tion, however, that a diastolic sound may occur when there is a systolic and not a diastolic pulsation. The mechanism of their production is obvious enough, the systolic sound being due to the vibration of the column of blood propelled into the sac, and the diastolic to the recoil from the shutting of the aortic valves. The second or diastolic sound has a "booming" quality, and is heard the more perfectly the nearer the heart the aneurism is placed. When there are cardiac murmurs of stenosis or insufficiency, or peculiarities of accentuation, they are propagated to and are audible over the aneurism. The fitness of the expression, that when aneurism is present "two hearts are beating in the chest," is quite obvious; so close, indeed, is the resemblance that the sounds heard in aneurism were considered by Laennec as cardiac entirely. Murmurs also occur in aneurism with, or take the place of, the sounds; they are formed in or of the sac, and are not propagated from the heart. They are by no means common, and a diastolic murmur is greatly less frequent than a systolic. They are produced by some irregularity in the interior of the sac, or by pressure on a neighboring vessel, or on an adjacent part of the aorta. A sacculated aneurism does not, but the other varieties do in some cases, retard the pulse-beat. If it occupy the ascending aorta the pulse will be behind on the whole round of the circulation; if the transverse portion of the arch and between the arteria innominata and the left subclavian, the pulse of the radial will be retarded; if the descending aorta, the femoral pulse will be delayed. The pulse is also changed in character. If the orifice of the efferent vessel is unobstructed, the normal dicrotism of the pulse is increased because of the secondary undulation imparted to the blood-column; on the other hand, if the efferent vessel is narrow or obstructed, the pulse is small, irregular, and without dicrotism.

The symptoms of aortic aneurism vary with the position of the sac in the course of the vessel. In aneurism of the ascending part there are pressure on the right auricle, cyanosis, venous stasis, and dropsy. The aortic valves are usually incompetent, and the murmurs thus produced are audible over the sac. As the tumor develops anteriorly, the pulsation is felt in the second or third right intercostal space at the border of the sternum. When it projects it forms an hemispherical tumor, having, usually, a double pulsation, a reddish and purplish tint, is crossed by enlarged and varicose veins, and presently softens. The radial pulse is retarded equally on both sides, unless compression of the innominate artery occurs. The laryngeal symptoms, so constant in aneurism of the arch, are wanting, but the pupillary phenomena and the unilateral sweating may be present. The trachea and œsophagus are occasionally encroached upon, but the right primary bronchus may be compressed. In about one half of the cases the pulmonary artery and the adjacent right ventricle are impinged on. According to the data

of Sibson, aneurisms of the ascending aorta compressed the right lung in thirty-four instances, the left lung in ten, the right bronchus in six, the left bronchus in one, the pulmonary artery in seven, the descending vena cava in sixteen, and the trachea and œsophagus in nine each. In aneurism of the arch there will be œdema of the head and upper extremities; the pupil will be affected but not invariably; laryngeal symptoms will be usually present from compression of the left recurrent nerve; there will be compression of the left primary bronchus, and consequent feeble respiration or collapse of the left lung; there will be dysphagia from obstruction of the œsophagus sometimes; attacks of angina pectoris from irritation of cardiac nerves. Referring again to the facts of Sibson, we find in regard to aneurism involving both the ascending and transverse aorta, that there were present dyspnœa in 74 per cent., orthopnœa in 21·5, cough in 47, hæmoptysis in 10, stridulous breathing or affection of voice in 17, dysphagia in 21·5, the head and neck were swollen in 14 per cent.; while in aneurism of the transverse aorta alone there were present, dyspnœa in 71 per cent., orthopnœa in 20 per cent., cough in 57·5 per cent., hæmoptysis in 19 per cent., inspiration stridulous in 47·5 per cent., dysphagia in 31 per cent., the pulse weaker in one wrist in 26 per cent. As regards the descending part of the arch of the aorta, we find that the vertebræ were eroded in 42 per cent.; the tumor made pressure on the trachea in 12·5 per cent., on the left primary bronchus in 37·5 per cent., on the œsophagus in 31 per cent., the left lung in 48 per cent.; dyspnœa occurred in 50 per cent., cough in 46 per cent., the voice affected in 25 per cent., and dysphagia existed in 33 per cent. The important disturbances arising from aneurism in this situation are obviously due to the recurrent laryngeal nerve, left primary bronchus, œsophagus, and trachea, which come into close relation with the vessel at this point. Aneurisms lower down compress the left lung, and cause erosion of the vertebræ in 74 per cent. There is a fixed boring pain about the site of the aneurism in one half the cases; there is also much pain in the intercostal nerves; the femoral pulse is retarded; and, when the spinal canal is invaded, disorders of sensation and of motility occur in the lower limbs, terminating in hemiplegia. A case is reported of an aneurism of the arch, dissecting downward between the trachea and œsophagus and bursting into the stomach. The symptoms were orthopnœa, dysphagia, and stricture of the œsophagus, but not of aneurism.*

Aneurism of the innominata causes very much the same symptoms as the first part of the arch: a systolic and a diastolic pulsation; a double sound, synchronous with the cardiac, and audible with the greatest intensity at the junction of the clavicle and sternum; retardation and increased dicrotism of the right radial pulse if unobstructed

* "Pathological Society's Transactions," vol. xxvii, p. 97, report of Dr. Frederick Taylor.

at orifice of exit; pain in the neck and arm; compression of the descending vena cava, and œdema of the head and upper extremities, or there may be compression of the left vena innominata, and consequent œdema of the left side of the head and the left arm.

Aneurism of the Abdominal Aorta.—The point of election is at or near the cœliac axis. In Dr. Sibson's collection of cases, 177 in number, 131 occurred at this point. Less than one half arise from the anterior face of the vessel, and consequently the vertebræ are eroded in a large proportion of cases—55 per cent. The variety of the aneurism is the so-called false, and the form sacculated in 60 per cent., and they attain considerable size, sometimes to a capacity of ten pounds.

Aneurism of the abdominal aorta is usually referred to a violent muscular effort—always, in the author's experience. It appears to be less associated with atheromatous degeneration of the arteries than is aneurism of the thoracic aorta. One of the earliest symptoms is pain, felt in the position of the tumor and radiating through the abdomen. As the aneurism is so situated that the semilunar ganglion and the nerves of the solar plexus must be compressed by it, pain is necessarily produced, and, as the nerves radiate from a common center, the pain also radiates, shooting up into the hypochondria and downward to the iliac regions and hypogastrium. These pains are paroxysmal, and may disappear for hours and days; but the attacks are of extreme severity, and when they subside leave the patient exhausted. The local pain seems to the patient to be in the stomach, and, as this organ is disturbed in function also, the attacks are often confounded with gastralgia. This local pain is more constant than the other, and there is rarely an entire cessation of it, although it may be little more at times than an uneasiness. In about one half of the cases the most violent pains occur in the back, and shoot down through the lumbar region into the hips along the course of the sciatic nerves. There is here also a fixed, boring pain felt opposite the cœliac axis, which is rarely absent. In both situations the pains are aggravated by pressure, by sudden jolting, or bending the body. The pain in front is increased by taking food, especially by distention of the stomach. Distress produced by eating, indigestion, flatulence, and nausea, are early symptoms, due to irritation of the solar plexus. As the pain is brought on by eating, and as pronounced stomach troubles are present in a majority of the cases, it need occasion no surprise that they are often supposed to be entirely stomachal. This mistake is persisted in even when a tumor is present, and the phenomena are then ascribed to cancer of the stomach. This mistake is all the more readily made, since the interference with digestion brings on a cachectic state with wasting, and since jaundice may be caused by pressure on the common duct. The stomachal disorders are less pronounced in those aneurisms springing from the posterior part of the aorta and making their way posteriorly. According

to Sibson, a pulsating tumor was observed in 55 per cent. of the cases. A large tumor may form posteriorly, and produce extensive erosions of the vertebræ, without being ascertained by the most careful palpation. A dislocated kidney, a migrating spleen, a bunch of enlarged lymphatics, may rest on the aorta and receive a pulsation synchronous with the cardiac systole. In applying the method of palpation, to determine the nature of a pulsating epigastric tumor, the sources of error just mentioned must be eliminated by putting the patient in such a position that these bodies will fall away from the aorta, when, of course, the pulsation will cease. The aneurismal tumor is situated usually in the epigastrium, a little to the left of the median line. It is a globular, elastic tumor, pulsating with an expansile movement in all directions, and on inspection there will be seen a swell of the whole abdomen with each pulsation. The pulsation of an abdominal aneurism is single, a little later than the cardiac systole, and there is usually a thrill. If pressure is made on the aorta below the aneurism, the sac will be filled with a stronger impulse, and retain its fullness, while the thrill ceases or is less marked. Percussion is of little value. Dullness may be elicited under favorable circumstances, but this affords no indication of the nature of the producing cause. Murmur is present in a considerable proportion of cases. It has a blowing character, is rather soft, and, in time, is a little later than the cardiac systole. When the aneurism springs from the anterior surface of the aorta, the murmur is audible in front, and, when the growth is posterior, audible behind; rarely is it audible in both situations in the same case. Standing erect arrests the murmur, because, according to Corrigan, of the increased tension in the sac produced by the superincumbent column of blood. To this statement and explanation must be opposed the important fact that the murmur was audible in the erect and ceased in the recumbent posture in an undoubted case of aneurism. Aneurism of branches of the aorta are occasionally encountered. An aneurism of the mesenteric artery is a movable tumor which may be confounded with floating kidney.* It differs from the latter in being globular and pulsating. Aneurism of the hepatic artery may cause jaundice, by pressure on the duct, or ascites, by pressure on the portal vein. As they are small in size and deeply placed, aneurisms of the hepatic artery are rarely, if ever, recognized during the life of the individuals affected by them.

Course, Duration, and Termination of Aneurisms of the Aorta.—The course of aneurism is much influenced by the condition of organs compressed, and the disturbances of function thus induced. They are essentially chronic, slow in development usually until of sufficient size to compress the organs about them, when symptoms are caused which

* Dr. Burney-Yeo communicates a case to the Pathological Society ("Transactions," vol. xxviii, 1877), in which the first part of the artery was affected and not movable. It compressed *both* renal arteries, and caused death by uræmia.

attract attention to them. Not all cases give rise to symptoms that indicate the cause of the disturbances which they produce; only the disturbances are recognized and treated as the real malady. Thus, aneurisms deeply placed in the thorax posteriorly, or of the abdominal aorta, high upon between the crura of the diaphragm, or growing toward the lumbar region, may produce no symptoms which can indicate the nature of the disease. Even when a tumor of considerable size exists, in the situation most favorable for recognition, grave doubts may be entertained as to its aneurismal character. They may terminate in a variety of modes; by exhaustion, by pneumonia, by rupture and hæmorrhage. Probably the most useful collection of statistics showing the course and terminations of aneurism is that of Sibson, and the author prefers, therefore, to illustrate these points from it. As regards aneurism of the first part of the aorta (sinuses of Valsalva), we find that 80 per cent. terminated by rupture, 45 per cent. into the sac of the pericardium, 13·5 per cent. into the pulmonary artery, 8·5 per cent. into the right auricle, 5 per cent. into the right ventricle, and 5 per cent. into the left ventricle. Aneurism of the ascending aorta "ruptured in 57 per cent.; externally in 8, into the pericardium in 22, into the pulmonary artery in 4, into the descending vena cava in 5, into the right lung in 5, into the left pleura in 4, "etc. In a series of 25 cases published in the "New York Pathological Transactions,"* the termination was by rupture; and in almost all of the cases death occurred suddenly, but few of them having been diagnosticated. Aneurisms of the ascending aorta and arch conjointly ruptured in 37 per cent., into the pericardium in 10, into the vena cava 4, into the trachea 4, etc. Aneurism of the descending part of the arch ruptured in 75 per cent., into the trachea in 4, into the left bronchus in 16·5, into the left pleura in 23, into the right pleura in 12·5, etc. Aneurism of the abdominal aorta ruptured in 77 per cent., into the peritoneal cavity in 28·5 per cent., into the subperitoneal tissue, in the left hypochondriac region, 22 per cent., etc. Although death is almost immediate when an aneurism ruptures, yet this is not invariably the case. A small opening may exist in the trachea, permitting a little blood to escape from time to time, simulating pulmonary hæmorrhage, and continuing to discharge in this way until a complete rupture occurred at the end of several months. These are called "weeping aneurisms." Gairdner† records a case of this kind in which the opening was blocked by some fibrin, and continued so for four years. An opening externally may discharge slowly, of which notable examples have been published—a free and fatal hæmorrhage being prevented usually by a plug of fibrin. As the beginning of an aneurism is very uncertain, it is difficult to state its duration within exact lim-

* Tabulated in "Transactions of the London Pathological Society," vol. xxix.

† "Clinical Medicine," *op. cit.*

its. They vary exceedingly in duration; from fifteen days to thirty years are the extremes which have fallen under the author's notice. Much depends on the influences, medicinal and moral, to which the patient is subjected. Some cures are effected.

Prognosis.—Aneurism must be regarded as a very grave disease. Under the improved methods of medical treatment now available, more cures are effected than formerly, and the question of treatment must enter largely into prognosis. Under any circumstances, a qualified opinion only should be given, for an aneurism that is apparently solidifying may take an unfavorable turn, and death be caused by some intercurrent malady.

Treatment.—The object of the medical treatment of aneurism is to secure the solidification of the sac. As this has occurred several times spontaneously, without the intervention of art, it is more difficult to assign to remedies their exact share in any successful treatment. To obtain coagulation of the blood in the sac and to effect the solidification of the fibrin are the objects before us. If we have to deal with a sacculated aneurism, the closure of the sac can be accomplished without interrupting the current through its proper channel. The importance of this is very obvious in dealing with the aorta, for no collateral circulation is here possible. The difficulty of a case is immensely increased from the therapeutical standpoint, when we have to treat a dilated vessel. The treatment by rest, as absolute as can be maintained, is a very old method, and has much to recommend it even now. If the patient maintains a position of recumbency, and moves in that position as little as possible, the action of the heart is slowed and its force lessened, so that the blood in the sac may coagulate. Formerly, the abstraction of blood and an absolute diet were combined with rest in the recumbent posture (Valsalva's plan), but, in the more recent method of Tufnell, only the rest and a restricted diet are considered necessary. The diet of this plan consists of two ounces of liquid and four of solid food morning and evening, and four ounces of liquid and six ounces of solid at mid-day.* In addition to this restricted diet, the blood-pressure is reduced by the daily use of laxatives. The period of confinement to a recumbent posture is from eight to thirteen weeks. The results obtained by Mr. Tufnell are certainly very satisfactory, for he has reported cases of aneurism of the abdominal aorta solidified in thirty-seven and twenty-one days, and one of popliteal cured in twelve days; and he affirms that, "if the plan of treatment by position be but *steadily* and *perseveringly* carried out, a successful issue can (in suitable cases) almost be guaranteed." In addition to rest, arterial sedatives are sometimes given, with the view to keep the action of the heart still lower than that rate of

* "Medico-Chirurgical Transactions," vol. xxxix, 1874, p. 83, *et seq.*

movement attainable by rest merely, according to Tufnell's plan. The arterial sedative employed for this purpose is the tincture of veratrum viride, given to bring down and to keep the pulsations about fifty per minute. The author has witnessed successes obtained in this way. Bloodletting is admissible in cases of large aneurism, a rupture being threatened by violent action and plethora. Recently, important results have been obtained by the free administration of the iodide of potassium, or *iodide of sodium*, which acts in the same way, but is less hurtful (gr. xv.—℈j) three times a day. It has a remarkable influence over the pain, probably because of its effect in diminishing the tension of the sac, the force of the heart, and the blood-pressure (Balfour). Besides this, the iodide seems to affect the sac itself. The use of the iodide of potassium may be combined with rest and a lowered diet, but these are only adjuvants, and are not essential to the treatment.

Since the publication of the last edition of this work, much new testimony has been published, especially by our French colleagues—Huchard, See, and others—in regard to the remarkable powers of the iodides for bringing about slow structural alterations of connective tissue, and of granulation tissue. In chronic endarteritis, the sclerosis can be removed by peristent use of the iodides, and of these they find that sodium iodide can be given the requisite time, and in the necessary quantity, to accomplish the object without hurt to the system. Not a little incredulity has been expressed on this side, but these adverse opinions are not based on any proper investigation; and on the other hand some of our best therapeutists have long entertained the same opinions.

Langenbeck has called attention to the great value of ergot as a remedy in aneurism, and has reported some successful cases. It has been used since with advantage. Its employment is based on the action which it exerts on the muscular fiber of the arteries, and, therefore, it is asserted, it can have no effect on the aorta. Those who use this argument forget that ergot slows the heart, and raises the blood-pressure at the periphery by contracting the arterioles—conditions highly favorable to promote coagulation of the blood in the sac. Two to five grains of the so-called ergotin, which is the aqueous extract,* should be administered hypodermatically, simply dissolved in water and filtered. This practice may be continued while the other measures are being carried out, as there is no therapeutical incompatibility. The success which has lately been obtained with barium, based on the experimental research of Boehm, is a beautiful example of the value of such investigations. From two to five minims of the liquor barii chloridi, well diluted, or one sixth grain to one grain of the salt in pill form, may be given three times a day, after meals. The physi-

* Squibb's preparation is probably best.

ological effects of this medicine on the vessels suggested its employment originally. Acetate of lead also affects the vessels—especially the muscular layer—but there are very obvious objections to its long-continued use.

Attempts have been made by direct means to secure the coagulation of blood in the aneurismal sac. These consist in the introduction of fine wires, horse-hair, etc., with the intent to supply a foreign body about which the blood will coagulate. Thus far, these attempts have been failures, except one success reported lately. Another method, of which very confident expectations were at one time entertained, is the method of *electrolysis*. This consists in the introduction of an insulated needle into the interior of a sac, and the application of a sponge electrode to the exterior, through which a galvanic current is passed. The blood coagulates about the needle. Much discussion has resulted as to the pole, anode, or cathode, to be introduced into the sac. As about the positive pole acids, oxygen, etc., collect, a firmer clot is there formed; while about the negative, hydrogen and the alkalies, producing a softer clot. The positive electrode needle is withdrawn with difficulty from the sac, owing to the firmness and adhesiveness of the adherent coagulum, and in making the effort there is danger of hæmorrhage and of setting free multiple emboli. On the other hand, although the clot produced by the negative needle is less firm, it acts as a nucleus about which denser coagula will form afterward. Although cures have been reported by electrolysis, this method is not so successful as others recommended above. Furthermore, the danger of hæmorrhage, of exciting inflammation, of detaching large clots in the circulation, is so great that this plan is not to be commended.

Aneurism of the coronary artery is a rare disease. Crisp* has collected and tabulated twelve cases. They occurred from eleven to seventy-seven years of age, but chiefly after forty, and in subjects exposed to such injury by occupation. They may cause sudden death without symptoms, or there may be suffocative attacks, pain, and palpitations. They vary in size from a pea to a walnut, and rupture into the pericardium. This is not the invariable termination, although usual, death being caused in three of Crisp's cases by bronchitis, exhaustion, and an unknown cause unconnected with the aneurism.

* "Transactions of the Pathological Society," vol. xxii, p. 108.