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PROGNOSIS OF
VALVULAR DISEASE
OF THE HEART

BY DR. JOHN H. HARRIS, M.D.

OF THE UNIVERSITY OF CHICAGO

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ON THE PROGNOSIS

IN CASES OF

VALVULAR DISEASE OF THE
HEART.

BY

THOMAS B. PEACOCK, M.D., F.R.C.P.,

HON. CONSULTING PHYSICIAN TO ST. THOMAS'S HOSPITAL.

*Being a Revised Reprint of a paper in the 'St. Thomas's Hospital
Reports,' Vol. II, 1871.*



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ON THE PROGNOSIS
IN
VALVULAR DISEASE OF THE HEART.*

FEW, if any, practical physicians will deny that, though the result in cases of valvular disease is ultimately unfavorable, the duration of life in the particular affections varies considerably, and that the process by which the fatal event is generally brought about also differs in the various forms. Notwithstanding this, it is remarkable how little information in reference to prognosis is to be found in systematic works. Corvisart does not attempt to distinguish the relative danger in the different forms of disease of the heart further than as applying to the acute, chronic, and organic affections; and the very imperfect means then available for detecting the various diseases during life sufficiently explains the mode in which he deals with the subject. Laennec, though he added greatly to our knowledge of the nature of valvular affections and the means of detecting them, has scarcely alluded to their relative danger; and the information in reference to prognosis in the works of Hope and Bouillaud is very scanty. Dr. Stokes makes many valuable remarks in illustration of the subject, and

* The remarks contained in this paper have formed the subject of observations made at different times to the pupils in the wards.

especially controverts the opinion generally entertained as to the great liability to sudden death in all forms of valvular disease, and shows that the final result in these affections depends more upon the condition of the muscular walls of the heart than on the disease itself. The only author, however, who, so far as I know, enters fully into the consideration of the prognosis in cardiac affections is Dr. Walshe, though other recent writers have alluded more or less at length to the subject.

The question of the viability of persons suffering under different forms of valvular disease cannot be decided by numerical calculations. It is often very difficult to ascertain the precise duration of any given case; first, because the date which is usually assigned by the patient for the commencement of his illness, is rather that at which the symptoms become so serious as to interfere with his ordinary occupations and occasion distress, than the true period of commencement; and, secondly, because some forms of disease are rarely primary affections, but usually succeed to other changes of a different description, and the time at which the alteration occurs cannot be precisely ascertained from the general symptoms. Were the patients under observation for the whole period of illness, these difficulties would be lessened, but, in London at least, whether in public or private consulting practice, such is rarely the case; and the physician has to draw his own conclusions from the history which he obtains, after perhaps a considerable period has elapsed since the commencement of the disease.

In order to ascertain the precise prognosis in the different forms of valvular disease, it is necessary to consider the modes in which these affections tend to terminate in death, and then to apply such information to the affections

of the different sets of valves, and to the various kinds of defect of which they may be the seat.

The sources of danger in cases of valvular disease may be classed under the following heads :

1st. Failure of muscular power in the heart. This may result from gradually advancing disease, from atrophy and disorganization of the muscular structure, or from impairment of the general strength ; in consequence of which the cavities behind the sources of obstruction become dilated, and the walls thinner and looser in their texture or the seat of interstitial change. They are thus no longer capable of contracting with sufficient power to propel the blood through the smaller vessels and capillaries, and there is liability to sudden cessation of action and to death by syncope.

2nd. Congestion of the organs behind the seat of obstruction. This condition is a necessary result of the former, if continued for a sufficient period. The congestion may be specially marked in the heart itself, giving rise to changes of structure and to effusion into the cavity of the pericardium ; in the lungs, exposing the patient to attacks of bronchitis and to œdema and hæmorrhage, and to effusion into the cavities of the pleura. The liver may be affected, producing engorgement first of the hepatic vessels and subsequently of the portal system ; the kidneys, shown by the presence of albumen or blood or of inflammatory products in the urine ; and the brain, indicated by cerebral symptoms ; or lastly, the system at large may be involved, producing dropsical effusions. Of these conditions the most frequent are affections of the lungs and the special tendency is to death by apnœa ; but the coincident affections of the other organs and the condition of the blood so resulting, modify in various ways the result.

3rd. **Thrombosis and embolism.** Thrombosis may occur either from inflammation of the lining membrane of the heart and arteries, or from the deposit of the fibrine of the blood about the valves and orifices or in the smaller vessels, so as to occasion obstruction; and embolism may result from the material exuded or deposited being separated and conveyed by the circulation into the smaller arteries and capillaries, so as to cause their occlusion. In this way the vessels of the brain may become embolic, giving rise to softening or hæmorrhage; or those of the lungs, and the patient may die asphyxiated; or secondary deposits may occur in the liver, spleen, or kidneys, or in the vessels of the extremities.

The sources of danger mentioned are respectively more prone to occur in some forms of valvular affection than in others, and they may be variously combined and may ensue at different times in the course of the same case. In estimating the risk from these causes, the different forms of disease must be considered separately.

AORTIC VALVULAR DISEASE.

1st. *Obstructive disease of the aortic valves.*—This affection, like the other kinds of valvular disease, may be either acute or chronic. In the acute form, it is the result of endocarditis occurring in the course of rheumatic fever or of some other febrile or inflammatory affection, and, more rarely, in connection with renal disease or in persons exhausted by want and destitution or by dissipated habits. The valves become thickened and the lining membrane studded with fibrinous deposits, which, together, diminish the capacity of the affected orifice, sometimes to such an extent as to produce serious impediment to the passage of

the blood. The vegetations are liable also to be separated and to produce embolism, or thrombosis may occur in distant parts of the system from the peculiar tendency of the blood to coagulate.

As a chronic affection, obstructive disease may ensue upon the acute or it may occur independently. It may be the result of slow changes, of a gouty or rheumatic character, and not unfrequently originates in atheromatous or fatty degeneration. The valves become thickened, and their edges and sides adherent to a greater or less extent, so as to give rise to extreme obstruction. This condition attains the most aggravated degree in cases of congenital malformation of the valves. In some instances there are only two segments, one of which is evidently formed by the blending or imperfect separation of two others; or all the three curtains may be united and the very greatest amount of obstruction be occasioned. I have found the aperture, instead of possessing as it should, an average capacity in men of 35·6 Paris lines (80·1 mm., 3·14 E. in.), and in women 34 (76·5 mm., 3·01 E. in.) to have only a circumference of 24 (54 mm., 2·13 E. in.) or even of 18 lines (40·5 mm., 1·59 E. in.), the valves being at the same time very greatly thickened and indurated. In one case, indeed, the aperture was only a mere slit, ten lines (22·5 mm., ·88 E. in.) in length, and the valves were so extremely thickened and indurated as to be scarcely capable of separation. This constriction might be supposed to be in all cases an impediment to the passage of the blood and therefore to be productive of more or less serious symptoms, and it would be so were it not that, in compensation for the increasing obstruction, the walls of the heart, especially of

* The following tables of the weights and dimensions of the healthy heart, quoted from the fourth volume of 'Reynolds' System of Medicine,'

the left ventricle, become hypertrophied, so that the power may remain equal to the resistance; and so in the slighter forms of obstruction no obvious symptoms may be produced, and even in the more extreme they may be very slight. Thus, it must have occurred to every one actively engaged in practice to have been consulted about patients,

may be referred to for comparison as to the weights and dimensions of the diseased heart given in this paper.

TABLE I.—*Average weight of the healthy heart in males and females, and in acute and chronic diseases, from twenty to fifty-five years of age.*

MALES—		
Mean weight		9 oz. 8 drs.
Ordinary range in acute cases		9 oz. to 11 oz.
" " chronic cases		8 oz. to 10 oz.
FEMALES—		
Mean weight		8 oz. 13 drs.
Ordinary range in acute cases		8 oz. to 10 oz.
" " chronic cases		7 oz. to 9 oz.

TABLE II.—*Dimensions* of the healthy heart (in French lines, millimètres, and English inches) in males and females.*

	MALES.			FEMALES.		
	Lines.	Milli- mètres.	Inches.	Lines.	Milli- mètres.	Inches.
Circumference of heart	103·7	233·32	9·209	104	234	9·236
Girth of right ventricle	55·4	123·85	4·919	58·4	131·4	5·184
" left	48·3	108·67	4·289	45·6	102·6	4·049
Length of cavity of right ventricle	43·3	96·42	3·821	44·3	99·67	3·925
" left	37·6	84·6	3·333	37·1	83·47	3·197
Thickness of walls of right ventricle, base	1·85	4·16	·164	1·85	4·16	·164
" " " " midpoint	1·98	4·35	·176	2·0	4·5	·177
" " " " apex	1·42	3·19	·125	1·3	2·92	·118
" " left	5·15	11·58	·425	4·9	11·02	·432
" " " " midpoint	6	13·5	·532	5·6	12·6	·497
" " " " apex	2·4	5·4	·214	2·5	5·62	·222
Thickness of septum	5·73	12·89	·51	4·7	10·57	·421
Circumference of right auriculo-ventricular aperture	53·4	120·15	4·74	51·4	115·65	4·562
" left	45·2	101·7	4	45	101·25	3·996
" pulmonic aperture	40	90	3·552	39·3	88·42	3·493
" aortic	35·6	80·1	3·146	34	76·5	3·019

* The dimensions of the orifices are taken by balls, the first of which is 12 lines in circumference, which increase in circumference three Paris lines, and are numbered from 1 to 20.

who when under treatment for some slight ailment, have been found by the medical attendant to have a loud basic murmur, and yet, on the most careful inquiry, no cause can be detected for its presence; while other evidences of the impediment may be very trivial or altogether absent. I know, indeed, and have heard of many persons who have for years had loud obstructive murmurs without presenting any other serious symptoms. So also patients occasionally come under notice labouring under aggravated symptoms of cardiac disease which have been only of short duration and soon prove fatal, and, after death, extreme aortic valvular obstruction, which must obviously have been of very long duration, if not congenital, is detected. In the Croonian Lectures* I have given the particulars of several cases of this kind, of which the following case is one.

A gentleman, æt. 40, who resided at Plaistow, was first seen by me on the 3rd of July, 1857, and then stated that he had been ill three weeks. He ascribed his indisposition to having taken cold from leaving off a flannel waistcoat during the very warm weather. He first suffered from what was supposed to be a bilious affection, and had two aguish attacks; one about a fortnight before he was seen, the other on the previous day. He had a peculiarly sallow, malarious aspect, and his pulse was quick and feeble. He had a somewhat tumid face and œdema of the ankles, with difficulty of breathing, increased on slight exertion, and palpitation of the heart. On examining the chest the resonance on percussion was found considerably impaired at the lower part of the left side, both before and behind, and in the dull space the respiratory sounds were

* "On some of the Causes and Effects of Valvular Disease of the Heart," being the Croonian Lectures delivered before the Royal College of Physicians for 1865, p. 17.

abolished. The præcordial dulness was found to extend much beyond its natural limits, and a loud systolic murmur was audible over the whole cardiac region, and especially at the base.

He was seen again on the 5th, in consultation with the late Mr. Beale, and was then much worse; the dyspnœa was so extreme that he could not lie down in bed, and the dropsical symptoms were increased; the lower extremities were very œdematous, the abdomen tumid, and the face swollen; the pulse was regular, but powerless and quick; and the dulness on percussion in the chest, and especially on the left side, was much extended, and there was subcrepitant rhonchus heard on both sides in the dorsal regions. From this time, he rapidly got worse, the anasarca increased, the dyspnœa became still more urgent, and he died suddenly on the 8th, after having got out of bed, having been quite sensible to the last.

The following notes of the *post-mortem* appearances were obligingly furnished by Messrs. Beale and Williams, of Plaistow, under whose care the patient had been.

“The body was examined thirty-six hours after death. On removing the sternum, the pleural cavities on each side of the chest were found to contain a large quantity of fluid, probably two quarts. The lungs were healthy, and without any adhesions. The pericardium was full of fluid, and the heart very much enlarged, occupying a considerable portion of the cavity of the chest, and was depressed below its usual situation by the fluid in the left pleural cavity. On cutting into the substance of the heart, the walls of the auricles and ventricles were much hypertrophied, particularly those of the left ventricle. The ventricles were both filled with coagula, and the external surface of the heart exhibited appearances of

recent inflammation. The valves of the pulmonary, and those of the left auriculo-ventricular aperture were not diseased. The ascending aorta was much enlarged, and on dividing it below the arch and passing the finger to its mouth, a hard, stony-like substance was felt, which on examination proved to be a deposit of bony matter occupying the sides of the vessels, and covering the aortic valves. The liver was large and rather pale, the spleen large, and, together with the kidneys, congested. The rest of the abdomen was free from disease."

The appearance of the aortic valvular apparatus is well shown in the accompanying figure. The three



Diseased aortic valves seen from above.

segments are entirely blended together, so as to form what has been termed a diaphragm, extending across the orifice of the artery, but having a triangular aperture in the centre, of about four lines wide, in each direction. The remains of the valves are very greatly thickened, indurated, and ossified, so that there must have been not only great obstruction to the flow of blood from the ventricle into the aorta, but also regurgitation from the artery into that cavity.

On first seeing this case, I stated, that I had much difficulty in forming a satisfactory diagnosis. The

patient had never had any of the usual predisponents to disease of the heart, and stated that he had been in good health till three weeks before. The district in which he resided, the aguish attack which he had had, and his peculiar appearance, indicated that he was labouring under the influence of malaria; and, in the absence of any symptoms of recent cardiac affection, it was thought most probable that he had for long suffered from some latent valvular disease; which, though slowly making progress, had been unproductive of any symptoms, till his powers became prostrated by the aguish attacks. A suspicion was, therefore, expressed that the disease might be dependent on some congenital defect of the aortic valves. This opinion proved, it will be seen, to be probably correct;—at least there can be no doubt of the very old date of the aortic valvular disease, and that it must have originated in early life, if, as seems most probable, it were not congenital.

Mr. Beale, who had known the patient during all his life, wrote:—"I attended him when a child, and he had then very delicate health, and a feeble circulation; and, if I remember rightly, he had one or two attacks of purpura. On his attaining nineteen or twenty years of age, his constitution became more robust, and it is remarkable that since that period, he has had good health, and has not complained of any disease." I was also informed by members of the patient's family, that he was of remarkably active habits, and so quick a walker, that few could keep up with him, and that he was never observed to be subject to difficulty of breathing on exertion. He was, however, of somewhat irregular habits, and had had considerable anxiety of mind shortly before his illness.

This case is one of great interest; first, as show-

ing in a more marked degree than, perhaps, any other which has fallen under my notice, how large an amount of valvular disease may exist during a long period, without giving rise to any symptoms to indicate its presence; and secondly, how suddenly those symptoms may be developed, under the influence of any cause which prostrates the general power, and so renders the heart, no longer capable of overcoming the long existing obstruction. The hypertrophy of the left ventricle in the case, was very marked. Mr. Williams, who, while at the London Hospital, had great experience in post-mortem examinations, stated that he had never seen so large and thick a left ventricle.

Since the first publication of this case I have met with another scarcely less remarkable.

W. J. M—, æt. 23, engaged at a steam saw-mill, was admitted as an out-patient of the Victoria Park Hospital, on the 26th of February, 1868, labouring under symptoms of cardiac disease. He stated that when twelve years old, he fell into the hold of a ship, and was insensible for five or six hours after the accident, and that he cut his head. He was laid by for three weeks, and then entirely recovered. Two years before his death he had another fall and very narrowly escaped coming in contact with the steam-saws, and this, though he was not injured, much alarmed him. Up to the middle of the summer of 1867, he was in good health; and he then, without any obvious cause, began to suffer from palpitation and shortness of breath, and on applying to be admitted as a member of the "Foresters," was declined, on the ground of having "something wrong with his heart." He was not, however, prevented from regularly continuing his work, and on Christmas-day he got married. Two or three days after he was suddenly taken

one evening with a severe fit of coughing, which was followed by profuse spitting or vomiting of blood, and he was away from work about a week. After that, however, he continued to follow his employment regularly till six days before his death, when his difficulty of breathing became great; he had pain at the sternum and lower part of the abdomen, was troubled with sickness and vomiting, became greatly exhausted, and could not sleep at night. The day before his death his feet began to swell. He came to the Victoria Park Hospital on the 26th of February, and was then very faint and pale; a loud double murmur was heard at the base, and he was evidently labouring under obstructive and regurgitant disease of the aortic valves, but as it was decided to treat him in the hospital, he was not fully examined. He returned home, having ridden both ways in a cab, and after his arrival he seemed as well as he had been for the last few days. In the evening he went out to the water-closet, and was found dead shortly after, having fallen off the seat, and having died apparently instantly. His mother was a healthy woman, 43 years of age, but his father had died suddenly at about the age of 40. His brothers and sisters, six in number, were living, and except a sister, who was said to have some affection of the heart, were healthy. He had never had rheumatism or any other serious disease; and his friends were not able to assign any cause for his illness, unless that in his occupation he had to press with his chest against the pieces of timber that were being sawn.

The body was examined the day after death by Mr. Power, the resident medical officer of the Victoria Park Hospital. It was found to be stout and well nourished. The pleural cavities each contained considerable quantity of serum; the pericardium also contained fluid, and some

was found in the peritoneal sac. The lungs were œdematous; the liver, spleen, and kidneys were congested, but not otherwise diseased. The heart was of very large size, and had the peculiar pointed form met with in cases of aortic valvular disease; it weighed twenty-four ounces, avoirdupois. All the cavities were enlarged, and their walls, especially those of the ventricles, increased in thickness; the hypertrophy and dilatation being very great in the left ventricle. The aortic valves were very greatly diseased, being blended together, and protruded forwards into the vessel, so as to make a funnel-shaped aperture, so small as only to admit the passage of the point of the little finger. Not only were the valves adherent, but they were also greatly thickened and indurated, being studded with cretaceous deposits, some of which were uncovered by endocardium, so as to be exposed to the current of blood. The valves scarcely admitted of any motion, and by their imperfect adjustment a somewhat triangular-shaped aperture was left, through which a column of water flowed slowly. The ascending aorta and sinuses of Valsalva were somewhat large for the age of the subject, but were not otherwise diseased; the mitral valves and the lining membrane of the left ventricle were somewhat opaque and thick.

The dimensions of the organ were as follows :

	Paris lines.	English inches.
Girth externally of right ventricle	66 = 148·5 m.m. or	5·86
" left "	66 = 145·5 " =	5·86
Thickness of walls of right vent. base	2 = 4·5 " =	·177
" " midpoint .	2½ = 5·6 " =	·22
" " apex	2 = 4·5 " =	·17
" left vent. base	6 = 13·5 " =	·53
Thickness of walls of left vent, midpoint ...	8 = 18· " =	·71
" " apex	5 = 11·25 " =	·44

	Paris lines.	English inches.
Length of cavity of right ventricle	54 = 121·5 mm.	= 4·79
" " left " 	54 = 121·5	" = 4·79
The aortic orifice admitted ball No. 3	18 = 40·5	" = 1·59
Pulmonic " " " " 12	45 = 101·25	" = 3·99
Right auricular ventricular ap. " 15	54 = 121·5	" = 4·79
Left " " " " 17	60 = 135·	" = 5·32

The case is interesting as showing the existence of very extensive disease, which must certainly have been of very long duration, but which had not manifested itself by any serious symptoms till shortly before the fatal event. The precise duration of the disease can, however, only be matter of conjecture. From the peculiar blending of the valves together it is probable that it may have been of congenital origin; though it is possible that it may have been aggravated by some injury to the valvular apparatus at the time the patient sustained the severe fall. The more urgent symptoms might have been excited by the alarm which he felt when he fell two years before his death, and narrowly escaped being injured by the saws.

The case also well illustrates the changes which take place in the heart in cases of great obstructive disease at the aortic orifice. The heart was fully two and a half times its proper weight, and all the cavities were dilated and hypertrophied, but the left ventricle was especially enlarged. The great diminution in the capacity of the aortic orifice may be estimated by the fact that it would only give passage to a ball eighteen lines in circumference, which is half the capacity of the natural orifice. The case bears a close resemblance to the one described by me in the Croonian Lectures, but it is perhaps even more remarkable than that: for in this instance the obstruction was probably quite as great, and the valves as extensively ossified, in a man at the early age of 23, as in

the other case in which the subject of the disease was 40 years of age. The description of the state of the heart in that instance was unfortunately imperfect; as, though it was reported that the organ, more particularly the left ventricle, was hypertrophied, the precise extent of the enlargement as indicated by weight and measurement was not ascertained. There is, however, no doubt that in cases of this kind, in which no serious symptoms are manifested till very shortly before the death of the patient, though the disease must be of very old date, the immunity from suffering is due to the great increase of power in the heart, and especially in the left ventricle, so as to enable it to maintain the circulation.

In the cases referred to in the Croonian Lectures the patients survived to the ages of twenty-three, forty, and forty-five. In a case exhibiting the most extreme degree of obstruction which I have ever seen, the patient died at the age of seventy-five, after the operation for strangulated hernia, and was not known to have presented evidences of cardiac disease.

The alterations in the condition of the left ventricle in such cases explains the absence of serious symptoms. The cavity is generally found large and the walls very thick, the increase of width being most marked near the base, so as to give to the ventricle a peculiarly pointed form. The other parts of the organ partake of the enlargement, so that the increase in the weight is often remarkable; indeed, I have weighed hearts in which there was simple aortic obstruction ranging in men from 14 to 21 oz. in weight, and in women from 13 to 18½ oz. In consequence of the compensation thus afforded the slighter degrees of aortic valvular obstruction are not in themselves of very great importance. The patients, however, generally have a plethoric appearance,

and suffer from sense of fulness in the head, vertigo, or headache, and they are liable to palpitation and become breathless on active exertion; and the condition predisposes to active inflammatory and hæmorrhagic affections and especially of the cerebral organs. It is remarkable how little the radial pulse is sometimes affected by even great degrees of aortic valvular obstruction; but generally it is full and powerful, and often it is slow and there is a tendency to intermit. The condition becomes, however, a serious source of danger when the ventricle is no longer capable of exercising sufficient power to overcome the increasing obstruction; when, from atrophy or interstitial change, the walls lose their full contractile power and the ventricle becomes dilated, or when the muscular power is prostrated from impairment of the general health by some serious malady.

Though, however, the subjects of aortic valvular obstruction may long be free from any serious symptoms, their lives must be regarded as uncertain, and they are specially liable to the occurrence of embolism from the deposit of fibrine about the edges and surfaces of the diseased valves, and to secondary affections resulting from the subsequent displacement of the deposited masses.

2nd. *Incompetency of the aortic valves.*—This condition may originate in various ways. It may be the result of acute disease causing the breaking down or destruction of one or more of the segments, or of the contraction and induration of valves which have been inflamed. The effects of the latter changes differ according to the seat of the original disease. In some cases the thickening and fibrous deposit is chiefly found at the free edges of the segments, along the portions, which, in the healthy condition,

come in contact when the aperture is closed. In other instances the morbid changes occupy the ventricular aspect of the valves, which is exposed under the same conditions. If the defect be in the former situation the edges of the valves do not properly adjust themselves together; if in the latter, the sinus of the valve is shallow; and, in either case, regurgitation may be allowed.

Incompetency may also depend on original malformation of the valves. Where two of the segments are blended together, the united curtain in the line of union may be hard and unyielding, so as not adequately to expand with the progress of growth; or, when all the three segments are united, an open triangular space may remain; and in either case, the blood may return into the ventricle during the diastole.

It may also result from the gradual stretching of the valves, and especially of their angles of attachment, from severe muscular exertion during long periods in persons following laborious occupations, so as to allow one or two of the segments to fall below their proper level; or there may be direct injury of the valves during violent muscular effort,* the angles or some other part of the attachment of the segments giving way or the curtain being torn across.

The aperture may also be imperfectly closed from expansion of the orifice, without any defect in the valves themselves. If the upper portion or the outlet be dilated, as often occurs in cases of dilatation or aneurism of the ascending or transverse portion of the aorta, the segments with the increasing expansion come in contact over a less and less space, till at length they touch only at their edges; retroversion then readily occurs and admits of regurgitation. If the lower portion of the orifice or the inlet be

* For cases of this kind see the 'Croonian Lectures,' p. 34.

enlarged, as in some cases of dilatation of the left ventricle, the sacs of the valves have a tendency to become deepened and to give way at the depending part. Lastly, incompetency may be a more distant result of a very great and old constriction of the orifice, causing the blood, under the influence of the powerful contraction of the ventricle, to burrow below and behind the valves; and so, either by the formation of a small aneurism or a direct canal, to form an opening into one of the sinuses of Valsalva above, and by the same channel to admit of regurgitation from the aorta into the ventricle.*

There can be no doubt that whether it occur as the result of acute or chronic disease, incompetency at the aortic orifice is a most serious defect. When, indeed, the valves break down under acute endocarditis, death generally rapidly ensues, for the ventricle is usually incapable of undertaking the additional labour of maintaining the circulation which is suddenly thrown upon it, but this is not always the case. It sometimes happens that a patient recovers and enjoys a fair share of health for a considerable period. I had a case illustrating this about two years ago at St. Thomas's. The subject of this disease is still alive and able to do some work. In some respects it would appear that mechanical injury to the valves, being a less complicated condition than their destruction in any other way, would be more favorable for the prolongation of life. Yet in these cases the patients do not generally survive for any great length of time. In two instances, which I have myself seen, the patients lived twenty-seven months and four months, and of several other cases which have been placed on record the patients in all but one died

* Cases of this kind by Dr. Bristowe and myself are reported in the 'Pathological Transactions.' See also 'Croonian Lectures,' Case VII, p. 19.

within three years, and in that instance he was still alive at the end of five years. It is only, indeed, by the left ventricle rapidly acquiring great increase of power that life can be maintained, but it is remarkable in how short a time this may sometimes be accomplished. Thus, in the cases which I have referred to the heart weighed $17\frac{3}{4}$ oz. and 23 oz. av., and an equal increase of weight has been attained in some other similar cases which have been published.

In the cases in which the valves become incompetent by a slower process, and especially when the condition ensues upon a previous state of obstruction, the heart has already acquired considerable increase of power, so as to be better able to maintain the circulation in opposition to so serious an impediment. It is in these cases that the heart is found to attain its greatest size and weight. The walls of the left ventricle are not only thick, as in cases of aortic obstruction, but the cavity rapidly becomes enlarged, and the right side of the heart, sooner or later, partakes of the hypertrophy and dilatation. I have myself found the heart in such cases to weigh 34 oz. in males and 23 oz. in females, and Dr. Bristowe has related a still more remarkable case, in which the heart weighed $46\frac{1}{2}$ oz. This great increase may also be attained in a comparatively short time. In a case of my own, in a boy *æt.* 18, in whom the valves, previously malformed, broke down as the result of endocarditis, the heart weighed 28 oz., having apparently acquired this weight in about three years. Notwithstanding, however, the recuperative power thus shown, the great danger is of sudden death by syncope from failure of power in the left ventricle, resulting from the constant strain to which it is subjected in the effort to maintain the circulation. This was the cause of death in the case of Dr. Bristowe, and also in a case of my own of scarcely less

unusual increase of weight where there existed no actual valvular disease. If, however, the patients escape for a time this source of danger, life is seldom much prolonged in cases of aortic incompetency.

When this paper was first published I stated that I could not refer to any instance of the kind in which the patients had lived more than a few months. This statement was, however, not fully warranted by my experience at that time, and I have since seen cases in which life was prolonged for several years, and recently I have had under my care a patient who certainly survived the occurrence of incompetency for five, or probably for seven, years.

The imperfect maintenance of the capillary circulation is very conspicuously shown in the appearance of these patients; they are pallid and anxious-looking, suffer from breathlessness on the slightest exertion, and complain of other symptoms equally indicating the failure of the circulation and especially in the brain, such as faintness and feeling of transient insensibility and vertigo. Though also in cases of regurgitant disease the special danger is of death from syncope, other serious complications may occur, such as embolism, and, provided the patient survive for a sufficient length of time, the lungs may become embarrassed, and symptoms of obstruction at the right side of the heart, and in the system generally, may ensue.

The changes which have taken place in the heart sufficiently explain the peculiar character of the regurgitant or, as it has been termed, "splashing pulse." From the obstruction to the flow of blood into the aorta the walls of the left ventricle become greatly hypertrophied, and the rapidly recurring distension from the incompetency of the valves gives rise to dilatation, and hence, at each beat of

the heart a large column of blood is thrown into the aorta, and the pulse is for a moment large and full; but as the blood rapidly regurgitates into the ventricle, the fulness is but momentary, and is followed by the immediate disappearance of the artery under the finger. For the production of this peculiar pulse the hypertrophy and dilatation of the left ventricle are not less necessary than the incompetency of the valves; and hence it is not characteristically produced in cases of very short duration, in which the changes in the ventricle have not had time to take place, nor in females and young persons, in whom the heart less readily becomes hypertrophied. The peculiar contortion of the smaller arteries, especially seen in the temporal artery, is also doubtless due to the same causes; and it follows from the greater readiness with which the blood escapes under the force of gravity, that the regurgitant character of the pulse is rendered more obvious by placing the patient into the upright position and even by raising the arm. In cases of rupture of the aortic valves, and possibly also in some cases of regurgitation originating in disease, the fibrous zone at the outlet of the ventricle appears to contract so as to decrease the size of the orifice. At least in one of the cases of ruptured aortic valve which fell under my own notice I found the capacity of the orifice reduced to 30 instead of 35.5 lines, though from the general enlargement of the organ, the size of the aperture would have been more likely to exceed the average.

MITRAL VALVULAR DISEASE.

1. *Obstructive disease of the mitral valves.*—This form of disease may, like the corresponding defect in the aortic

valves, be either acute or chronic. As an acute affection it occurs in connection with endocarditis, generally rheumatic, more rarely connected with other forms of fever. Occasionally it is seen as a complication of renal disease, or as an idiopathic affection in persons in a depressed state of system from destitution or habits of intemperance. In the chronic form mitral obstruction may be the result of less active inflammation slowly progressing for a considerable period, and so not unfrequently ensues in persons who have had rheumatic fever, though during the attacks they have been quite free from cardiac symptoms. It is also questionable whether it may not be a congenital affection, by which I must be understood to mean a disease of the valves analogous to that which arises in after life, occurring before birth. This idea was first thrown out by Mr. Burns; it has received the support of Laennec, at least that writer is disposed to regard a case of combined disease of all the valves which he mentions, as probably congenital; and Dr. Farre has related cases which he supposes to have had a similar origin in his work on malformations of the heart. It is in favour of this view that the cases of most characteristic mitral contraction, the so-called "button-hole mitral," are almost always seen in comparatively young persons; and generally in those who are stunted in their growth or otherwise imperfectly developed, and who have been delicate or ailing all their lives. In these cases the curtains of the mitral valve become entirely adherent together, so that the aperture is reduced to a small oval opening. The extent to which the contraction sometimes attains is very remarkable, so great, indeed, that it seems scarcely possible to conceive that it could be the result of disease in after life. Thus, instead of the aperture having the normal capacity, in adults, of 45·2 Paris lines (101·7

mm., 4 E. in.) in males and 45 (181·25 mm., 3·99 E. in.) in females, I have found it not to exceed 18 (40·5 mm., 1·59 E. in.), 12 (27 mm., 1·06 E. in.), and 11 (24·75 mm., ·96 E. in.) French lines in circumference. In consequence of this extreme degree of contraction the curtain is pushed forwards by the blood in the left auricle, so as to occupy a large portion of the left ventricle and diminish very greatly the amount of blood which that cavity is capable of receiving; and, for the same reason, the tendinous cords are much shortened, so that sometimes the fleshy columns appear to be directly inserted into the expanded curtain. As in the case of the aortic valves the mitral also is liable to be the seat of atheromatous deposits, leading to great thickening and induration and to contraction of the orifice; and this frequently occurs in connection with gouty symptoms in persons who have passed middle age.

In very rare cases small tumours, of a fibrous or fibroplastic character, are found growing on the auricular surface of the mitral valve, and projecting into the auriculo-ventricular opening, so as to occasion more or less obstruction to the flow of blood into the ventricle. I have myself seen only one such case, and in that instance the tumour was about the size of a filbert.

When the disease is limited to the mitral valve, the aortic segments being healthy, the left ventricle does not usually undergo much alteration in capacity and the walls are not materially increased in thickness. Indeed, it has been supposed that the left ventricle becomes, in some cases, smaller. This is, however, scarcely correct; it is rather that when extreme degrees of contraction occur in young persons the left ventricle does not materially increase in size, as compared with the cavities on the right side; though, in cases of long duration, the left side also is

generally found more or less hypertrophied. The left auricle, however, becomes greatly expanded, the lining membrane is generally opaque, much thickened and often roughened, and the muscular walls considerably hypertrophied. The right ventricle is also enlarged, and its walls become thick and very dense.

The danger which attends mitral obstruction is greater than that in the similar form of aortic disease. The left auricle and right ventricle, though they become considerably hypertrophied, have yet comparatively little power of overcoming the obstruction to the flow of blood into the ventricle; the pulmonary capillaries are, therefore, permanently distended; the process of aëration is interfered with; and the usual effects of general venous engorgement ensue. So long, however, as the valves continue competent, the general congestion is not extreme, and dropsical symptoms do not readily occur. There is usually but little lividity or the patient may be even pale, and the pulse is generally small, from the small amount of blood which is capable of being contained in the left ventricle, and feeble from the little power with which it is propelled into the aorta. When, however, from dilatation of the right and left ventricles the walls become weak, or the valves from increasing rigidity are no longer capable of being properly approximated so as to close the aperture, all the effects of an embarrassed circulation ensue. At all times also, the patients are liable to aggravation of their symptoms from the occurrence of pulmonary inflammation resulting from cold, and to the occurrence of hæmorrhage, though this is less apt to arise in cases of simple obstruction than where there is also regurgitation. Thrombosis often occurs, either in the contracted orifice, or in the sinus, and especially in the appendix of the auricle, or in the branches of

the pulmonary artery, on the right side of the heart, or the smaller vessels of the extremities and parenchymatous viscera may become embolic.

2. *Incompetency of the mitral valves.*—The mitral valve may become incompetent as the result of acute disease. A portion of the fold may be destroyed or separated from its attachments; or there may be adhesions between the lesser or posterior segment and the ventricular walls, so that it may not admit of being expanded, and the orifice may be imperfectly closed. More frequently, however, it ensues upon obstructive disease from the curtains becoming increasingly thick and rigid, till they are almost incapable of movement. Occasionally, also, a valve or its attached tendons, rigid from previous disease, is destroyed as the result of acute endocarditis; or the diseased curtains or its tendons may be ruptured during a slight strain; and, still more rarely, a similar accident may occur in valves that are quite healthy. In these cases a portion of the valve may be separated from the tendinous cords, or the cords may be torn through, or a muscular column may be torn from the ventricular walls; the detached portion of the curtain then falls back towards the auricle during the ventricular systole, and allows the blood to follow the same course. The aperture also may become enlarged, either in cases of dilatation of the ventricle resulting from muscular strain or any other cause; or, and while the aperture retains its normal proportions and the valves are free from disease, the curtains may be imperfectly adjusted so as to allow of regurgitation. Lastly, in some cases, small aneurismal dilatations occur in the valves, and these giving way form passages through which the blood may flow back.

The effects which are produced by incompetency of the

mitral valves on the size and form of the ventricle and the state of its walls, are different from those which attend simple obstruction. The left ventricle becomes enlarged, and is widened at the apex, so that the cavity has a peculiarly rounded shape; the walls also are thickened, but the excess of width is somewhat evenly distributed over the whole of the parietes, and the fleshy columns may almost disappear, being blended with the muscular walls. The right ventricle also is remarkably enlarged, and thus the alteration in the general form of the heart is very striking as compared with that which occurs in aortic disease. The increase of weight in these cases, though much less marked than in aortic valvular disease, is considerable. I have weighed hearts in males ranging from 14 oz. 8 drs. to 19 oz. 8 drs.; and in females from 12 to 18 oz.

The pathological effects of mitral disease are seen in their most characteristic form in cases of regurgitation, whether primary or occurring as the sequence of obstruction; but especially when the aperture is but slightly or not at all diminished in capacity. In this case a large column of blood is thrown back into the auricle with the ventricular systole, and the engorgement of the auricle and of the pulmonary vessels becomes extreme; the left auricle is, therefore, greatly expanded, and the dilatation of the cavities on the right side of the heart is very marked. Hence, also, there is great tendency to bronchitis and œdema of the lungs; and from the intermittent distension of the vessels they are very liable to rupture, and pulmonary apoplexy and hæmoptysis to occur. The engorgement of the liver, spleen, kidneys, and brain is also extreme, and the secondary affection so occasioned rapidly ensue; and from the great systemic engorgement dropsical effusions quickly supervene in the cellular tissue and serous

cavities. Thus it generally happens that though a patient may for long have had even considerable mitral obstruction with comparatively little suffering, so soon as the signs of incompetency occur all the symptoms become aggravated. I have, however, often known the more serious symptoms of mitral incompetency relieved by treatment; and have reason to believe, that, under favorable circumstances, patients so affected may survive and enjoy a fair share of health for many years.

The pulse of mitral regurgitation is necessarily small and feeble, for only a small portion of the blood entering the left ventricle is propelled into the aorta; and, from the enlargement of the cavity of the ventricle without a proportionate increase of strength in its walls, the blood is expelled with little power. The pulse is often quick. To the same causes must be ascribed the alterations of the rhythm of the heart, the great irregularity both in the force and frequency of its action, which occur at an earlier period and to a more marked extent in cases of mitral incompetency, than in any other form of valvular disease, but which are only indications of the failure of muscular power, not a necessary result of the incompetency. The engorgement of the pulmonary and systemic vessels also explains the tumid countenance and the lividity of the face and extremities, which are equally characteristic of the condition.

DISEASE OF THE RIGHT SIDE OF THE HEART.

In all forms of disease of the left side of the heart occurring in after life, there is often found more or less affection of the valves on the right side, but this is generally only to a slight extent and does not materially affect the result. In some instances, however, we meet with very marked

affection limited to the pulmonic or tricuspid valves or orifices, and in these cases the disease is probably generally of congenital origin. When as in many of these cases the foramen ovale or the ductus arteriosus are still open, or there is an aperture in the septum of the ventricles the congenital origin of the disease is indisputable, but when that is not the case the nature of the disease is less certain.

The following case affords an instance of this description :

G. D. T—, a boy, æt. 13, residing in Wandsworth Road, was admitted into Charity ward, St. Thomas's Hospital, under my care, on July 20th, 1876.

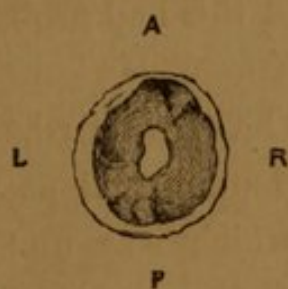
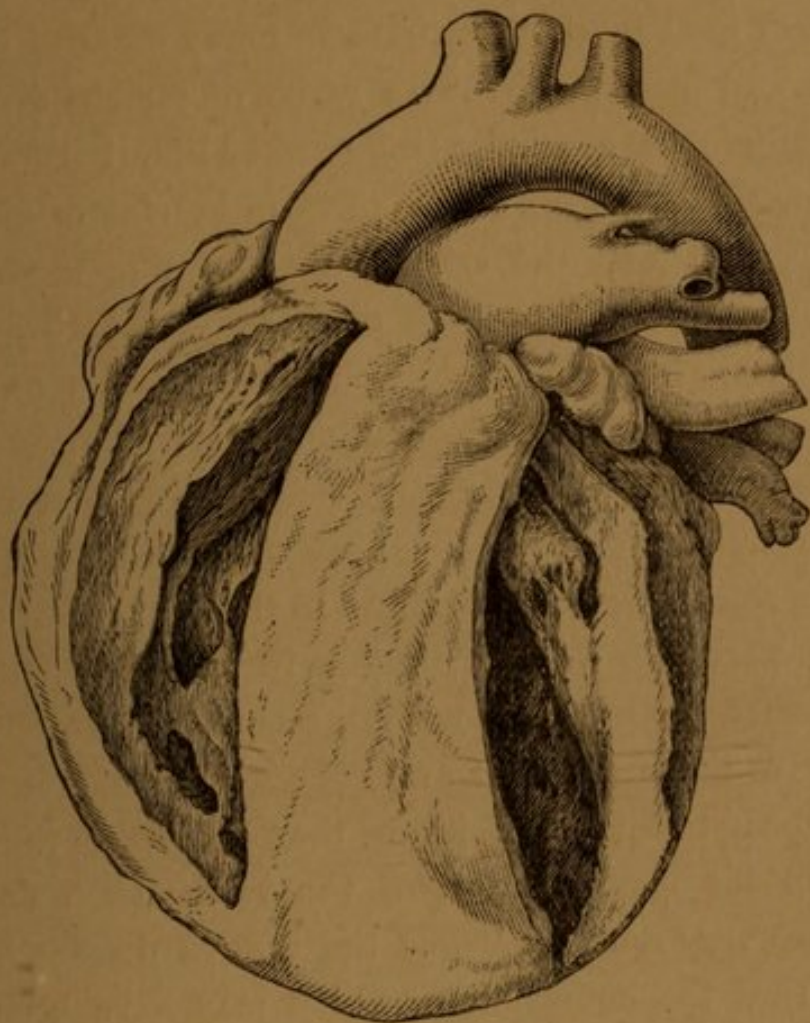
No satisfactory history of his previous state of health could be obtained, but he was not known to have ever had rheumatism or any other illness likely to lay the foundations of cardiac disease. He was reported never to have been strong, and to have always been livid in the face in cold weather. He was, however, in his usual health till four months before his admission into the hospital. When admitted his face was flushed and the lips purple. He had much difficulty of breathing, and the face and extremities were puffy, and the abdomen tumid. The urine had a specific gravity of 1025, and was not albuminous. On examination a loud double murmur was heard at the base of the heart, at the upper part of the sternum, and on each side of that bone, and it was the most distinct in the course of the pulmonary artery, where also a very marked thrill was felt. The jugulars were distended, and there was very obvious pulsation of the carotids. The dropsical symptoms became more marked after his admission, and on September 19th the abdomen measured in circumference at the umbilicus $27\frac{1}{2}$ inches, and above that point 30 inches.

Two days after, the dimensions were 28 and $31\frac{1}{4}$ inches, and there was distinct fluctuation to be felt. On October 11th he was tapped, and eight pints and a half of greenish-yellow coloured fluid was removed. The abdomen, however, very rapidly refilled, and on October 27th the circumference at the umbilicus was 30 inches, and above that line 31 inches. In addition to the loud systolic murmur, followed by a slight diastolic whiff, heard over the orifice and in the course of the pulmonary artery, there was also a double murmur audible towards the apex, and a systolic sound in the left dorsal region. The thrill was very distinct over a large space, but was most marked in the second and third left inter-cartilaginous spaces. The abdomen continued to enlarge, and on November 29th the girth at the umbilicus was 31 inches, and above that line $33\frac{3}{4}$ inches. He was therefore again tapped, and thirteen pints and a half of fluid were removed. On the following day he complained of pain in the abdomen, and soon after he began to sink, and died in a few hours.

On post-mortem examination the lower extremities were not materially anasarcaous. The peritoneal cavity contained a pint and a half of fluid. The surface was generally opaque and irregularly thickened with a thin layer of recent lymph, and the serous coat of the intestines was somewhat injected. The capsule of the liver was opaque and covered with rather dense fibrinous layers, and very firm and tough. The hepatic veins were distended, and the surface of the liver mottled. The spleen was much enlarged, and the capsule irregularly thickened, and its substance tough and deeply congested. The kidneys were of their natural size; the capsules were not adherent; their substance was tough and congested. The brain and its membranes were somewhat congested. The pericardium

contained eight ounces of clear fluid. The heart weighed about nine ounces avoirdupois. The anterior surface was composed almost entirely by the right ventricle, and the organ measured 42 Paris lines=94.5 millimètres, or 3.73 English inches, across; and 44 P. l.=99 mm., or 3.84 E. in., in height. The right ventricle was dilated, and its walls very greatly hypertrophied, being excessively firm and resistant; they measured 3 P. l.=6.75 mm., or 0.266 E. in., at the base; 2.75 P. l.=5.17 mm., or 0.14 E. in., at the midpoint; and 2 P. l.=4.5 mm., or 0.177 E. in., near the apex. The walls of the left ventricle measured at the base 3.5 P. l.=7.87 mm., or 0.31 E. in.; at the midpoint 5 P. l.=11.25 mm., or 0.44 E. in.; and at the apex 3.25 P. l.=7.31 mm., or 2.88 E. in. The right auriculo-ventricular aperture admitted the passage of a ball measuring 42 P. l.=94.5 mm., or 3.72 E. in., in circumference. The left auriculo-ventricular aperture had a circumference of 21 P. l.=47.25 mm., or 1.86 E. in. The pulmonic orifice was very much contracted from disease of the valves. The three curtains were blended together so as to form a kind of diaphragm extended across the aperture, and protruded forwards in the course of the vessel, and perforated in the centre by a rounded aperture, only admitting the passage of a ball 10 P. l. in circumference=22.5 mm., or 0.88 E. in. There were the remains of three raphes or cross-bars on the upper aspect of the diaphragm, indicating the former separation of the valves or their lines of incomplete division. The imperfect curtains had deep sinuses behind them, and were very much thickened and indurated. The trunk of the pulmonary artery was of somewhat large size, and its coats thick. The heart was otherwise well formed, the fœtal passages, the foramen ovale, and the ductus arteriosus being per-

fectly impervious. The left auriculo-ventricular valves were opaque and much thickened, and the aperture somewhat constricted.



The upper figure shows the general form of the heart and the great hypertrophy of the right ventricle. The lower the diseased valves of the pulmonary artery seen from above.

In the absence of any satisfactory history of the mode of development and the course of the symptoms in this case, it is impossible to say, with confidence, what was the precise nature of the disease of the valves of the pulmonary artery. From, however, the similarity of the condition of the valves to that which obtains in many cases of malformation, and from the extreme rarity of serious disease of the pulmonic valves originating in after life, it seems a fair inference that the disease was of intra-uterine origin. If, however, that was the case, the amount of obstruction which existed at the time of birth must have been comparatively slight, or it would almost necessarily have prevented the closure of the foetal passages. Various cases very similar in character, except that the foramen ovale or ductus arteriosus still remained open, are on record, and of them there can be no question as to the congenital origin; and there are also a few instances in which the condition of the heart was precisely the same as in the present case; and I have not hesitated to regard such cases as instances of malformation.* We know that when there is any defect in the conformation of the valves such defective valves are very apt to become the seat of disease in after life, so that the constriction, which may have been comparatively slight at the time of birth, often ultimately becomes very great, and this had probably been the case in the present instance.

This form of disease has recently been made the subject of a graduation thesis published at Wurzburg by Gr. J. Bozanis. The case, which was under the care of Dr. Gerhardt, occurred in a female, æt. 37, a patient in the

* See 'Malformations of the Human Heart.' By the Author. Second edition. 1866. Pp. 120-121.

Julius Hospital, who had been more or less cyanotic all her life. The orifice of the pulmonary artery was very much constricted from adhesion of the valves, there being only a small slit 35 mm. long. The foramen ovale was imperfectly closed, and the ductus arteriosus also was not entirely obliterated. The author has no hesitation in regarding the condition as of congenital origin.

1. *Pulmonic obstruction and regurgitation*.—Obstruction near the pulmonic orifice may occupy three distinct situations. It usually depends on disease of the valves, which are found blended together and very greatly thickened and indurated, leaving a rounded or triangular aperture in the centre of the diaphragm so produced. The united curtains are protruded forwards by the pressure of the blood in the ventricle, so as to project into the pulmonary artery; and there are generally two or three ridges or frena on their arterial side, separating more or less completely the same number of deep sinuses. In other cases the constriction occurs at the fibrous zone, which forms the boundaries of the orifice and to which the valves are attached, while the valves themselves may be nearly or quite free. In yet others the contraction may be caused by hypertrophy of the muscular structure and induration of the endocardium at the beginning of the conus arteriosus, or point of union between the arterial cone or infundibular portion of the right ventricle, and the sinus. When the disease is at the outlet of the ventricle the whole cavity is greatly dilated and the walls hypertrophied; but the condition of the ventricle differs in several respects, according to the period of intra-uterine life at which the constriction arose or became considerable. If it commenced shortly before birth or only

became serious at that period, the foramen ovale or the ductus arteriosus may remain open, and the conus arteriosus or infundibular portion of the right ventricle may be large and its walls thick. If, on the other hand, the obstruction existed to a marked degree at the earlier period of foetal life, the septum of the ventricles also may be found incomplete and the aorta may be in connection with both cavities. In this case the sinus of the right ventricle will be found very large and its walls thick and firm; while the infundibular portion will be very imperfectly developed, its cavity small, and its walls less remarkably hypertrophied. When, also, in connection with obstruction at the outlet of the ventricle or independent of any defect at the pulmonic orifice, there is a constriction at the point of union of the infundibular portion with the sinus, the smallness of the cavity and feebleness of the walls of the conus arteriosus, as compared with the hypertrophy and dilatation of the other portion of the ventricle, are very striking.

The extent to which the constriction at the pulmonary orifice attains in these cases is sometimes very marked. Instead of having a capacity of 40 Paris lines (90 mm. 3·55 E. in.) in males, and 39·3 (88·42 mm., 3·49 E. in.) in females, I have found it only capable of giving passage to a cylinder 13 and 12 Paris lines (29·25 mm., 1·15 E. in.; 27 mm., 1·46 E. in.) in circumference in males of fifteen and twenty years of age, and in a female of nineteen it was only 8 lines (18 mm., ·71 E. in.) in circumference. The most marked constriction is generally found in cases where the septum of the ventricles is also deficient, so that a ready outlet is afforded for the blood to pass from the right ventricle into the aorta. When the obstruction is between the sinus and infundibular por-

tion of the right ventricle, it exists to a less marked degree.

In the cases of extreme pulmonic obstruction the aperture is also generally permanently patent, and this must augment the impediment to the transmission of the blood to the lungs; but it is probable the condition does not materially modify the general symptoms and results, as, from the great contraction of the orifice, the quantity of blood which can pass through it, either with the direct or regurgitant current, must be very small.

In this form of disease there is generally very marked and peculiar lividity, "cyanosis," and this is doubtless chiefly due to the intense congestion; though the colour is probably influenced by the peculiar darkness of the blood, from the small portion which is capable of being transmitted to the lungs and subjected to the influence of the air, and especially by the peculiar thinness and transparency of the integuments, from the defective nutrition of all the tissues. The patients are also peculiarly liable to affections of the different organs, especially of the brain and lungs, to hæmorrhages, and to thrombosis and embolism of the constricted artery and other vessels. It has been asserted by Rokitansky, apparently adopting an idea casually thrown out by Laennec, that the condition of the blood in cyanosis is decidedly opposed to the deposition of tubercle. I have, however, elsewhere shown that this is not correct, indeed, that provided cyanotic persons survive to the period of life at which tuberculous affections of the lungs most commonly occur, they very frequently die of phthisis. I found that of fifty-six cases of malformation of the heart, in which there was more or less cyanosis and the patients reached the age of eight, 9 or 16·09 per cent. died of tuberculous disease in the lungs.

More recently, however, the very opposite opinion has been advanced by Lebert, that stenosis of the pulmonary artery very generally leads to phthisis. This, however, is equally incorrect, patients suffering from that affection not unfrequently being entirely free from tubercle. Thus, of five patients who have fallen under my own notice, two who had simple stenosis died of phthisis; while in the other three in whom the constriction was combined with other serious defects in the conformation of the heart, the lungs were entirely free from disease though generally much congested. The ages of the patients ranged from fifteen to twenty-three, or they were at the period of life in which tuberculous affections of the lungs are of very frequent occurrence. Lebert also supposes that the liability to phthisis in cases of stenosis of the pulmonary artery is to be ascribed to the congestion and irritation of the lungs; but it seems more probably to be due to the defective nutrition of all parts of the body, resulting from the unhealthy condition of the blood from the very small portion which can be exposed to the influence of the air. Certainly the subjects of the more extreme degrees of malformation are generally most singularly thin and ill nourished, and they are liable to strumous affections of other organs as well as to tubercle in the lungs.

The probable duration of life in persons labouring under pulmonic constriction varies according to the degree of obstruction and the condition of the other parts of the heart. Thus, a patient of my own, in whom, notwithstanding the great constriction at the orifice of the pulmonary artery, the conformation of the heart was otherwise natural, survived to twenty-three years of age. I have also met with a case in which, with the pulmonic

disease, the foramen ovale was open in a man of twenty, and cases in which the septum of the ventricle was also deficient in persons of 15, 17, and 19 years of age. There are, indeed, on record still more remarkable instances of the prolongation of life under similar circumstances.

2. *Tricuspid obstruction and regurgitation.*—As with the more marked degrees of pulmonic obstruction, so when the tricuspid aperture is considerably constricted, the affection is probably generally, if not always, congenital. The curtains are found united together and forming a diaphragm stretched across the opening, and perforated in the centre by a small aperture, generally of a triangular form. This condition occasionally coexists with similar disease of the mitral valve, or with some form of pulmonic obstruction. If the constriction existed to a marked degree at the period of birth, the foramen ovale and the ductus arteriosus will probably be still open; and if the aperture have been seriously constricted at the earlier period of the foetal life, the septum of the ventricles also may be incomplete. More rarely, however, the tricuspid aperture is found very greatly constricted in cases in which the heart is otherwise naturally formed, but in these instances also there is often reason to suspect the congenital origin of the affection from the patients having been delicate and subject to cardiac symptoms throughout their lives. I have seen two cases of the kind; in one of them the patient had had rheumatic fever, and the obstruction was probably aggravated by changes in the valves occurring at that period; but in both I think it most likely that the disease was congenital.

In cases of tricuspid contraction there is, of course,

great congestion of the general venous system and of the parenchymatous organs, and the sources of danger are similar to those in pulmonic disease.

With the obstruction to the flow of blood from the auricle into the ventricle generally also there is regurgitation, and this must aggravate the impediment. More frequently, however, regurgitation occurs independently of any valvular disease, from dilatation of the ventricle and of the orifice; thus the valves become incompetent often in the advanced stages of mitral disease, in cases of great obstruction to the pulmonary circulation such as occurs in some cases of chronic bronchitis, and especially in cases of imperfect expansion of the lungs with deformed spine. It occurs also in cases of stenosis of the pulmonary valves and of constriction in the conus arteriosus, whether seated at its pulmonic end or at the point of union with the sinus of the right ventricle. Difference of opinion has prevailed as to the practical importance of tricuspid regurgitation; some observers, with the late Mr. Wilkinson King, regarding the condition as rather lessening the danger of the primary disease, by allowing the blood to flow back into the systemic veins; while others look upon the condition as in itself a very serious defect. For my own part I am rather disposed to concur in the former opinion; for while the reflux of blood into the larger veins with the ventricular systole must greatly aggravate the general venous engorgement, that is, probably, a less serious condition and attended with less immediate danger, than the excessive distension of the lungs and of the right side of the heart which it relieves.

In reviewing what has been said as to the sources of danger in different forms of valvular disease, it will be seen that incompetency of the valves is regarded as a more

serious defect than obstruction; and of the affections of the valves of the left side of the heart, I conceive incompetency of the aortic to be more dangerous than the similar condition of the mitral valves. Not only does incompetency of the aortic valves occasion great impediment to the circulation, and especially cause an imperfect supply of blood to the brain; but, as the power of the left ventricle becomes rapidly exhausted, there is danger at any moment of death by syncope. In the corresponding condition of the mitral valve, though it seriously obstructs the pulmonic circulation and occasions great visceral congestion, death is brought about more slowly as the result of the imperfect aëration of the blood and its impure condition from the state of the parenchymatous viscera, and by dropsical effusions, and sudden death is less likely to occur. As regards obstructive disease of the two sets of valves, I should reverse the order in which they are to be regarded as serious, obstructive disease of the mitral being apparently a more important defect than the same affection of the aortic valves. In the former condition the combined power of the left auricle and right ventricle is unable adequately to propel the blood through the left auriculo-ventricular aperture, and hence the lungs and other organs soon become very greatly engorged; while in cases of aortic constriction, the left ventricle long resists the impediment, and it is only when the obstruction has become extreme and the power of the ventricle is impaired, that the more distant organs are involved.

The order in which these conditions should be placed, as indicating their relative danger, beginning with the more serious affections, would, therefore, be as follows :

Aortic regurgitant disease.
Mitral regurgitant disease.
Mitral obstructive disease.
Aortic obstructive disease.

The comparative rarity of serious affections of the right side of the heart, and their being usually combined with other defects in the conformation of the organ, make it difficult to estimate the relative danger which attends them, as compared with disease of the left valves.

It is, however, rare that patients with affections of this kind survive beyond a few years; though, in exceptional cases, life may be prolonged to middle age. Thus cases are on record, in which there was only slight constriction of the orifice of the pulmonary artery, probably of congenital origin, though the heart was otherwise well found, and the patients attained the ages of 30, 44, and 60. In similar instances, but with an imperfect closure of the foramen ovale, patients are stated to have lived to the ages of 30, 37, 44, 57, and 60. When the septum of the ventricles is defective, the duration of life is usually very short, the valvular constriction being generally in such cases very great. The existence of an opening in the septa of the auricles or ventricles, or of a previous ductus arteriosus, so far from increasing the danger in these cases as facilitating the passage of the blood after birth from the right to the left side, must be regarded as favorable to the prolongation of life.

Cases of stenosis of the tricuspid orifice are referred to in my book on 'Malformations,' in which the patients attained the ages of 32 and 37.

The remarks which have now been made indicate the

more serious sources of danger in cases of valvular affection; but there are other circumstances which exercise important influence on the result in such cases. These are the limitation of the disease to one set of valves or its extension to others; the nature of the complications which may arise during the progress of the affection; and the circumstances of the individual who is the subject of the defect.

3. *Diseases of two or more sets of valves.*—The most important combination is the union of disease of the aortic and mitral valves. This is by no means uncommon in cases which owe their origin to rheumatism, and that it should be so is readily explained by the close proximity of the orifices. Indeed, it is rather surprising that the combination should not under such circumstances more frequently occur. The two sets of valves are also more or less involved in other cases of constitutional origin, as in affections of a gouty character or dependent on atheromatous degeneration. Not unfrequently, also, disease of one set of valves entails secondary defect of the other. Thus in cases of obstructive and regurgitant disease of the aortic valves, the resulting dilatation of the ventricle often gives rise to mitral incompetency, either from the orifice partaking in the dilatation or from the action of the valves being interfered with. In some cases, also, there is independent disease of the aortic and mitral valves, and of this the following case affords an instance.

G. S—, æt. 43, fireman of a steam-boat, was admitted into St. Thomas's Hospital under my care on the 14th of June, 1860. He ascribed his illness to cold taken four months before, and stated that though he had served for ten years in the army, he had not had rheumatism or

any serious illness or accident before his present attack, and that his family were healthy.

He complained of shortness of breath, a dry cough, pain across the lower part of the chest, and restlessness at night. His appetite was pretty good, but his tongue was thickly coated, and his breath had an hepatic odour; he suffered from thirst, felt sickly, and had occasional vomiting; the bowels were torpid. Pulse 98 to 100, somewhat jarring; the urine was scanty and high coloured, specific gravity of 1012, and contained one sixth of albumen. The abdomen and lower extremities were much swollen.

The cardiac dulness commenced at the level of the fourth cartilage and extended from the right side of the sternum to near the line of the nipple. The resonance on percussion was impaired in other parts of the chest. Respiration was attended with sub-crepitation and bronchitic rhonchi, especially on the left side. A systolic murmur was audible in all parts of the chest, but it was decidedly most distinct and harsh at the apex, and thence towards the left axilla. At the level of the third cartilage it was very indistinct, and it was inaudible at the upper part of the sternum. It was feebly heard at the lower angle of the left scapula. There was also a distinct musical murmur heard at the base of the heart, with the diastole, but this was inaudible at the apex, along the course of the ascending aorta, and to the left of the spine, posteriorly.

He was directed to take pills containing blue pill and colocynth, with digitalis, hyoscyamus, and compound ipecacuan powder; the compound scoparium mixture and two glasses of gin in the day.

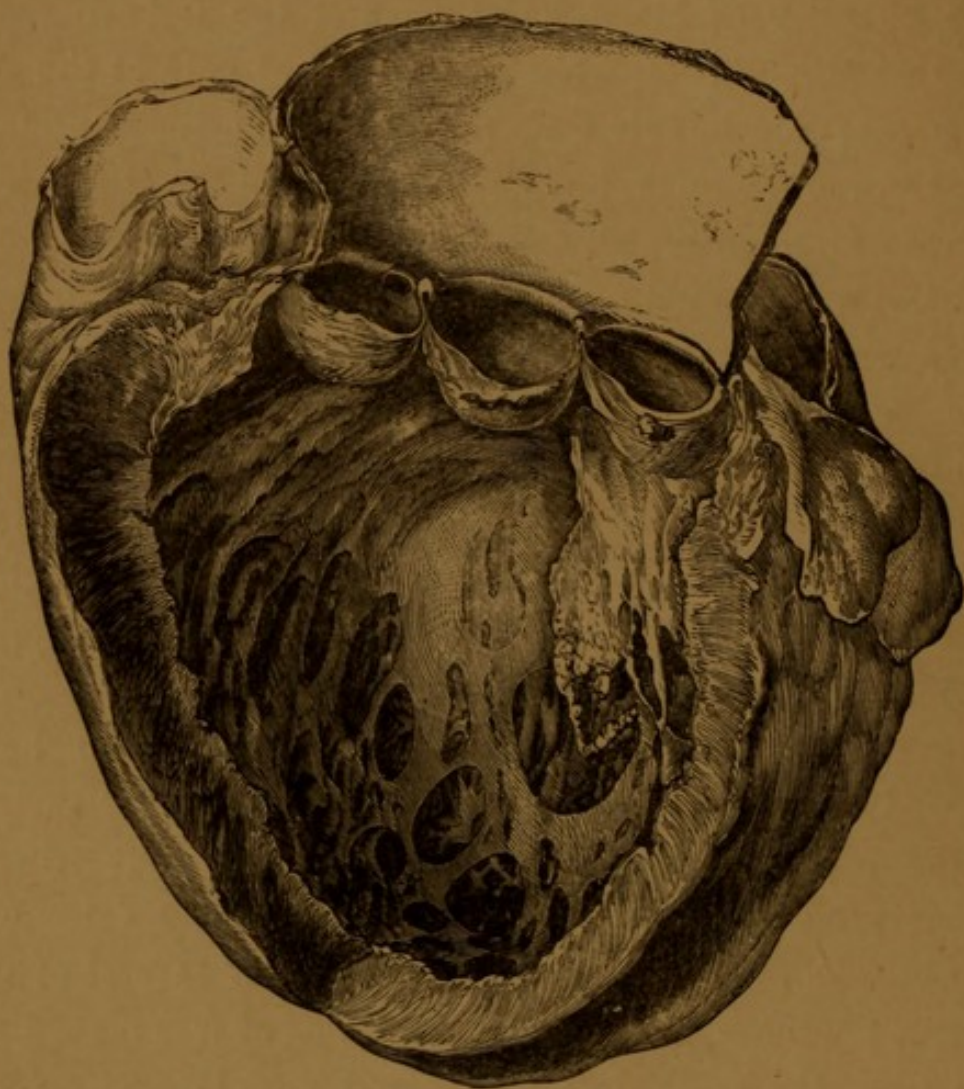
On the 28th, his gums were slightly affected by the mercury. The pulse was somewhat bounding, but compressible. His breathing was freer, but he complained of

suffering more from the cough; he still had no expectoration. The abdomen and lower extremities were less swollen than before. To take the pills every other night and to have half a drachm of compound tincture of camphor in each dose of the mixture.

On the evening of the 1st of July he passed a considerable quantity of blood by stool, and the following day vomited much blood. He complained of pain at the epigastrium; the bowels were relaxed; the urine contained one third of albumen, but was increased in quantity. The pills were discontinued, and replaced by the hyoscyamus and Dover's powder at night. On the same day he was taken with epistaxis, and subsequently spat blood. The urine became suppressed, and his intelligence impaired, and he died on the 5th.

The body was very anasarcaous. The pericardium healthy, the heart hypertrophied and dilated and weighed twenty-one ounces avoirdupois. The free edge of the posterior semilunar valve was retroverted, and hung loosely into the cavity of the left ventricle so as to have allowed regurgitation from the aorta. The under surface of the retroverted portion had a few fibrinous fringes adhering to it. The free fold of the mitral valve was perfectly loose, owing to the destruction of several of the chordæ tendineæ, and must have allowed of free regurgitation from the ventricle into the left auricle. The fragments of the destroyed chordæ tendineæ were covered by vegetations, as was also the under surface of the valve itself, and some of these vegetations were infiltrated with earthy deposit. A granular patch of old lymph was adherent to the endocardium at the posterior surface of the left auricle, immediately above the valve. The left auricle was dilated, and the left ventricle hypertrophied

and dilated. The valves of the right side were healthy, but the right ventricle was hypertrophied. The aorta was healthy. The pleuræ were free from adhesions, but each cavity contained about half a pint of serum. The lungs



The woodcut shows the retroverted edge of the posterior semilunar valve and the destroyed chordæ tendineæ of the mitral valve.

were large, œdematous, and crepitant everywhere, except at the lower part, where they were airless from collapse. The bronchial tubes contained much frothy fluid. The liver was large, congested, and somewhat cirrhotic; the

spleen was large, pulpy, and contained a partially decolorized fibrinous mass of considerable size; the kidneys were much hypertrophied, weighing together nineteen ounces; they were minutely congested and studded with red, bloody points. On microscopic examination the tubes contained more or less decomposed blood, but there was no other appearance of disease. The stomach, intestines, pancreas, and supra-renal capsules were all healthy.

The great interest of the case lies in, 1. The existence of disease both in the aortic and mitral valves, which had been manifested by distinct physical signs, so that a correct diagnosis had been effected during life.

2. In the musical character of the murmur heard at the base with the diastole of the heart, and which was clearly traceable to the loose retroverted edge of the posterior semilunar valve.

3. I have already alluded to the frequent coexistence of slight disease of the valves on the right side of the heart with more serious defect in those of the left, and to the occasional occurrence of very marked changes in the valves on both sides; but such affections are, as before stated, probably generally at least, congenital. In cases where both the aortic and mitral valves are involved, the condition of the heart partakes of the changes due to the two forms of disease. The left ventricle is hypertrophied and dilated to a greater degree than occurs in any simple form of mitral defect, but to a less extent than in aortic disease. I have weighed hearts under such circumstances, varying, in males, from $14\frac{1}{2}$ oz. to $21\frac{1}{2}$ oz.; and in females, from 19 oz. to 23 oz. av.

4. The *complications* which may occur during the progress of valvular disease are, affections of the lungs, liver,

spleen, kidneys, and brain ; dropsical effusions into the cellular tissue and serous cavities ; gangrene, rheumatism, gout, dyspeptic symptoms ; and alterations in the constituents of the blood, giving rise to anæmia, purpura, extravasation, &c. Of these it is not necessary further to speak, than to remark that, in cases of chronic valvular disease which have hitherto been almost entirely latent, more active symptoms are often excited by cold, giving rise to bronchitis and so to great aggravation of the congestion in all parts of the system and to various secondary affections of the viscera. Often, also, in quite chronic cases, from the same cause, the kidneys become congested, and dropsical symptoms suddenly set in.

In cases in which there is a combination of renal and cardiac symptoms, it becomes a great question in estimating the probable result to know which of these diseases has been the primary one. If the renal disease have been the first, the cardiac affection must almost necessarily advance ; if, on the contrary, the cardiac disease were the primary defect, the renal symptoms may be only due to congestion of the kidney and may admit of very great alleviation, and the patient may recover the state of comparative health which preceded his attack. In deciding this point the condition of the urine will afford great assistance. In cases of simple renal congestion, though the quantity passed may be small, the specific gravity does not generally fall below the healthy standard ; whereas in those cases in which the renal disease is primary, the specific gravity of the urine is usually low, whatever be the quantity of water passed.

The frequency with which heart and brain disease are combined has been long known, and has attracted the attention of some of the ablest pathologists. It has been

supposed that cerebral affections were more frequently associated with some forms of cardiac disease than with others. The truth of this opinion, however, does not appear to have been established, and the subject requires a fuller investigation, founded upon a large series of facts. I have myself seen different forms of cerebral disease associated with various descriptions of cardiac defect. Thus, in connection with fatty degeneration, simple hypertrophy, and disease of the aortic and mitral valves, both obstructive and regurgitant, dependent on different causes, I have known embolism and thrombosis, apoplectic extravasations both central and meningeal, with softening and inflammatory exudations; and I have met with similar cerebral affections in cases of disease of the right side of the heart both pulmonic and tricuspid, probably of congenital origin. These complaints are not, however, necessarily fatal, or the cause of permanent impairment of function. Some years ago I had under my care in the hospital a case of rheumatic fever with heart complication in which hemiplegia, doubtless from embolism, occurred; but the patient, nevertheless, recovered, and is still living, though suffering from slight cardiac symptoms.

Rheumatic affections must always be regarded as of serious import when they occur in persons already the subjects of cardiac disease, especially when such disease is the result of previous rheumatism. In these cases the local mischief is very apt to be aggravated during the secondary attack, even though it be very slight, or fibrinous exudations or deposits may occur about the previously diseased valves and produce immediate danger or a fatal result. So also in gouty persons changes may occur in the diseased valves and seriously aggravate the mischief.

Anæmia is a very frequent and very serious complica-

tion of old heart disease, for it both aggravates the symptoms and makes it more difficult to ascertain the nature and extent of the organic changes that have occurred.

I know few questions sometimes more difficult to decide than whether a murmur is anæmic or organic, and, if the latter, to ascertain to what extent it may be aggravated by the condition of the blood. Sometimes the seat and character of the murmur, or the very limited space over which it is heard, and the facility with which a bellows sound can be produced by slight pressure on the more exposed arteries, or the existence of a continuous murmur in the large veins of the neck, may show conclusively that the cardiac sound is, in part at least, anæmic; but in other cases the nature of the murmur is very uncertain, and this occurs especially in rheumatic fever in delicate females, and with the affections of children and young persons. The same uncertainty also often obtains in persons residing in a tropical or malarious district who labour under cardiac symptoms. These difficulties chiefly occur in reference to basic sounds, but I believe that murmurs heard at the apex, which according to received ideas depend on mitral disease, are sometimes anæmic. Frequently also mitral murmurs are much aggravated by anæmia. Thus in hospital practice patients are often admitted with a loud bellows sound at the apex and in a very prostrate and anæmic condition, and after a prolonged course of steel medicines, with rest and a nutritious diet, very greatly improve, so that, at the end of a few weeks, they are discharged in better health, and with the murmur much reduced in intensity and the symptoms greatly relieved.

We occasionally see in cases of old valvular disease a

great tendency to the occurrence of purpurous eruptions on the skin, and to extravasations of blood into the cellular tissue or muscular structure, especially of the lower extremities. The former not unfrequently occur in successive crops, the spots which first appear entirely fading away, to be succeeded after a few days by a further outbreak, and this though, throughout the whole period, suitable treatment has been persevered with.

It will be seen that the remarks in this paper are essentially limited to the prognosis in cases of valvular disease, but there is a class of cases about which we are frequently consulted to which some reference may be made. I allude to the cases in which there is excessive irregularity in the action of the heart, without there being any murmur indicating valvular disease; such symptoms probably depend on mitral incompetency, originating in dilatation and failure of muscular power of the left ventricle, and when the irregularity is very great the cases are always of grave import, for they very generally terminate unfavorably, and often run a rapidly downward course, whatever be the treatment which may be adopted. In the cases of less marked irregularity great benefit often results from treatment, and especially from the use of iron.

5. The *circumstances of the individual*—the sex, age, occupation, residence, and previous habits, may all affect the prognosis. Thus in men valvular affections most commonly originate either in active inflammation or in overstrain of the valves from violent and long-continued muscular exertion, and they generally follow an active and rapid course, and the heart readily becomes hypertrophied. On the other hand, in females, though

rheumatic affections are also a common source of disease, a considerable proportion of the cases originate in emotional causes. In them, also, the diseases most commonly assume a passive form, and the cavities of the heart have a tendency to dilatation, and the muscular walls to become atrophied and to undergo interstitial changes.

In early life valvular diseases are almost always either congenital or occur in connection with rheumatism. In middle age they originate frequently both in inflammation and in injury or gradual yielding during muscular efforts; while, in advanced life they are rather the result of fatty or atheromatous disease of the valves or muscular structure, or occur in combination with renal disease or with a gouty state of system. They are generally also combined with dilatation of the cavities and are passive in their character and are often indeed entirely latent.

The residence of the patient, especially if that be in a hot climate and in a malarious district; his occupation, as exposing him to the weather and to alternations of temperature, or requiring the exertion of great physical force, or causing prolonged and severe mental labour; and his habits, if at all intemperate, are all influential on the progress of the disease.

In estimating, therefore, the probability of temporary or more permanent benefit being attainable by treatment in any particular case, we must consider:

1st. The cause of the disease, its duration, and the rapidity with which the symptoms have advanced, as indicating its probable nature or its active or passive character.

2nd. The degree of impediment to the circulation

which it occasions, and the power of the heart to overcome such obstruction, as indicated by the force and regularity of its beat and by the relation which it bears to the pulse at the wrist, and the amount of congestion in the lungs and other organs and in the general system.

3rd. The presence or absence of serious complications, as of the lungs, liver, brain, kidneys, &c., and the existence of dropsical symptoms, and of a gouty or rheumatic condition.

4th. The circumstances in which the individual is placed, as affording the means of obtaining rest of body and mind and protection against atmospheric changes, together with the proper regulation of diet and facilities for medical treatment.

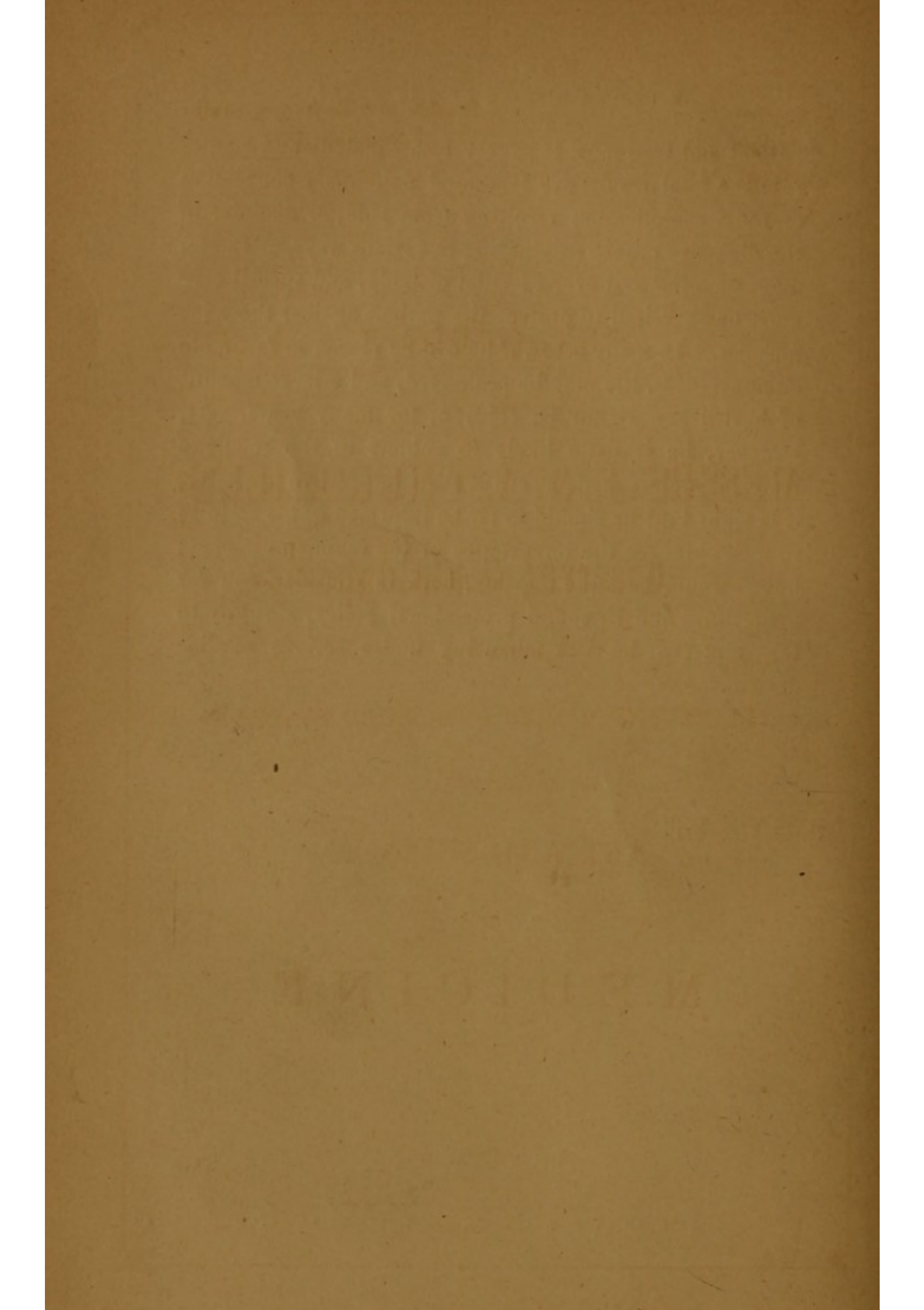
In reference to the means of ascertaining the degree of impediment to the circulation, it must be understood that the intensity and character of the murmur attendant on valvular disease affords but little information. For the production of a murmur two elements are necessary; there must be a source of obstruction to the circulation, and the blood must be propelled with power through such impediment. A loud murmur may be produced by a very slight amount of obstruction, and a very great degree of obstruction may be attended by little or no murmur. The former must be supposed to be the explanation of those cases which have before been referred to, in which murmurs are heard for many years, though, perhaps, during this time the patient has remained entirely or nearly free from any symptoms of cardiac defect. Of the latter we often have examples in hospital practice. A patient is admitted with symptoms of general bronchitis and with a very embarrassed circulation, the action of the heart and the pulse being very feeble and irregular both in force and frequency,

and the different viscera and the system generally congested, with usually more or less dropsy. On listening over the heart, however, no murmur can be heard. After a time, when, under the influence of rest, a genial temperature, and suitable treatment, the bronchitic symptoms have subsided and the action of the heart has become stronger and more regular, a mitral regurgitant murmur begins to be heard, and increases in intensity with the improvement in the condition of the patient and the increase in the power of the heart, till, at the time of discharge, when he considers himself, perhaps, well, there is a loud murmur heard over a large portion of the front of the chest. So, also it not unfrequently happens that in cases of advanced mitral regurgitant disease the action of the heart is extremely irregular, there being two or three very imperfect contractions followed by one of greater power; and while with the former no murmur will be heard, there will be a short whiff with the more powerful beat.

As regards the importance to be attached to the drop-sical symptoms in cases of valvular disease, there is some difficulty in making a general statement. The occurrence of a certain amount of puffiness of the face and of swelling of the lower extremities, if the heart be not very seriously embarrassed and the viscera much involved, and, especially, if the kidneys be free from disease, is often readily recovered from; but the occurrence of considerable anasarca, of effusion into the tissue of the lungs and pleural cavities, and into the pericardium and peritoneum, must always be regarded as involving immediate danger, and affording but little prospect of even temporary relief.

Generally speaking, the causes which in chronic cases of valvular disease entail the greatest suffering on the

patient and tend most to aggravate his malady and accelerate the fatal result, are increased pulmonary congestion or renal complication resulting from cold, or disorder of the digestive organs originating in various ways, or excitement of mind and over-exertion of body, and special care must be exercised to protect the patient against these influences. In many cases, if he can be placed in favorable circumstances, life may be prolonged, and a large amount of health and vigour be enjoyed, for many years. As, however, he is little likely to submit to the requisite restraint, unless made aware of their imperative necessity, it is right that he should so far be informed of his state as to make him see the importance of the regimen directed; but it would be alike wanting, both in consideration for his feelings and in sound professional policy, abruptly to tell him that he was labouring under serious cardiac disease.





London, New Burlington Street.

November, 1877.

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INDEX

	PAGE		PAGE
Acton on the Reproductive Organs . . .	8	Dalby on the Ear . . .	6
Adams (W.) on Clubfoot . . .	6	Dalton's Human Physiology . . .	9
— (R.) on Rheumatic Gout . . .	18	Day on Children's Diseases . . .	13
Allen on Aural Catarrh . . .	6	— on Headaches . . .	18
Allingham on Diseases of Rectum . . .	7	De Valcourt on Cannes . . .	16
Anatomical Remembrancer . . .	11	Dobell's Lectures on Winter Cough . . .	15
Anderson (McC.) on Eczema . . .	19	— First Stage of Consumption . . .	15
— (McC.) on Parasitic Affec- tions . . .	19	Domville's Manual for Hospital Nurses . . .	14
Arnott on Cancer . . .	19	Druitt's Surgeon's Vade-Mecum . . .	4
Aveling's English Midwives . . .	14	Dunglison's Medical Dictionary . . .	22
Balfour's Diseases of the Heart . . .	16	Ellis's Manual of Diseases of Children . . .	12
Barclay's Medical Diagnosis . . .	11	Fayrer's Observations in India . . .	4
Barker's Puerperal Diseases . . .	13	Fergusson's Practical Surgery . . .	4
Barnes' Obstetric Operations . . .	14	Fenwick's Guide to Medical Diagnosis . . .	11
— Diseases of Women . . .	14	— on the Stomach, &c. . .	18
Basham on Renal Diseases . . .	8	Flint on Phthisis . . .	15
— on Diseases of the Kidneys . . .	8	— on Percussion and Auscultation . . .	15
Beale on Kidney Diseases . . .	8	Flower's Nerves of the Human Body . . .	10
Bellamy's Guide to Surgical Anatomy . . .	10	Foster's Clinical Medicine . . .	12
Bennet's Winter and Spring on the Mediterranean . . .	16	Fox (T.) Atlas of Skin Diseases . . .	19
— Pulmonary Consumption . . .	16	Fox and Farquhar's Skin Diseases of India . . .	20
— Nutrition . . .	18	Frey's Histology . . .	9
Bennett (J. R.) on Cancerous Growths . . .	19	Gamgee on Fractures of the Limbs . . .	6
Bigg's Orthopraxy . . .	6	Gant's Science and Practice of Surgery . . .	4
Black on the Urinary Organs . . .	8	— Diseases of the Bladder . . .	8
— on Bright's Disease . . .	8	Gaskoin on Psoriasis or Lepra . . .	20
Braune's Topographical Anatomy . . .	11	Glenn's Laws affecting Medical Men . . .	20
Brodhurst's Orthopædic Surgery . . .	6	Godlee's Atlas of Human Anatomy . . .	11
Bryant's Practice of Surgery . . .	4	Gordon on Fractures . . .	6
Bucknill and Tuke's Psychological Medicine . . .	21	Habershon on Diseases of the Liver . . .	17
Burdett's Cottage Hospital . . .	14	— on Diseases of the Stomach . . .	17
Buzzard on Syphilitic Nervous Affec- tions . . .	9	— on the Pneumogastric Nerve . . .	17
Carpenter's Human Physiology . . .	10	Hancock's Surgery of Foot and Ankle . . .	6
Carter on Mycetoma . . .	20	Harris on Lithotomy . . .	7
Cauty on Diseases of the Skin . . .	20	Hayden on the Heart . . .	15
Chapman on Neuralgia . . .	18	Heath's Minor Surgery and Bandaging . . .	5
Charteris' Practice of Medicine . . .	11	— Diseases and Injuries of Jaws . . .	5
Clark's Outlines of Surgery . . .	4	— Operative Surgery . . .	5
— Surgical Diagnosis . . .	5	— Practical Anatomy . . .	11
Clay's Obstetric Surgery . . .	13	Higgins' Ophthalmic Practice . . .	23
Cobbold on Worms . . .	20	Holden's Landmarks . . .	10
Coles' Dental Mechanics . . .	23	Holt on Stricture of the Urethra . . .	7
Cooper's Surgical Dictionary . . .	4	Hood on Gout, Rheumatism, &c. . .	19
Cormack's Clinical Studies . . .	12	Hooper's Physician's Vade-Mecum . . .	11
Cottle's Hair in Health and Disease . . .	20	Horton's Tropical Diseases . . .	17
Coulson on Syphilis . . .	9	Hutchinson's Clinical Surgery . . .	5
— on Stone in the Bladder . . .	9	Huth's Marriage of Near Kin . . .	10
Cullingworth's Nurse's Companion . . .	14	Ireland's Idiocy and Imbecility . . .	21
Curling's Diseases of the Rectum . . .	7	Jones (C. H.) and Sieveking's Patho- logical Anatomy . . .	10
		— (C. H.) on Functional Nervous Disorders . . .	17

	PAGE		PAGE
Jones (Wharton) Ophthalmic Medicine and Surgery . . .	23	Smith (W. R.) Nursing . . .	14
Jordan's Surgical Inflammations . . .	6	Spender's Bath Waters . . .	16
— Surgical Inquiries . . .	6	Steiner's Diseases of Children . . .	12
Kennion's Springs of Harrogate . . .	16	Stowe's Toxicological Chart . . .	20
Lawson on Sciatica, &c. . .	18	Sullivan's Tropical Diseases . . .	17
Lee (H.) Practical Pathology . . .	8	Swain's Surgical Emergencies . . .	5
— on Syphilis . . .	8	Swayne's Obstetric Aphorisms . . .	13
Leared on Imperfect Digestion . . .	18	Taft's Operative Dentistry . . .	23
Liebreich's Atlas of Ophthalmoscopy . . .	22	Tait's Hospital Mortality . . .	14
Living on Megrim, &c. . .	18	Taylor's Principles of Medical Jurisprudence . . .	20
Macdonald's Examination of Water . . .	22	— Manual of Medical Jurisprudence . . .	20
Mackenzie on Growths in the Larynx . . .	15	— Poisons in relation to Medical Jurisprudence . . .	20
Macnamara on Diseases of the Eye . . .	22	Thompson's Stricture of Urethra . . .	7
Madden's Health Resorts . . .	16	— Practical Lithotomy and Lithotrity . . .	7
Marsden on certain Forms of Cancer . . .	19	— Diseases of Urinary Organs . . .	7
Mason on Harelip and Cleft Palate . . .	5	— Diseases of the Prostate . . .	7
Maunder's Operative Surgery . . .	4	— Calculous Disease . . .	7
— Surgery of Arteries . . .	4	Thornton on Tracheotomy . . .	16
Mayne's Medical Vocabulary . . .	22	Thorowgood on Asthma . . .	15
Meryon's System of Nerves . . .	18	— on Materia Medica . . .	12
Moore's Family Medicine for India . . .	17	Thudichum's Pathology of Urine . . .	9
Parkes' Manual of Practical Hygiene . . .	21	Tibbits' Medical Electricity . . .	22
Parkin's Epidemiology . . .	23	— Map of Motor Points . . .	22
Pavy on Food and Dietetics . . .	18	Tilt's Uterine Therapeutics . . .	13
Peacock's Valvular Disease . . .	15	— Change of Life . . .	13
Phillips' Materia Medica . . .	12	— Health in India . . .	17
Pirrie's Surgery . . .	4	Tomes' (C. S.) Dental Anatomy . . .	23
Ramsbotham's Obstetrics . . .	13	— (J. and C. S.) Dental Surgery . . .	23
Reynolds' Uses of Electricity . . .	22	Tufnell's Internal Aneurism . . .	7
Roberts' Practice of Midwifery . . .	13	Tuke on the Influence of the Mind upon the Body . . .	21
Roussel's Transfusion of Blood . . .	5	Van Buren on Diseases of the Genito-Urinary Organs . . .	9
Routh's Infant Feeding . . .	12	Veitch's Handbook for Nurses . . .	14
Roy's Burdwan Fever . . .	17	Virchow's Post-mortem Examinations . . .	10
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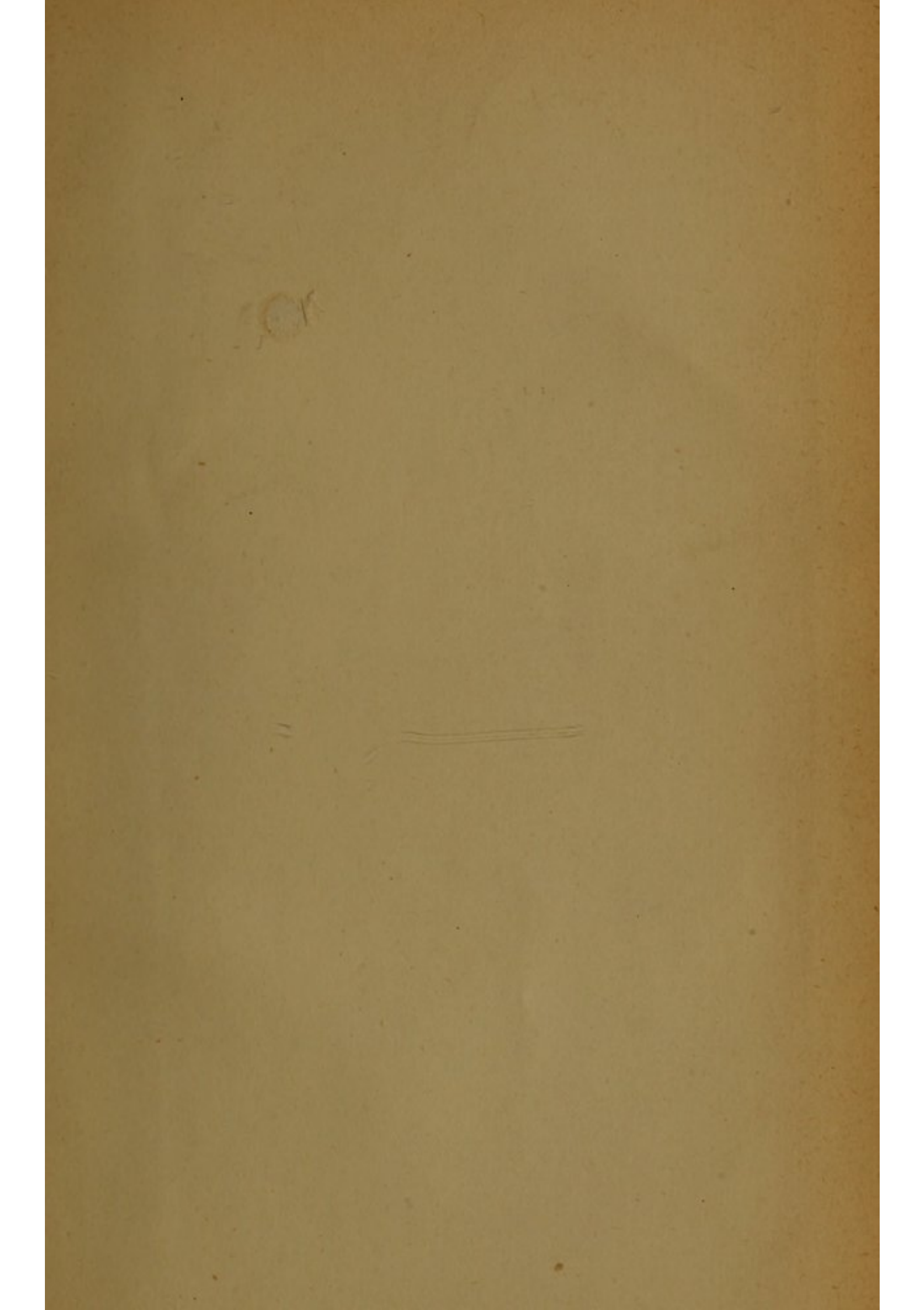
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