son with 197 at Zurich at the same season, and 457.4 at Davos—an average of about five and a half hours a day.

The winter climate of Arosa, as we learn from the above, is characterized by a dry, cold, pure atmosphere, a high average of sunshine, absence of winds and fog, and the attenuation and clearness of the air which are the accompaniments of high altitudes. None of the Alpine health resorts would seem to offer more favorable climatic conditions for the high-altitude treatment of phthisis.

A discussion of the class of cases suitable for such a climate will be given under *Tuberculosis, Pulmonary*, but in brief it may be said that incipient cases with little constitutional disturbance have a better chance of recovery in high altitudes than elsewhere. The writer would express his indebtednees for much of the above data to Regnard's "La Cure d'Altitude."

Edward O. Otis.

ARRINGTON MINERAL SPRINGS.—Atchison County, Kansas.

Post-Office.—Arrington.

Access.—Via Union Pacific Railroad. Hotel.

These springs are located on a tract of land eighteen acres in extent, in a level, highly fertile farming country. The springs are three in number, and flow about eight gallons per minute. The following analyses of two of the springs were made by Juan H. Wright, M.D., chemist, of St. Louis, Mo.:

SPRING NO. 1 (REACTION DECIDEDLY ALKALINE).

One United States Gallon Contains:

Solids.	Grains.
Calcium carbonate	9.76
Magnesium carbonate	5.93
Sodium carbonate	11.45
Potassium carbonate	1.44
Iron carbonate	3.57
Lithium carbonate	0.47
Sodium carboate	2.04
Calcium sulphate	1.29
Magnesium sulphate	1.87
Sodium chloride	3.63
Silica	0.97
Ammonium crenate	0.89
Organic matter	0.27
Total	43.58
Carbonic acid gas	42 cubic inches.

SPRING NO. 2 (REACTION ALKALINE).

One United States Gallon Contains:

Solids.	Grains.
Calcium carbonate	6.61
Magnesium carbonate	3.26
Sodium carbonate	3.55
Iron carbonate	2.01
Sodium chloride	2.16
Silica (soluble)	0.55
Organic matter	0.91
Ammonia	Trace.
Total	19.05
Carbonic acid gas	39.30 cubic inches.

These waters are both of the alkaline-chalybeate-carbonated variety. They are highly esteemed in dyspepsia, general debility, rheumatism, constipation, hemorrhoids, and liver and kidney complaints. Commodious bathrooms, supplying hot and cold water, are open to visitors.

James K. Crook.

ARROW-HEAD HOT SPRINGS.—San Bernardino County, California.

Post-Office.—Arrow-Head Springs.

Access.—By stage from San Bernardino, six and a half miles distant to the south. Parties leaving Los Angeles, sixty-seven miles distant, should take the 8:30 or 11 A.M., or the 12:20 P.M. Santa Fé train, or the 7:45 or 8:30 A.M. train on the Southern Pacific line. Hotel.

These springs burst from the mountain slope of the Sierra Madre, 2,000 feet above the level of the sea, and 1,000 feet above the foot of the mountain. A bench-like mesa, containing 100 acres, projects at this point from the mountain, and is bounded on the east and on the west by two enormous cañons. Down the deep ravine or cañon on the east comes a mountain stream of water as cold as ice, while in the cañon on the west flows a stream formed by the boiling spring so hot that it fills the air with steam and sulphurous gas. The springs here were known to the Indians long before the settlement of the country by whites. On the face of the mountain back of the hotel is the figure of an arrowhead 1,360 feet long and 450 feet wide, believed to have been executed by the aborigines. The figure gives its name to the resort, and so perfect is its contour and so elevated its situation that it can be seen from almost every part of the valley, and stands as a prominent landmark for miles around. The Arrow-Head Hotel is located near the springs, on the plateau of land between the two cañons. It is a very comfortable modern structure with a capacity for 150 guests. The meteorological conditions are similar to those usually prevalent in Southern California, the weather being, as a rule, clear, balmy, and bright. The winter season is most favorable for visiting the springs. These are 87 in number, the aggregate flow of water being equal to 10 miner's inches. Following is an analysis of one of the fountains by Prof. E. W. Hilgard, of the State University:

One United States Gallon Contains:

Solids.	Grains.
Potassium sulphate	4.00
Sodium sulphate	42.48
Sodium chloride	8.18
Lithium	Strong test.
Calcium sulphate	1.34
Calcium carbonate	1.34
Barium	Faint test.
Strontium	Well marked.
Magnesium sulphate	0.15
Magnesium carbonate	0.32
Silica	4.94
Organic matter	Trace.
Total	62.75
Free sulphureted hydrogen	0.264 cubic inches.

The water shows a very high temperature, 193° F. The analysis bears some resemblance to that of the Carlsbad springs. The water is soft, clear, and pleasant to drink and is believed to aid in the elimination of malarial and miasmatic poisons from the system when taken internally. The springs owe their chief reputation, however, to the beneficial effects of the water when used for bathing purposes. It is employed in the form of vapor, hot mineral water, and mud baths. These baths have proved of value in cases of glandular enlargements, rheumatism, and rheumatoid arthritis, as well as in some of the manifestations of syphilis and in various neuralgic conditions.

James K. Crook.

ARROWROOT.—*Arrowroot Starch; Maranta Starch.* The starch obtained from *Maranta arundinacea* L. (fam. *Marantaceæ*). The genus *Maranta* contains some fifteen species, natives of tropical America. They are perennial herbs, with tuberous or thickened, starch-laden, scaly rhizomes, and leafy, often branched stems.

The arrowroot plant is extensively cultivated in nearly all tropical countries. A large amount of arrowroot is now produced in Southern Asia. The Indian plant differs somewhat from the American, but is considered as only a variety of it.

The early medicinal application of arrowroot among the aborigines appears to have been as a remedy for the wounds of their arrows, to which it owes its name. It was both given internally and applied as a poultice to the injured part. It was also used as a food. Accounts of its cultivation in the West Indies date back about a hundred and fifty years, since which time it has been an article of general commerce.

Arrowroot is prepared in essentially the same way as other starches, namely, by washing it out of the cellular tissue. The yield is about ten per cent. of the fresh rhizome. That of the West Indies, generally called

Bermuda arrowroot, is regarded as the best. It is a beautifully white, lumpy powder, without odor or taste; rubbed between the fingers it gives a slight crackling sound, or rather, feeling, for the sensation is conveyed more through the fingers than the ears. Its other properties are simply those of starch in general, to which the reader is referred.

When the antiphlogistic treatment of diseases was more in vogue than at present, arrowroot took quite an important place in the dietary of the sick. It was also extensively used as an ingredient of foods for infants. For neither of these purposes is it to be much recommended. As a food, it has scarcely any advantages over the cheaper indigenous starches now so admirably prepared.

Florida Arrowroot is a starch prepared from the large fleshy stem of *Zamia integrifolia* Jacq. *W. P. Bolles.*

ARROWROOT, INDIAN. See *Curcuma.*

ARSENIC.—1. General Medicinal Properties of the Compounds of Arsenic.—The predominant feature of the action of arsenical preparations is intense irritation. Locally applied in fairly concentrated form to a denuded surface the irritation is so severe as to excite the extreme of reaction, namely, gangrenous inflammation; the part sloughs, strangulated by congestion and inflammation. Arsenic is thus indirectly, and, because indirectly, is slowly, painfully, and dangerously caustic. When arsenic is used to cauterize, there is also a risk of absorption of enough of the mineral to produce constitutional poisoning, a risk greater when the application is weak than when it is strong, since in the latter case congestion is developed early, whereby absorption is impeded. When arsenic is taken internally, gastro-intestinal irritation is easily produced, a result which, in acute arsenical poisoning, constitutes the most prominent feature of the derangement. Apart from tendency to irritate, arsenic is fairly antiseptic, and in the higher organisms, such as man, has an action upon the nervous system. In arsenical poisoning nervous symptoms are prominent, and, therapeutically, much of the avail of arsenicals hinges upon the allaying of nervous derangements.

For the purposes for which arsenic is used in medicine, the remedy has to be administered continuously for days, weeks, or months. In this medication the rule is so to adjust the dosage as not to develop constitutional disturbance. The initial symptoms of over-impregnation of the system with arsenic are, first, an irritation of the conjunctiva, showing itself in suffusion and smarting of the eye, and œdema of the lower lid; and secondly, an irritation of the stomach, shown by failure of appetite and soreness and sensation of weight at the epigastrium. In some persons the gastric symptoms precede the conjunctival. The two sets of symptoms should be watched for in arsenical medication, and the dosing diminished or temporarily discontinued until their abatement, which speedily follows the withdrawal of the poison.

The properties of arsenic valuable therapeutically are as follows:

(*a*) *Improvement of Nutrition.*—Even in the healthy, carefully graduated dosage with arsenic tends to improve general nutrition, the individual fattening, the skin being specially rosy and smooth, or, in animals, the fur sleek and glossy, and the bones thick and dense.[1] In the case of the so-called arsenic-eaters of Styria, the women are said to indulge for the beautifying of their complexion, and the men for an improvement of wind and increased physical endurance which they claim to derive from the use of arsenic. This habit of regular consumption of arsenic among certain of the working class in Styria seems now established as a fact by competent and reliable testimony.[2] Arsenous acid is the preparation commonly used, and the daily allowance has been known to reach five and even ten grains. But attempts in other countries to acquire the tolerance of the poison which the Styrian peasantry show commonly end in disaster. The property of arsenic to modify nutrition is utilized principally in the following diseases: *Progressive Pernicious Anæmia:* In this affection, where iron is so notoriously futile, arsenic has in many cases proved of great benefit, patients even recovering fully under its use. *Scaly Skin Diseases:* In skin diseases arsenic is more or less used, but experience agrees that it is much more likely to be of benefit in affections of the epidermis than in those involving the corium. *Psoriasis* is a typical disease of the former kind, and in its treatment arsenic is a standard remedy. At the beginning of an arsenical course the symptoms often suffer an exacerbation, but this commonly subsides in a few days. The medicine should not be prescribed during the inflammatory stage of a skin disease, but when used should be persisted in for weeks, or even months, after apparent cure. Under all circumstances the remedial action is slow.

(*b*) *Control of Neuroses.*—The property of arsenic to affect nerve functions, seen in the nervous phenomena that attend arsenical poisoning, shows itself therapeutically in a tendency to abate pain, spasm, and undue reflex irritability. The property is utilized most especially in the following conditions: *Gastric Irritability:* In idiopathic dyspeptic irritability of the stomach, or in the irritability attending the chronic gastritis of drunkards, or ulcer or cancer of the stomach, arsenic is often of considerable benefit, and is especially efficacious when the nervous disturbance is disproportionately great. *Neuroses of the Respiratory Organs:* Some asthmatics find a certain amount of temporary relief from arsenic, a relief more likely to be obtained in the pure neurotic form of the disease than when the symptoms are secondary to bronchitis, emphysema, or disease of the heart. Yet also the nerve irritation in coryza may be relieved, and, according to Ringer, paroxysmal sneezing is often promptly broken by the remedy, except when caused by true hay fever the result of the inhalation of pollen. *Other Neuroses:* In *chorea* arsenic is probably the most generally serviceable of medicines. Simple uncomplicated cases recover under the use of the remedy more frequently than not. *Neuralgia* also sometimes yields to arsenic, more particularly when the attacks show a regular periodicity of onset; in other words, when the affection is very likely of malarial origin. Other neuroses also, such as angina pectoris, and even epilepsy, have occasionally been treated by arsenic, and isolated cases have been reported in which benefit has been claimed from the medication.

(*c*) *Control of Malarial Diseases.*—Arsenic has a notorious power over malarial affections, being commonly resorted to as next choice after the cinchona alkaloids. In a broad way arsenic is inferior in potency to those alkaloids, but yet in old cases, and particularly in intermittents of tertian and quartan rather than quotidian type, it may succeed even after quinine has failed. As compared with quinine, furthermore, arsenical preparations have the advantage of being tasteless and cheap, and for those reasons alone may be selected for prescription in malarial disease in the case of poor people or of children.

Besides the foregoing, arsenic has been used in a great variety of diseases on the general principle of being an "alterative," with alleged success in many cases.

2. The Preparations of Arsenic Used in Medicine.—The arsenical compounds used in medicine are the *trioxide* (arsenous acid), *triiodide*, and the two salts, *potassium arsenite* and *sodium arsenate*.

Arsenic Trioxide, As_2O_3, *or* As_4O_6. This well-known compound is official in the U. S. P. as *Acidum Arsenosum*, Arsenous Acid, an appellation which chemically belongs only to the aqueous solution of the oxide. This is the preparation known also as *white arsenic*, or, in common parlance, simply *arsenic*. Arsenous acid, so-called, is "a heavy solid, occurring either as an opaque, white powder, or in irregular masses of two varieties: the one amorphous, transparent and colorless, like glass; the other crystalline, opaque or white, resembling porce-

lain. Frequently the same piece has an opaque, white, outer crust enclosing the glassy variety within. Contact with moist air gradually changes the glassy into the white, opaque variety. Both are odorless and tasteless. In cold water both varieties dissolve very slowly, the glassy variety requiring about 30, the porcelain-like about 80 parts of water at 15° C. (59° F.). Both are slowly but completely soluble in 15 parts of boiling water. In alcohol, arsenous acid is but sparingly soluble, but it is soluble in about 5 parts of glycerin. Oil of turpentine dissolves only the glassy variety. Both varieties are freely soluble in hydrochloric acid, and in solutions of alkali hydrates and carbonates. When heated to 218° C. (424.4° F.), arsenous acid is completely volatilized without melting. When thrown on ignited charcoal, it emits an alliaceous odor. When its vapor is passed through red-hot charcoal, in an arsenic tube, it is deoxidized, and metallic arsenic is deposited on the cooler portion of the tube as a mirror having a metallic lustre. An aqueous solution of arsenous acid has a faintly acid reaction upon litmus paper" (U. S. P.). Arsenous acid is obtained by sublimation, by roasting ores containing arsenic, and is subsequently purified by resublimation. When first obtained it is in transparent glass-like masses, but these, in after-exposure, acquire the porcelain-like appearance in which arsenous acid is commonly met with in the shops. This change, beginning on the surface, gradually extends in time throughout the whole thickness of the mass; not so quickly though but what commercial samples may often be found where the masses, on fracture, show a vitreous interior. For medical use the mineral is pulverized, appearing then as a very fine, white, smooth powder. In this condition it is easily adulterated, but the fraud can readily be detected by submitting the sample to sublimation, when the arsenous acid will all disappear by volatilization, and the impurities be declared by a non-volatile residue.

Arsenous acid possesses all the physiological properties of arsenicals, as set forth above. It does not act upon the sound skin, but upon a mucous membrane or denuded surface produces violent irritation. Taken internally it is capable of sufficient absorption to produce the constitutional effects of arsenic, therapeutic or toxic, and so may be used as a medicine, in doses of 0.003 gm. (gr. $\frac{1}{20}$) three times a day, generally given in pill. But it is not an eligible preparation for internal use, because of the local irritation it is apt to set up. Externally it has been employed to destroy the tissues of cancer or lupus, applied in ointment or paste. For such purpose the arsenous acid is mixed with from four to eight times its weight of inert matter, such as ointment or a paste made of some indifferent powder mixed with mucilage. Such arsenical ointment or paste is then applied to the tissue to be destroyed, the point being observed, if the part be covered by skin, first to remove the epithelium by blistering. The application is to continue for from twelve to twenty-four hours. Weak arsenical mixtures are more dangerous than strong, because of the greater likelihood of constitutional poisoning. Even strong applications, if at all extensive, are risky, and at best the destruction of tissue by arsenic is a slow, uncertain, and very painful process, not to be commended. Most of the numberless caustic pastes of quack "cancer doctors" are preparations of arsenous acid. The following have been celebrated in their day: *Arsenical Paste of Frère Côme:* Arsenous acid and animal charcoal, each one part; mercuric sulphide, four parts; to be used only over a small area at a time. *Sir Astley Cooper's Arsenious Ointment:* Arsenous acid and sulphur, each 1 part; spermaceti cerate, 8 parts. *Plunket's Caustic:* Bruised plant of *ranunculus acris* and of *ranunculus flammula*, each 24 parts; arsenous acid, 3 parts; sulphur, 5 parts; the whole mixed to a paste, rolled into balls, and these dried in the sun. For application the balls are again to be reduced to pasty consistence by rubbing with yolk of egg. In using this preparation, preliminary denudation of the skin is unnecessary, that operation being performed by the acrid matter of the crowfoot. The only preparation of arsenous acid official in the U. S. P. is what is entitled *Liquor Acidi Arsenosi*, Solution of Arsenous Acid. This is a one-per-cent. solution of the arsenical in water slightly acidulated with hydrochloric acid. The preparation is of the same strength as Fowler's solution (see below), and is given in doses of 0.30 gm. (mℏ v.) three times a day, largely diluted with water.

Arsenic Triiodide, AsI_3. This compound is official in the U. S. P. as *Arseni Iodidum*, Arsenic Iodide. It is in "glossy, orange-red, crystalline masses, or shining, orange-red, crystalline scales, having an iodine-like odor and taste, and gradually losing iodine on exposure to air and light. Soluble at 15° C. (59° F.) in 7 parts of water and in about 30 parts of alcohol; also soluble in ether, and in carbon disulphide. The salt is gradually decomposed by boiling water and by boiling alcohol. By heat it is completely volatilized, and if it be heated with diluted nitric acid, vapor of iodine will be evolved. The aqueous solution of the salt has a yellow color, is neutral to litmus paper, and, on standing, gradually decomposes into arsenous and hydriodic acids" (U. S. P.). This iodide has been given internally as an arsenical in doses of 0.008 gm. (gr. $\frac{1}{8}$), and used externally on malignant growths in a one-per-cent. ointment; but its principal purpose among medicines is to furnish the pharmacist with the arsenical ingredient of the official preparation, *Liquor Arseni et Hydrargyri Iodidi*, Solution of Arsenic and Mercuric Iodide, commonly known as *Donovan's Solution*. This is an aqueous solution of one per cent. each of arsenic iodide and red mercuric iodide. It is a pale yellow fluid, slightly astringent in flavor, and precipitating with alkalies, silver solutions, and solutions of alkaloidal salts. It is used as a composite "alterative" internal medicine, its reputation being principally in the line of scaly skin disease, syphilitic or idiopathic, and in rheumatic affections. Dose, from five to ten drops, well diluted with water, after meals.

Potassium Arsenite. An arsenite of potassium is official in the U. S. P. only in the solution entitled *Liquor Potassii Arsenitis*, Solution of Potassium Arsenite, better known by the common name of *Fowler's Solution*. This solution is made by boiling 1 part of arsenous acid and 2 of acid potassium carbonate in water until chemical union is effected, then bringing the solution to the standard strength of one per cent. of arsenous acid, and adding a small charge of compound tincture of lavender. This latter addition is to give the preparation sufficient taste and color to prevent its being mistaken for simple water. Fowler's solution is clear, and tastes only of lavender. It responds to the usual tests for arsenic. Physiologically it acts the same as would a solution of arsenous acid of like strength. It is in imitation of a famous remedy known as "tasteless ague drop," and is the most convenient and commonly used arsenical for internal giving. The average dose is five drops, well diluted with water, to be taken, like all arsenicals, after eating, and repeated two or three times a day.

Sodium Arsenate, $Na_2HAsO_4+7H_2O$. The salt is official under title *Sodii Arsenas*, Sodium Arsenate. It occurs in "colorless, transparent, monoclinic prisms, odorless, and having a mild, alkaline taste (the salt is very poisonous). Efflorescent in dry air, and somewhat deliquescent in moist air. Soluble in 4 parts of water at 15° C. (59° F.), and very soluble in boiling water; very sparingly soluble in cold, but soluble in 60 parts of boiling alcohol. When gently heated, the salt loses five molecules of water (38.8 per cent.), and is converted into a white powder. At 148° C. (298.4° F.), the rest of the water of crystallization is lost, the salt fuses, and at a red heat is converted into pyroarsenate. It imparts an intense, yellow color to a non-luminous flame" (U. S. P.). Sodium arsenate has the usual properties of the arsenicals, but is a little milder than potassium arsenite.[3] It is generally prescribed in the official *Liquor Sodii Arsenatis*, Solution of Sodium Arsenate, which is simply a one-per-cent. aqueous solution of the salt. This solution may be given in the same dose and manner as Fowler's solution.

Edward Curtis.

[1] Th. Gies: Archiv für experiment. Path., December, 1877, quoted in Phillips's Materia Medica.
[2] Maclagan: Edinburgh Medical Journal, 1864, p. 203.
[3] Ringer: Journal of Physiology, vol. i., p. 213.

ARTERIES, ANOMALIES OF.—Arteries are subject to frequent variations of size, origin, and distribution. Some of these are so common that it is difficult to decide what is the normal condition. Many anomalous arteries are merely a persistence of an early fetal condition, others are reversions to forms of distribution which are natural in the various species of the lower animals, while some are due to an abnormal enlargement or diminution of vessels which naturally exist. I propose in the present article chiefly to describe those anomalies which are important surgically—that is, those which exist in parts liable to diseases which necessitate a surgical operation for their cure or relief. However interesting would be a consideration of anomalies of arteries from a morphological point of view to pure anatomists, I fear the subject is not of sufficient interest to the general profession to justify me in devoting much space to it here.

AORTA.—This vessel is subject to many variations. It may vary in length and position. The summit of the arch has been seen as high as the top of the sternum and as low as the fifth dorsal vertebra. The distance to which it reaches on the spine before dividing into the two common iliacs also varies, the point of division being occasionally as low as the fifth, and as high as the third, or even the second, lumbar vertebra. The aorta has been seen consisting of two closely united tubes, in part or the whole of its course, due to a persistence of the original double aorta of early fetal life (Fig. 288). The aorta is sometimes very tortuous, of large size, and displaced to one side, especially in old people, but this condition is due more to pathological changes than to congenital malformation.

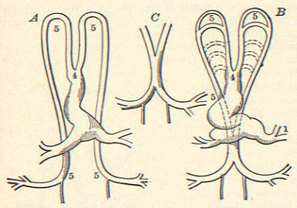

FIG. 288.—Diagrammatic Outlines of Heart and First Arterial Vessels of the Embryo, as Seen from the Abdominal Surface. 4, Aortic bulb; 5, 5, the primitive aortic arches and their continuation as the descending aorta. These vessels are separate in their whole extent in *A* (36 to 38 mm. in thickness), but at a later period, as shown more fully in *C*, have coalesced into one tube in a part of the dorsal region. In *B*, below upper 5, the second aortic arch is formed, and farther down the dotted lines indicate the position of the succeeding arches, numbering five in all. (Quain's "Anatomy.")

The main trunks of the *aorta* and pulmonary artery are (4, Fig. 288) both derived from the arterial bulb of the fetal heart, "and are liable to variations which may be traced to deviations from the natural mode of their septal division and of their union with the left or right ventricles of the heart respectively" (Quain's "Anatomy"). These variations are generally associated with malformations of the heart, and often with patency of the ductus arteriosus. The aortic or pulmonary trunk may be almost obliterated, or the two trunks may communicate freely with each other, owing to the failure of complete septal division; again, their origins may be transposed, the pulmonary artery arising from the left ventricle and the aorta from the right. A very rare anomaly has been reported where the pulmonary artery and aorta form one stem which arises from a simple heart like that seen in fishes. A few cases are reported in which the descending aorta arose from the pulmonary artery and gave off the left subclavian, the left ventricle giving off only the innominate and left carotid. Most of these varieties are incompatible with life, and are fully described in works on pathological anatomy.

Varieties of the Aortic Arch.—The various anomalies of the aortic arch depend on the mode of development of the fourth and fifth fetal branchial arches. In man and nearly all mammalia the arch is a left one, produced by the persistence of the fourth left branchial arch (Fig. 289). In birds the permanent aorta is formed from the right fourth branchial arch; and in reptiles both the right and left fourth branchial arches are persistent. In cases in which there is transposition of the heart, and also, of course, of the arch of the aorta, the aorta is a right one, instead of the usual left, and this is owing to the persistence of the right fourth branchial arch, as in birds. The pulmonary artery in these cases is also transposed and is formed from the right fifth arch in place of from the left. Many of these cases have been reported and have been diagnosed during life, the direction of the apex of the heart being toward the right, the apex beat being felt on the right side between the fifth and sixth ribs. A very good specimen of this anomaly is to be seen in the museum of the Pennsylvania Hospital in Philadelphia.

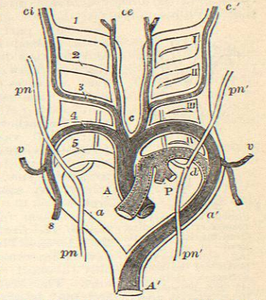

FIG. 289.—Diagram of the Fetal Aortic Arches, Showing Their Transformation into the Permanent Vessels of the Mammal. (After Rathke.) The permanent vessels are represented by the deep shading, the pulmonary arteries lighter, the temporary primitive arches in outline only. A, P, Primitive aortic stem, divided into A, aortic arch, P, pulmonary artery; *a*, right aortic root; *a'*, left aortic root; *A'*, descending aorta; 1, 2, 3, 4, 5, primitive vascular arches; *pn*, *pn'*, right and left pneumogastric nerves; *v*, *v'*, right and left vertebrals; *s*, *s'*, right and left subclavians; *ce*, external carotids; *ci*, *ci'*, internal carotids. (From vol. ii., Quain's "Anatomy.")

Occasionally the aortic arch has been observed completely double (Fig. 290), as in reptiles, due to the persistence of both right and left aortic roots (*a*, *a'*, Fig. 289) and the fourth branchial arches of both sides. The double aorta embraces the trachea and œsophagus, and unites below to form a single trunk on the left side of the spinal column, as in early fetal life (*B*, Fig. 288).

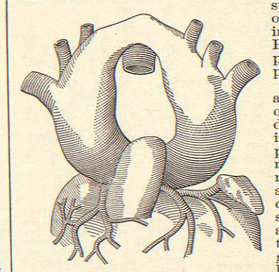

FIG. 290.—Example of a Double Ascending Aorta, from the Arch of Which Arise Six Branches—Two Subclavian and Four Carotid Arteries. (After Malacarne.)

The aorta may pass to the right of the trachea and œsophagus instead of to the left, and this without the transposition of the heart mentioned above. If we study the fetal conditions the explanation of this anomaly is easy. It is a persistence of the right fourth branchial