resume their normal appearance gradually. This production of pseudo-parasites during each paroxysm of an intermittent fever and disappearance during the apyretic interval would of course render more difficult the differentiation of parasitic from non-parasitic ague except by experts. The establishment of the theory that there is an intermittent fever due to environment would, however, relieve Laveran's supporters from the difficulty of explaining how those cases in which no parasites can be discovered in the blood can possibly be caused by parasites. Moreover, the presence of pseudo-parasites in the blood of such cases would enable us to understand the assertion of those who maintained that the bodies they found in malarial blood were not parasites at all but simply altered blood corpuscles. Manson says that the staining process for diagnosing malaria is not to be depended on unless carried out by those with great experience.

IX.—INCREASE OF WATER IN THE BLOOD WILL PRODUCE ENLARGEMENT OF THE SPLEEN.

As we have seen, increase of water in the blood increases hæmolysis or the destruction of red blood corpuscles. But the taking up and disposal of the fragments of disintegrating red blood corpuscles is the normal function of the spleen. Hence when increase of water in the blood produces increased destruction of these corpuscles increased functional activity of the organ and therefore increase of its size or bulk follows. Moreover, the increase of water by increasing the volume of the blood will of itself also directly tend to enlarge the spleen.

When critical elimination of water (sweat) occurs there is, of course, diminished volume of the blood, diminished destruction of red blood corpuscles, and consequently diminished functional activity and size of the organ which is normally called on to dispose of the disintegrated corpuscles. Hence in the apyretic intervals the spleen resumes normal size. But if this intermittent increase of water in the blood is frequently repeated the organ will become permanently enlarged, for it is known that transitory but repeated hyperæmia of any organ leads to a permanent enlargement of the organ, such as is found in ague cake, in those suffering from chronic malaria.

Now this view that the enlargement of the spleen is in some cases of intermittent fever at all events due to the intermittent excess of water produced by meteorological environment receives some support from a consideration of the periodical change in size of the organ that takes place in health. In health it is known that the spleen enlarges to some extent after every meal, reaching its maximum after some hours and then returning to its normal size. When food is taken into the stomach the first portion of it to be absorbed is its water, which enters the blood directly through the gastric vessels. This addition of water, of course, increases the volume of blood, and also destruction of blood corpuscles, thus leading, as described above, to the enlargement of the organ. This rapid absorption of water of the food by disintegrating and so getting rid of the old and useless blood corpuscles prepares the blood for the pouring into it some hours later of the other constituents of the food *via* the longer route of the intestinal lacteals and thoracic duct.

Another point which supports this view of the cause of enlargement of the spleen is that whatever other medicines, &c., we may also employ, a free use of hydragogue purgatives is indispensable for the reduction of the organ to its normal size. Is not this an indication that in the first instance its enlargement is due to increase of water in the blood?

The spleen is enlarged in ague, then, because in this disease there is increased destruction of red blood corpuscles, the disposal of which in ague, as in health, is the normal function of the organ, and the increased destruction of corpuscles is produced by increase of water in the blood.

X.—THE MEASURES FOUND MOST USEFUL IN THE PREVENTION AND TREATMENT OF AGUE REDUCE CONSIDERABLY THE AMOUNT OF WATER IN THE BLOOD.

Prevention.—Drainage of the soil in paludal districts undoubtedly eradicates or at least considerably reduces the prevalence of ague. The most obvious effect of drainage is, however, that it dries the soil and therefore the superincumbent atmosphere. Drainage removes or at least reduces one factor (atmospheric humidity) of the environment that produces increase of water in the blood. In

well-built, well-raised houses the humidity of the air is less than in the open, and those occupying such houses are therefore less likely to contract the fevers to which I am referring than those who are liable to exposure at night. The same may also be said of residence in huts, tents, or even within mosquito curtains.

Treatment.—All effective treatment of ague reduces the amount of water in the blood. Diaphoretics, diuretics, and purgatives certainly do so. And it is to this that I attribute the curative and, indeed, preventive action of quinine. When ague becomes chronic a course of Turkish or *dry*-air baths is most beneficial; and what so obviously reduces the amount of water in the blood? Removal from the influence of the meteorological environment that produces increase of water in the blood usually cures ague.

XI.—SUMMARY.

What I have written above may be shortly summarised as follows: 1. Cases of fever, clinically identical with malaria, occur in the blood of which parasites could not be found after repeated search before quinine had been given. 2. The meteorological environment found where such cases occur, and indeed in all malarial climates, increases the amount of water in the blood of those exposed to its influence by impeding elimination through the skin and lungs (evaporation—heat loss) and through the kidneys. 3. There is known to be increase of water in the blood of those suffering from ague (Liebermeister). 4. Increase of water in the blood increases metabolism—i.e., heat production—and produces a rise of body temperature (Payne). 5. As environment thus causes diminished heat loss from the body and increased heat production within the body it is plain that it causes pyrexia. 6. This pyrexia must be of intermittent variety as the environment which produces it is of intermittent intensity—i.e., undergoes diurnal variation. 7. Elimination of water from the blood (sweat) in ague reduces the temperature to normal. 8. Increase of water in the blood produces poikilocytosis, pseudo-parasites, liberation of hæmoglobin, extensive destruction of red blood corpuscles, and melanæmia. 9. An extreme degree of these changes obviously leads to hæmoglobinuria. 10. Increase of water in the blood produces enlargement of the spleen. 11. Removal from the environment that produces increase of water in the blood usually cures ague. 12. All treatment of ague which is efficacious reduces the amount of water in the blood. 13. From these facts I think it is not unreasonable to conclude that those cases of ague or intermittent fever in which no parasites can be found are demonstrably due to the environment under which they arise.

If my view is correct it is only one more illustration of the truth of the old saying that pathology in many instances seems to be but physiology in distress.

RESULTS IN HAVANA DURING THE YEAR 1901 OF DISINFECTION FOR YELLOW FEVER,

UNDER THE HYPOTHESIS THAT THE STEGOMYIA MOSQUITO IS THE ONLY MEANS OF TRANSMITTING THE DISEASE.¹

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In order clearly to show the results of our work in Havana it may be well to go over the ground and to point out what the conditions were before we commenced work, and to look into some general considerations with regard to the habitat of yellow fever. When we attribute the results of the work here to our methods of destroying infected mosquitoes it has been objected that yellow fever has disappeared from many other cities under other methods of disinfection and when no particular effort was made to stamp out the disease; and instances are cited of cities of the United States, such as Boston, Philadelphia, New York, and New Orleans, and some of the smaller towns in the West Indies, Mexico, and South America.

Havana is unique in being the only city in the Western

¹ A paper read before the International Sanitary Congress held at Havana, Cuba, on Feb. 15th, 1902.

Continent where yellow fever has really always been endemic during historic times, and when we come to look into the matter the reasons are obvious. In any community where frost occurs yellow fever will always disappear during the winter. Even in our Southern ports, such as New Orleans, Mobile, and Pensacola, yellow fever habitually disappears at that period. Incidents might be adduced of its persisting through the winter, but such instances are rare. The natural tendency of these cities would be to free themselves of yellow fever if re-introduction from the outside is prevented. In the smaller towns within the tropics, those having a non-immune population of, say, 50, the same tendency is observed from other causes. While yellow fever would not die out from climatic conditions, in the course of a year or two these few non-immunes would disappear as non-immunes either from death or by becoming immune from having had yellow fever, and the tendency would be for this disease to disappear and to re-appear when the population had again become non-immune to a considerable extent. This is really the history of the disease as observed. Of course, the larger the non-immune population in the tropics the longer the epidemic period lasts, sometimes many years. Even cities of the size of Vera Cruz and Santiago de Cuba are not truly endemic foci in the same sense that Havana is. Looking back over the history of these cities many years at a time can be found in which there was no yellow fever, and if introduction from the outside could have been prevented they would have freed themselves from yellow fever from the above causes. In Havana the conditions have been different: it is the principal port of entry for Cuba and there has been a considerable influx of non-immune Spaniards—from 4000 to 30,000 annually. Theoretically, from the existing conditions we would expect that yellow fever would be endemic in Havana, and as a matter of fact as far back as the records go from which any at all reliable history of the statistics of the city can be obtained a month has never passed until the American occupation without a death from yellow fever. And there has probably in all this time never been a day on which there was not a case of this disease in Havana. This is the only city in the world of which that can be said. Probably Rio de Janeiro can in future be placed in the same category. Its large population, large immigration, and latitude would seem to make the conditions very similar to those of Havana.

I go over this ground to show that the causes which have made yellow fever disappear from other cities in all latitudes of the Western Hemisphere cannot occur in Havana. The statistics of yellow fever for Havana, as far back as we have official record, are given in the appended table and show the deaths from this disease month by month.

When we commenced work in Havana the island had been suffering for five years from an exhausting civil war and during the few months preceding the city had undergone a blockade by the American fleet. The hygienic conditions of the city were therefore at that time considerably worse than they were in normal times. But the non-immune population was small; immigration had dwindled during the war and had practically stopped for the year preceding. We went to work on the usual sanitary lines with our efforts directed more particularly toward yellow fever. I will not attempt any description of the general sanitary work but will enumerate the methods adopted towards yellow fever.

Up to July of the first year of American occupation there was little yellow fever in the city. Then immigrants began to pour in and some 16,000 reached Havana between July and Dec. 31st in the year 1899. From July to Dec. 31st we had quite an epidemic of yellow fever, and the December of 1899 was the severest December as regards yellow fever that had occurred for years. In February, 1900, I was appointed the Chief Sanitary Officer of Havana and I know from personal observation that from that time the regulations with regard to yellow fever were carefully carried out.

The reporting of yellow fever was compulsory. Upon the report of a case it was promptly isolated and quarantined by guards employed by the Sanitary Department. No communication whatever was allowed within the quarantined area except that of the visiting physicians and the sanitary inspector. All supplies had to pass through the sanitary guard. The isolation was as complete as military authority and liberal expenditure could make it. The case was then referred to a board of experienced physicians who visited the patient and made the diagnosis. If the case terminated in death the body was buried with the usual sanitary precaution adopted in highly dangerous diseases. In all cases the quarantined area was disinfected. First, by carefully wiping down everything with a bichloride solution and then

TABLE SHOWING DEATHS FROM YELLOW FEVER IN THE CITY OF HAVANA.

Years ...	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Months. January ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18	20	32	7	16	24	8	26	11	16	7	9	14	26	4	4	5	8	17	10	10	15	15	7	15	10	69	7	1	8	7
February ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23	13	23	4	16	24	9	13	13	9	3	11	9	16	3	0	6	8	5	4	3	10	6	4	7	24	1	0	9	5	
March...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12	4	27	18	32	29	11	5	6	20	3	14	21	8	1	0	8	14	5	4	4	1	4	2	3	30	2	1	4	1	
April ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	54	4	37	22	34	33	8	28	13	44	6	18	34	32	2	1	22	24	8	13	5	8	8	4	6	14	71	1	2	0	0
May ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	91	13	127	85	32	103	16	53	40	40	6	84	75	55	3	1	84	26	17	23	7	7	23	16	10	27	88	4	0	2	0
June ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	201	68	378	172	142	292	143	184	237	50	37	176	162	66	4	14	128	36	37	38	41	13	69	31	16	46	174	3	1	8	0
July ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	234	68	416	361	187	675	249	504	475	179	90	195	177	131	13	33	102	74	48	67	66	27	118	77	88	116	168	16	2	30	1
August ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	138	70	127	416	144	250	285	374	417	148	127	73	148	97	34	39	73	113	73	60	66	67	100	73	120	262	102	16	13	49	2
September..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	72	59	35	186	102	97	234	179	148	75	94	56	50	41	32	37	36	63	37	33	65	70	68	76	135	166	56	34	18	52	2
October ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	55	38	28	91	109	42	185	106	44	32	39	33	72	24	41	16	33	48	21	32	48	54	46	40	102	240	42	26	25	74	0
November...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	51	85	5	42	105	31	150	53	31	21	38	36	45	8	22	13	20	33	21	15	24	52	28	23	36	244	26	13	18	54	0
December...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	42	73	9	21	82	19	76	34	9	11	35	24	42	7	6	9	15	21	14	9	17	33	11	29	20	147	8	13	22	20	0
Totals ...	1309	2058	1396	1193	439	1020	1386	550	555	238	51	591	290	1000	572	991	515	1244	1425	1001	1619	1374	1559	1444	645	485	729	849	511	165	167	532	468	303	308	356	357	496	382	553	1282	858	136	103	310	18

by filling all rooms with formalin gas, using a litre of the 40 per cent. solution to each 1000 feet of space disinfected. Fabrics of all kinds were taken to the steam disinfecting plant and there disinfected. Under this system we hoped to decrease yellow fever greatly and in the course of a few years to eradicate it from the city.

The general sanitary measures adopted appeared to be rapidly decreasing the general death-rate. The general death-rate in 1898 was 91·03 per 1000, in 1899 it fell to 33·67, and in 1900 continued to decrease to 24·40. But our work apparently had no effect upon yellow fever. The winter epidemic of 1899 continued through the spring and summer, reaching in the fall the proportions of a sharp epidemic, even for Havana. We had during the year 1900 1244 cases of yellow fever, with 310 deaths. All classes suffered, particularly the higher officials on the military governor's staff. The chief quartermaster of the island, the chief commissary for the island, and one of the aides of the military governor died from yellow fever.

The Sanitary Department was much discouraged at the result of the work. It seemed to me that general sanitary measures could not be more extensively carried out than we had done during this year. We had all the power of the military authority behind us and ample means. During this year, on the internal sanitation of houses, exclusive of street-cleaning, disposal of garbage, &c., we spent about \$25,000 per month and employed some 300 men daily. The general sanitary conditions were improving in the most satisfactory manner but we evidently had not produced the slightest effect upon yellow fever. We commenced 1901 much discouraged, with the most unfavourable outlook as far as yellow fever was concerned. The non-immune population was larger probably than it had ever been before. 26,000 immigrants had come into Havana during the year 1900. Yellow fever was in every part of the city. The deaths from yellow fever in January and February were large and the probabilities all pointed to our having a more severe epidemic in 1901 than in 1900.

The results of the investigations by the Army Board of the theory that the *stegomyia* mosquito was the only carrier of yellow fever, first advanced by Dr. Charles Finlay, were published about this time. This work was so brilliant in its execution and so positive in its results that, as I look back now, I am surprised that I was not at once convinced. But many years of contact with men engaged in the practical work of managing yellow fever and my own personal experience with this disease had so impressed me with the belief that fomites were the principal, and practically the only, carrier of the disease that I had scant belief in the mosquito theory. But General Wood was determined that every possible measure should be taken for the reduction of the disease and he authorised me to go to any reasonable expense in providing for the destruction of mosquitoes, which I then considered only a possible and exceptional means of transmitting yellow fever. But having undertaken it the department bent every energy to carrying it out thoroughly, and as I look back I have the satisfaction of believing that we could not have carried it out more thoroughly even if we had known that the results would be what they have been.

In looking over the ground beforehand we concluded that for practical operations three fields of work had to be considered. In the first place, to destroy all the *stegomyia* we could, so as to limit the number of insects capable of conveying the disease. For it seems obvious that if we had no *stegomyia* we would have no yellow fever. In the second place, to prevent the *stegomyia* from biting the yellow fever patient; because, if we could prevent the mosquito from becoming diseased we would also prevent yellow fever. And in the third place, to destroy all mosquitoes that had bitten yellow fever patients and thus become infected; because if these are destroyed it is evident that the disease would be stopped.

With the object of reducing the number of mosquitoes an ordinance was issued requiring all people within the city limits to keep receptacles containing water mosquito proof. The city was divided up into districts and an inspector was appointed for each district who kept up a constant inspection, with the view of enforcing these ordinances. He was accompanied by men with oil-cans to pour oil into all puddles, cess-pools, &c., about the dwellings, and after sufficient notice had been given all receptacles in which larvæ were found were destroyed. All persons having larvæ on their premises were fined under the municipal ordinances.

50 men were employed in this work. 100 men during most of the summer were employed under proper superintendence in the suburbs, draining all pools and low ground and pouring oil into such places as could not be drained—that is, during most of the past summer 150 men devoted their attention to killing mosquitoes in the larval stage.

To meet the second proposition—that is, to keep the *stegomyia* from biting the infected man—all hospitals where yellow fever was received were ordered to be thoroughly screened, and this was at first enforced. In cases of yellow fever occurring in private houses the sanitary department screened them at public expense. Ordinarily, within two hours after the report of a case of yellow fever the quarantined area was thoroughly screened. We kept a sufficient number of ready-made screens on hand for the purpose and 30 men were employed in this work.

To meet the third proposition—that is, killing the infected mosquitoes—the infected building and all adjacent buildings were gone over from top to bottom with pyrethrum powder; 150 pounds, on the average, were used in each case. This work was done in addition to the disinfection as carried out the preceding year. While pyrethrum powder is not as good a mosquitocide as some other substances it is the least objectionable to the people whose dwellings are being fumigated. It causes no injury to fabrics and within four or five hours the room can be again occupied without discomfort. It, however, does not kill all mosquitoes. A good many of them are simply intoxicated and will revive if exposed to fresh air. For this reason the mosquitoes have to be carefully swept up and destroyed. The houses contiguous to the infected house were gone over in the same way on the possibility of infected mosquitoes having escaped to neighbouring houses. Every room was carefully sealed and pasted just as we had done in using formalin. In this work some 40 men were employed during the summer. We used a pound of pyrethrum powder to each 1000 cubic feet of air space.

In January, 1901, we had 24 cases of fever with seven deaths—a large number for that month; in February there were eight cases and five deaths.

The mosquito work was inaugurated on Feb. 27th. We went through March with only two cases, which occurred on the 2nd and 8th. I was much pleased with this but not particularly impressed, knowing that it might be a coincidence. We then went to April 20th without another case. This was unexpected, particularly as the year had commenced so badly and as there was plenty of non-immune material around. The table will show that this condition of affairs had never been approximated before in Havana. On April 21st and 22nd there were two more cases, but under our system of disinfection the disease did not spread. I began to feel pretty certain by this time that the results were due to our mosquito work. On May 6th and 7th we had four more cases, but this focus was promptly controlled. We then went through the whole month of June up to July 21st before we had another case.

It was exceedingly important to have all cases reported so as not to let a focus get started and spread. A great element in the reporting of cases was to have as little opposition as possible on the part of the people. The fumigation for the mosquito caused very little inconvenience compared with the disinfection of fomites and after much discussion and deliberation with the officers in charge of the disinfecting work I determined, the latter part of June, to do away with all sanitary measures against yellow fever, except those directed towards the mosquito, as the only means of the transmission of the disease.

These measures went into effect on July 1st and after that time nothing was sent to the disinfecting plant in yellow fever cases and at the infected point only measures looking to the destruction of mosquitoes were taken. The guard was still kept at the infected house, but the physician was allowed to specify a reasonable number of immunes who might go to and from the quarantined area. The guard was directed to see that the screen doors were kept closed and that the ordinary sick-room hygiene was carried out.

About the middle of June a pronounced focus of yellow fever developed in Santiago de las Vegas, a town about 12 miles from Havana. The successful management of this focus was another evidence of the efficacy of the methods adopted in Havana, but the length of this paper does not allow me to go into details of these cases. Santiago de las Vegas is a town of 5000 inhabitants, with a non-immune population of 475. It is really a suburb of Havana and

considerable numbers of people come and go every day. Besides Santiago de las Vegas there were three or four other towns with direct communication that were having yellow fever about this time. We discovered nine cases that came into the city of Havana from Santiago de las Vegas during June, July, and August. As Havana had been entirely free from yellow fever during June I am inclined to think that Santiago de las Vegas was the point from which we became reinfected. During July we had four cases in Havana, with one death; during August we had six cases with two deaths. Becoming satisfied that we were being reinfected from outside towns I obtained authority from the Military Governor to place inspectors on all railroads coming into Havana from infected points. These took the names of all the non-immunes coming into the city and kept them under observation for a week. This worked very well in practice. All the cases known to have come into the city were reported by these inspectors.

As the infection was severe in Santiago de las Vegas an appropriation of \$4000 was made for the purpose. We adopted the same methods there as in Havana and at once controlled the disease. The last case occurred in Santiago de las Vegas on August 31st. A case from this point was reported on Oct. 14th, but I, personally, do not think it was a case of yellow fever. It was an exceedingly mild and doubtful case, though diagnosed as yellow fever by the board. On Sept. 28th we had our last case in Havana. During October, December, and January we had none.

The whole year has been very unusual in its yellow fever conditions and is far below any preceding year of which we have record in the number of cases which have occurred. October and November have always been months when yellow fever was rife in Havana, and to have had none at all in these months in 1901 is remarkable. During 1900 the general death-rate had been greatly lowered by the sanitary work done, but yellow fever had not been much affected and we had a sharp epidemic. In 1901 all the conditions were unchanged, except that work for the destruction of mosquitoes was carried out, with the result that yellow fever at once almost disappeared and really did disappear in the last three months of the year.

I submit that this is evidence of the practical demonstration of the mosquito theory.

Havana.

CASE OF RIGHT AORTIC ARCH WITH ABNORMAL DISPOSITION OF THE LEFT INNOMINATE VEIN AND THORACIC DUCT.

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Few parts of the human body are subject to such interesting abnormalities as are the pulmonary artery, the aorta, and its branches, and since the researches of Rathke, Allen Thomson, and others it has been possible to account for and to classify the vast majority of these abnormalities on embryological grounds. It will be remembered that in the early foetus the dorsal aorta is formed by the junction of the fourth arches on the right and left sides, and that a great portion of the fourth right arch afterwards disappears, the remnant forming the right subclavian artery, while the fourth left arch becomes the arch of the aorta. The fifth right arch also disappears, whilst the fifth left arch is represented in the adult by the pulmonary artery and by the ductus arteriosus connecting that artery with the aorta. The causes of variation from the normal are obscure, but it is a natural supposition that when inflammation or obstruction affects those vessels which should normally persist and causes them to atrophy compensation will be brought about by an increase in the size of the corresponding vessel on the opposite side. A certain degree of inherent instability in the development of the foetal vessels must also be considered as existing apart from pathological causes.

The subject of the present irregularity was an adult male. The position of the heart was quite normal and there were no irregularities of its valves, septa, arteries, or veins. The ascending aorta, which was somewhat large, arose from the base of the left ventricle and took a course upwards and to the right, passing behind the sternum, crossing the trachea

until it reached the level of the second dorsal vertebra on the right side. It here bent acutely backwards on itself, thus coming in contact with the right side of the third dorsal vertebra. The vessel was now directed gradually towards the middle line, but when it reached the level of the upper border of the seventh dorsal vertebra it described a gentle curve with the convexity towards the right side, till it reached the middle line between the twelfth dorsal and first lumbar vertebrae. It will thus be observed that the vessel in its course arched over the root of the right lung. The main arterial trunks were given off in the following order:—(1) left common carotid; (2) right common carotid; (3) right subclavian; and (4) left subclavian. It will be observed that the innominate artery was absent. The left common carotid was somewhat larger than usual and measured 14 centimetres from its origin to its bifurcation. The right common carotid measured 11 centimetres. These vessels pursued a normal course, as did also the right subclavian artery. The

FIG. 1.

FIG. 2.

FIG. 1.—Diagram of case recorded. A, Left common carotid. B, Left innominate vein. C, Left subclavian artery. D, Left vagus nerve with recurrent laryngeal. E, Ductus arteriosus. F, Pulmonary artery. G, Right common carotid. H, Right subclavian artery. I, Right vagus nerve with recurrent laryngeal. J, Right innominate vein. K, Vena azygos major.

FIG. 2.—Diagram from Quain showing the mode of development of the great arteries in the present case. 1, 2, 3, 4, 5, The primitive vascular arches. A, Internal carotid. B, Vagus nerve. C, Common carotid. D, Recurrent laryngeal nerve. E, Vertebral artery. F, Subclavian artery. G, Ductus arteriosus. H, Descending aorta. I, Pulmonary trunk. J, Ascending aorta. K, External carotid.

left subclavian presented some points, however, which are of much interest; as noted above it was the last of these vessels arising from the aorta. Its origin was from a pouch-like process projecting from the left side of the descending aorta. This pouch measured one and a half centimetres in length and equalled a normal common iliac in diameter. It ran to the left side at right angles to the aorta, having the third dorsal vertebra behind it, while the posterior surface of the oesophagus rested on its anterior wall. This pouch presented several undulations on its posterior and under wall. At the point where the subclavian took its origin from this pouch the ductus arteriosus, which was very well marked and of large size, joined the pouch, thus connecting it with the left pulmonary artery. The ductus arteriosus measured four centimetres in length. It was quite impervious and lay to the left of the oesophagus. The pulmonary arteries were normal both in their relations and distribution. The subclavian after arising from the pouch ascended to gain the inner margin of the scalenus anticus. There were two left bronchial arteries arising from the dorsal aorta, the left (upper) arising by almost a common origin with the fourth left intercostal artery. There was one right bronchial artery which also arose from the front part of the descending aorta. The left innominate vein was of large size and began behind the inner part of the clavicle. In its descent it passed forwards and inwards and came to lie immediately in front of the origin of the left subclavian artery from the