, gives as the personnel required for a hospital train of nine cars, seven of which are used for patients with a capacity for two hundred men, the following:

Two Medical Officers.—One captain, assistant surgeon, commanding. One lieutenant, assistant surgeon.

Three Non-Commissioned Officers of the Hospital Corps.—One sergeant, first-class. Two sergeants.

Twenty-four Privates of the Hospital Corps.—Twenty nurses. Two cooks. Two medical officers' orderlies.

The number of non-commissioned officers here prescribed will prove adequate, but the medical officers and privates are not sufficient in number. One medical officer will usually be detailed as quartermaster and commissary of the train, and would only occasionally be free to attend patients, leaving but one other officer to look after the professional needs of two hundred patients and attend to the numerous other duties incident to a service of this character; three medical officers would be more satisfactory. If the journey to be performed be twenty-four hours or more in duration, and if it be assumed that each hospital car carries at least twenty-four patients, three nurses will be needed to each car—two for duty during the day and one for night duty; two additional men would also be required for work in the dining car. There is no economy apparent in limiting the number of cars for patients to seven; ten cars could be as easily hauled and administered; this would increase the capacity of the train by one-third, and would only necessitate an increase of three nurses to each car.

The problem of the transportation of the disabled in the military service is one which confronts the military surgeon under varying conditions and circumstances, and is no less a question of importance to the military commander. In many wars lives have been lost which might have been saved had adequate means of transportation been at hand. Even at the present day the means at our disposal are often crude and still limited; advance has been made, more yet remains to be done. War can never be waged with comfort to its participants. Nevertheless it behooves us as military surgeons to mitigate its horror and suffering as best we may. Improvements in both means and methods of transportation for the disabled will contribute to this end. *Charles Richard.*

TRANSPOSITION OF THE VISCERA.—(Synonym: Situs Viscerum Inversus.) DEFINITION.—In this condition the relations of the various organs of the body are exactly reversed; right and left are changed about like the reflection in a mirror. As applied to the heart, this organ is on the right side of the chest, with the apex directed outward, giving the anomaly known as dextrocardia. The lungs may take part in the transposition, the left having three lobes and the right two. The position of the aorta and its branches may be reversed. The spleen is located in the right hypochondrium and the liver in the left. The stomach may also be affected in this change, the fundus lying to the right of the median line and the pylorus to the left. The sigmoid may lie on the right side of the abdomen and the cæcum and appendix vermiformis on the left. Transposition of the viscera may be *total* or *partial*. The heart alone may be transposed; or the transposition may be limited to one or more of the abdominal organs. Complete transposition is much more common than partial. The congenital transposition, which is under consideration in this article, must be carefully distinguished from acquired displacements of organs, such as the dextrocardia due to traction or pressure from disease in the thoracic cavity.

HISTORY.—Gruber made a remarkable collection of all cases found in literature up to the year 1865. Of the 79

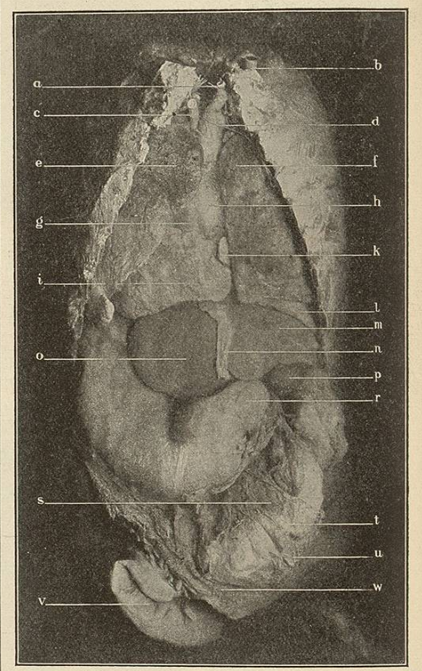

FIG. 4769.—Dr. Blackburn's Case of Transposition of Viscera. Photograph. *a*, Right common carotid artery; *b*, innominate vein; *c*, left common carotid artery; *d*, innominate artery; *e*, left lung (?); *f*, right lung (?); *g*, pulmonary artery; *h*, aorta; *i*, right ventricle of heart; *k*, appendix of right auricle; *l*, diaphragm; *m*, right lobe of liver; *n*, suspensory ligament of liver; *o*, left lobe of liver; *p*, gall bladder; *q*, cardiac end of stomach, and situation of spleen; *r*, pyloric end of stomach; *s*, gastro-colic omentum; *t*, transverse colon dragged downward; *u*, situation of cæcum; *v*, sigmoid flexure; *w*, omentum.

cases which he reports, only 5 or 6 were discovered during life. This fact seems rather remarkable since his report covers a period of more than two centuries. In 1643

Petrus Servius reported the first case as occurring at Rome.

Küchenmeister, up to the year 1888, collected 149 cases. The majority of these were discovered in the anatomical

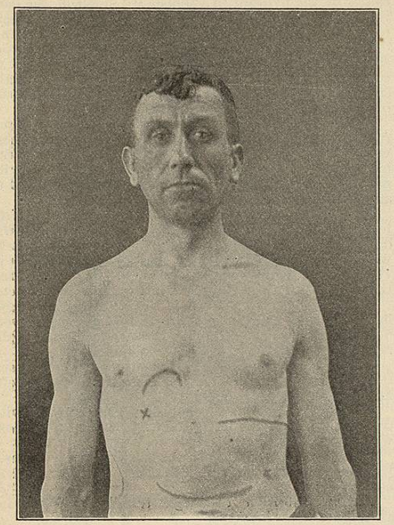

FIG. 4770.—Photograph of Schüppel's Case of Transposition of the Viscera. The X below right nipple indicates the position of the apex beat. The curved line above shows the absolute heart dulness. The straight line below the left nipple indicates the upper border of the liver dulness. The X below this line indicates the lower border of the liver dulness. The curved line above the navel indicates the greater curvature of the stomach. The curved line low down on the right side indicates the splenic dulness.

laboratory and on the post-mortem table. Pic in 1895 increased the number of reported cases to 190. Lochte up to the year 1894 collected 13 cases of partial transposition of the viscera. In more than half of these very poor descriptions were given.

An attempt to collect all the cases of situs viscerum inversus is extremely difficult and unsatisfactory, because they are reported in the literature under numerous headings. Perhaps something like 300 of these cases have been reported.

Until recent years cases of transposition of the viscera have been discovered, studied, and reported chiefly by anatomists and pathologists. Judging from my own personal experience with these cases, and from that of a large number of prominent clinicians and anatomists to whom I addressed letters of inquiry regarding their experience with transposition of the viscera, it would seem that the pendulum has swung about of late years, and that now a much larger percentage of cases of transposition is discovered by the clinician. This fact is a natural result of the much more frequent and careful physical examinations that are now being made. However, even with this improvement, all physicians know that a very small percentage of even sick people submit to careful physical examination, and that the percentage of the entire population who are thus examined is extremely small.

Since the spring of 1897 I have seen in hospital and private practice six cases of transposition of the viscera. It is rather a remarkable fact that three of these cases were seen within the short period of six months. I am also personally familiar with three other cases of situs inversus, discovered in the living subject by members of the internal medical staff of the University of Michigan, two by Dr. Warthin, and one by Dr. Cowie.

These cases have been reported in detail in the *American Journal of the Medical Sciences*. November, 1902, and in the *Vaughan Festschrift*, 1903.

In reply to my letters the following facts were gleaned: Five well-known internists and four professors of anatomy had never seen a case of transposition of the viscera. In the remaining letters 37 cases were reported. All save 6 of these were discovered during life. In this country, at least, cases of transposition are nowadays much more frequently discovered during life than after death. Note the contrast between Gruber's report and my own. Of his 79 cases only 5 or 6 were discovered during life. In my collection, which simply covers the cases reported in the letters referred to, together with those with which I am personally familiar, are 46 cases, of which 40 were discovered during life.

Method of Examination.—Careful inspection, palpation, percussion, and auscultation of the chest are of course prime essentials. The failure to find the heart apex and heart dulness on the left side most often puts one on the right track. A careful examination of the right chest may then reveal a dextrocardia. This is at once a key to the physical condition. An absence of liver dulness is then detected in the right hypochondrium. It is sought for and discovered in the left hypochondrium; the splenic dulness will then be found in the right midaxillary line.

The position and outline of the stomach may be demonstrated by inflation or by the use of the gastrodiaphane; the same is true of the sigmoid. *x*-Ray examination of the heart with the fluoroscope easily demonstrates the right-sided position of this organ. (See Fig. 4771.)

Theories Explaining the Development of Transposition.—These are chiefly of interest to the embryologist and anatomist, and will hardly be understood except by those who have devoted special study to embryology. The following are some of them.

Von Baer explains transposition by the turning of the embryo in the opposite direction; that is, the embryo normally lies on the left side of the umbilical vesicle; but if it lies on the right side, then we have transposition. According to him this occurs at the beginning of the developmental period.

Förster considers situs inversus a malformation in which the transposition of the anlagen takes place in the

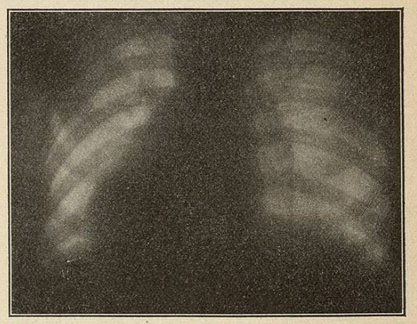

FIG. 4771.—Radiograph showing Transposition of the Heart to the Right Side. (Schüppel's case.)

first embryonal formation. In the double monster the fœtus of the right side shows a complete transposition, while the fœtus on the left side shows a normal situs.

Rindfleisch believes that a spiral turning of the blood column is responsible for the displacement of the heart. Normally it flows from left to right, but in situs inversus an opposite direction must obtain. The asymmetry of the heart is made responsible for all asymmetry in the animal body.

Virchow emphasizes the influence of the umbilical cord. In situs inversus it is wound spirally to the right; in situs solitus to the left.

Küchenmeister thinks that the location of the fertilized germinal disc at the surface of the egg is the essential thing. The normal situs in single birth probably depends upon growth of the germ from below upward, instead of from above downward. He says that from this it must be self-evident that the turning of the embryo has been inverted. This must also affect the later spleen side and the side of the arterial heart. Concerning the congenital partial situs viscerum, solito inversus, which shows itself either in the chest or in the belly, but not in both places at the same time, he believes that the growth on the whole follows the type for the situs inversus. The rarer partial situs is an inhibition formation which grows according to the type of the normally projected embryo.

Martinotti in the situs transversus of the single born emphasizes the condition of the vena omphalo-mesenterica, first mentioned by Dareste. The direction which the heart loop takes depends upon the dissimilar growth of the two halves of the vascular area. Under normal conditions a dissimilar formation of the two halves exists. The left omphalo-mesenteric vein is more developed than the right; the right gradually disappears. The heart reacts in a very sensitive way toward the cause of situs transversus.

Marchand says that the loop formation of the vena omphalo-mesenterica about the intestines under normal conditions prevents the intestines from slipping toward the right. So a right turning takes place if the loop formation is absent. He considers a left-sided persistent vena omphalo-mesenterica the cause of the right position of the stomach. In a more recent monograph Marchand states it as his belief that the development of the vena omphalo-mesenterica can have no influence upon the rotation of the stomach.

Lochte advances the view that the growth of the organ considered in the sense of situs solitus is associated with a persistence of left-sided omphalo-mesenterica and umbilical veins, while those of situs transversus totalis, on the other hand, are associated with corresponding right-sided veins.

To the clinician transposition of the viscera presents many interesting problems in differential diagnosis. The displacement of the heart to the right makes it necessary to examine the lungs and pleura carefully, in order to exclude acquired displacement. The discovery of an enlarged area of dulness in the left hypochondrium suggests a number of possibilities. It is most likely an enlarged spleen—either of leukæmia, malaria, splenomegaly, or some other disease. This point is illustrated by actual cases in practice. In Munson's case the diagnosis of an enormously enlarged spleen had been made; and the displacement of the heart was thought to be due to dilatation.

In the normal patient it is a very common experience to find an entire absence of liver dulness in the right hypochondrium. It is also common to find that the apex beat is neither seen nor felt on the left side, especially if the patient is quiet and in the horizontal position. Heart dulness is also frequently absent. So it is easy to understand how these cases of transposition often are overlooked.

It is possible to mistake an aneurism of the arch for a dislocated heart. This fact was recently brought to my attention.

Gruber refers to the following errors in diagnosis. In one case of transposition a pain in the right hypochondrium led to the diagnosis of a chronic inflammation of the liver. In another case a soldier was wounded in a duel, in the right hypochondrium; from the position of the wound and the vomiting of green fluid it was thought that the liver had been penetrated. In a third case, in the Würzburg clinic, the transposed liver was diagnosed as a spleen tumor. In a fourth case, one of cancer of the pylorus, in a transposed stomach, the hard tumor felt deep in the left hypochondrium was thought to belong to the left part of the stomach or the pancreas.

In appendicitis developing in a patient with transposition of the viscera the signs and symptoms would of course be located on the left side instead of on the right side. The surgeon would choose Monroe's point instead of McBurney's point for the site of his incision.

Gruber arrived at a number of interesting conclusions from a study of 79 cases. "Concerning the sex there were 49 men, 19 women, and 11 in which sex was not mentioned. These individuals lived as long as those with normally placed organs. Five of the 19 women lived to an age between seventy and eighty-four.

The women were normally fruitful. One gave birth to twelve children. Among the 79, 4 died an unnatural death, and only 4 were extremely malformed. There was transposition of *both* chest and abdominal organs in 71; of the abdominal organs alone in 8. In the first kind the transposition was complete, in the latter incomplete.

The lungs were transposed in 35 of 71 cases; the right had two lobes, and the left three. In 2 cases they were not transposed; in 2 both lungs had two lobes; in *one* the right had one lobe, and the left two lobes.

Curvature of the dorsal portion of the spine is mentioned in only 11 cases. In 7 of these it was to the left, in 4 to the right as normally.

We cannot draw the conclusion that persons with transposition are more likely to be left-handed than those with normally located viscera.

The position of the testicle was mentioned only 7 times. In 4 the right was lower, in 1 the left. In 1 the left had not descended.

The lower position of the right testicle is unimportant as a sign of situs inversus.

In only 9 cases were there notes on the position of the kidneys. In 7 the left was lower, in 2 the right.

In 32 cases in which the vessels arising from the arch of the aorta are mentioned, these were transposed 29 to 30 times.

H. Steinhauser mentions the fact that in the operation of œsophagotomy, it is well to know that the œsophagus lies over the right trachea in persons with transposition.

In situs partialis the transposition of the abdominal organs may be very irregular. In one case the stomach and duodenum were normally located, while the other organs were transposed. In another case the liver alone was transposed.

In 1888 a case of pure dextrocardia with congenital pulmonary stenosis, without malposition of the viscera in general, was shown to the Vienna Medical Society by Dr. Gruss. In discussing the case, von Bamberger concurred in the diagnosis, and remarked that Professor Schrötter had lately stated that no single case of pure dextrocardia had ever been proved, whereas all anatomists of experience, for example Rokitansky, Friedberg, Förster, *et al.*, had mentioned such cases, and he himself had seen two.

The above quotation emphasizes the fact that partial situs is a much rarer condition than complete. If the transposition is located in the abdominal cavity, it will most likely be overlooked in the physical examination.

James Rae Arneill.

TRAUMATOL—iodocresol, orthocresol iodide, $C_6H_4 \cdot CH_3 \cdot OI$—is a reddish, odorless, insoluble powder which is used as an antiseptic substitute for iodoform in wounds and ulcers. It is an efficient drying powder and deodorizer.

W. A. Bastedo.

TREMATODA.*—The class Trematoda, or Flukes, constitutes one of the prominent subdivisions of the

* A general discussion of parasitism and its effects is to be found under the heading *Parasites*.

branch or phylum Plathelminthes, the characteristics of which were outlined under the Cestoda. The group was recognized as distinct in 1800 by J. G. H. Zeder, a practising physician in Germany, who with great clearness of vision separated the then accepted class of Helminthes or intestinal worms into five groups of closely related forms. These groups received in 1809 at the hands of K. A. Rudolphi, the celebrated Berlin helminthologist, the scientific names of Nematoda, Acanthocephala, Trematoda, Cestoda, and Cystica. The latter have since been shown to be immature stages of the Cestoda, and C. Vogt in 1851 demonstrated the unnatural character of the association Helminthes, making as a natural group the flatworms in which are now included the flukes, the tapeworms, and the free living flatworms, as three great classes of the phylum designated Plathelminthes.

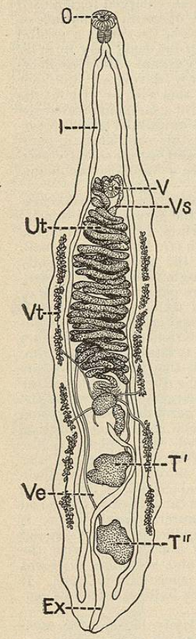

FIG. 4772.—*Opisthorchis pseudofelineus* Ward. From liver of cat. *Ex*, Excretory bladder; *I*, intestinal crura; *O*, oral sucker; *T'*,*T''*, testes; *Ut*, uterus; *V*, ventral sucker; *Vt*, vitellaria; *Ve*, vas efferens; *Vs*, vesicula seminalis. × 7. (Original.)

In certain features, such as the simple body, the presence of an alimentary canal, and in some cases even of special sense organs, the Trematoda stand much nearer the free living forms than do the Cestoda, although all of the species included in both classes are parasitic. The consistent parasitic habit, in which the flukes resemble the tapeworms, is varied by a modification in degree among the flukes which serves to show their relation also to free living species and contrasts strongly with the intensive endoparasitism of the Cestoda. Thus among the flukes there are not only the endoparasitic species, but also such as are ectoparasitic and preserve in some degree those features of free living forms that are lost with the assumption of endoparasitic existence. Withal the group is a well-defined one, and manifests greater uniformity in structure than the Cestoda, while it also embraces both fewer species and fewer human parasites than the latter class.

In form the Trematoda are generally flattened and elongate, more rarely cylindrical, conical or irregular, with plane ventral surface on which are located the sexual pores and arched dorsum. The mouth is at or near the anterior tip of the body and the excretory pore is similarly related to the posterior end. The mouth is nearly always surrounded by an oral sucker, and other suckers may occur on the ventral surface, at the posterior end, or more rarely on the margin or dorsal surface. In connection with the suckers chitinous hooks or anchors are found as additional organs of attachment, and the exterior of the body is often covered more or less completely by scales or spines of varying form and size. Most flukes are comparatively insignificant in size, measuring only a few (1 to 15) millimetres in length, though rare species largely exceed both limits.

A cross section shows that a body cavity is wanting. The trematodes belong to the group of forms in which the space between all organs is filled up by parenchymatous tissue, giving a firm consistence to the mass. The exterior is bounded by a homogeneous membrane of varying thickness known as the cuticula, which actually is formed by the fused bases of cells lying deeper in the tissue, but which presents the appearance of a basement membrane. It was formerly construed as such, and the trematodes were believed to be without an epithelial covering in the adult condition. As a matter of fact the pyriform epithelial cells lie in bunches between or within the diagonal muscles, and are connected by numerous fine processes with the basal surface of the so-called cuticula. Some of these cells are especially developed as unicellular glands.

The dermomuscular sac lies just within the cuticula and consists of layers of circular, longitudinal, and diagonal fibres which surround the body, though of varying thickness in different regions. Running obliquely from one surface to the other occur also dorso-ventral or parenchymatous muscles which are inserted on the cuticula. Especial development of the muscular layers is found in the suckers, which consist of muscle fibres extending in three directions and designated as equatorial, meridional, and radial; these correspond to the circular, longitudinal, and dorsoventral muscles respectively. In addition one finds a special set of muscles radiating from the sucker through the tissue. In certain cases at least special muscles are developed in connection with the reproductive organs, with the hooks, and even with the surface spines, as in the common liver fluke. The high development of the muscular system, associated with the absence of special skeletal structures, combine to make the form of the flukes extremely mobile and variable. Locomotion is achieved by means of the body musculature and the suckers, aided in rare cases by the cuticular spines already mentioned.

An alimentary canal is always present and forms the ultimate distinctive feature between Trematoda and Cestoda. In all cases it has but a single opening, the mouth, which lies at the anterior tip of the body, or more rarely on the ventral surface and in all higher forms is surrounded by the oral sucker (*O*, Fig. 4772). In lower members of the group, two or more suckers may lie near the oral opening or the latter may be entirely unarmed. In form the alimentary canal may be rhabdocœl, though much more frequently it is of the triclad type. In the latter case one can distinguish an initial unpaired region variable in length, which extends posteriad from the oral opening and is called the œsophagus. It is thin-walled and not digestive in function, though frequently numbers of unicellular salivary glands are connected with it. Near its oral end a prominent sphincter muscle forms a bulbous mass known as the pharynx. By its action the oral sucker is closed posteriorly to act as a simple organ of prehension, or stands in open communication with the canal, for which it serves as an aid in the ingestion of food.

The simple œsophagus divides into two intestinal crura (*I*, Fig. 4772), which form the digestive and absorptive region of the canal. They are blind sacs, usually symmetrically placed right and left, but of variable length and character. In some genera they are so short as not to reach the sides of the body; in other cases they extend to the posterior end, and may even be connected by several commissures or anastomoses. Usually the crura are of uniform calibre throughout, and yet in some genera they manifest an irregular wavy outline, or even possess numerous lateral diverticula which may branch again and give the system a dendritic aspect. The endoparasitic forms subsist on the intestinal contents and secretions of the host, but also ingest epithelial cells and blood, thus giving rise in some cases

FIG. 4773.—Flame Cell and Excretory Tubule of *Azygia tereticollis* (R.) × 700. (After Looss.)