RESEARCHES INTO THE ÆTIOLOGY OF ACUTE RHEUMATISM

I.—RHEUMATIC CARDITIS: POST-MORTEM INVESTIGATION OF NINE CONSECUTIVE CASES

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Introduction

Westphal, Wassermann and Malkoff (1899) isolated streptococci from the blood, brain and heart valves of a girl dead as a result of acute endocarditis, and thereby initiated countless attempts to define the exact relationship between streptococcal infection and rheumatism. Independently and almost simultaneously Poynton and Paine (1900) recorded their first observations, in which they came to the conclusion that streptococcal infection was a cause of acute rheumatism. Among those workers who have reported confirmation of these findings may be mentioned Walker and Ryffel (1903), Beattie and Yates (1912), Lyall (1912), Swift and Kinsella (1917), and Clawson (1925). Probably an even greater number of investigators have recorded complete failure to recover organisms from any site in rheumatic subjects. Even in the successful series streptococci were recovered from the blood during life or after death, and only occasionally from the joint or cardiac lesions. These facts have given rise to the general conclusion that the cultural findings did not support the simple explanation that rheumatism was the result of the direct invasion of the joint and cardiac tissues by streptococci, but did not exclude the possibility that some association of more complex nature existed. Agonal and post-mortem bacterial invasion of the blood stream is of frequent occurrence, as shown by Wright (1925), and must be carefully considered in relation to post-mortem cultural investigations. There was no uniformity as regards the type of streptococcus isolated by successful investigators, and this again has thrown doubt on the exact significance of their findings. In most instances, however, the organism has been

of the alpha-hæmolytic variety, or, according to Birkhaug (1927), Small (1927) and Kriedler (1928), the organisms may be indifferent in type. At the present time death in the acute or subacute phase of rheumatic infection is uncommon, but the series of nine consecutive cases described below were observed in Edinburgh during the space of twelve months.

Methods

Collection of Specimens.—The bacteriological investigations were made during the course of the routine post-mortem examination, the shortest interval between death and autopsy being fifteen hours and the longest thirty-six hours. After opening the thorax any free fluid present in the pleural sacs was collected by means of a sterile syringe. The anterior surface of the pericardium was then seared while the heart was still *in situ*, and any free fluid in the pericardial sac was collected by means of a syringe plunged through the seared surface. The parietal pericardium was then partially reflected aseptically, and one or more pieces of any exudate present on both parietal and visceral surfaces were taken. The surface of the heart was then seared, and from 2 to 5 c.c. of heart blood were taken for culture, distributed as 1 c.c. volumes in 10 c.c. digest broth. The heart was then removed from the body, opened aseptically, and portions of any valves showing recent vegetations were cut into two or more fragments, each of which was cultured separately. No attempt was made to wash the valves free of traces of adherent blood. For controls, portions of valves without vegetations were taken from the same hearts.

Culture Media.—Horse digest broth: The medium described by O'Meara (1934) was used throughout in the primary culture of all specimens. In the case of fluids—*e.g.*, pericardial fluid—1 c.c. of the specimen was added to 10 c.c. digest broth. Tissue specimens were cut into small fragments, and each cultured in a separate tube of broth.

Blood agar plates: After twenty-four hours' incubation at 37° C. the digest broth cultures were plated on 5 per cent. horse-blood agar and incubated aerobically.

Serological Typing.—The slide agglutination technique described by Griffiths (1934) was used in the identification of strains of hæmolytic streptococci isolated by the above methods.

Results.

Nine consecutive cases of primary or recurrent rheumatic carditis were examined by the above methods, and twenty-two non-rheumatic subjects were similarly treated as controls.

Rheumatic Series:

Case 1.—C. C., female, aged fifty-three years.

Clinical Diagnosis.—Acute rheumatic endocarditis.

Clinical Features.—Admitted to hospital in fourth attack of acute rheumatism with obvious signs of established endocarditis. She developed acute congestive failure after the subsidence of joint pains. Hæmolytic streptococci, type 27, were isolated from the throat ten days before death.

Post-mortem Findings.—The pericardial sac was completely obliterated by fibrinous adhesions, no free fluid being present. The heart showed generalised dilatation, with marked hypertrophy of the left ventricle and auricle.

Tricuspid valve: Areas of old fibrous thickening, and several small, recent vegetations of rheumatic type.

Mitral valve: Gross stenosis due to old fibrous thickening of chordæ tendineæ, with several recent vegetations on auricular surface.

Aortic valve: Fibrous lesions, resulting in partial adhesion of cusps, but no evidence of recent endocarditis.

Pulmonary valve: Healthy.

There were no vegetations of the ulcerative type nor those associated with subacute bacterial endocardial endocarditis. The lungs, liver and spleen presented the appearances produced by venous congestion, and no infarcts were detected.

Cultural Results:

Heart blood	Tube 1. *B. coli.* Tube 2. *B. coli.*
Tricuspid valve ..	Tube 1. Hæmolytic streptococci, type 27, and *B. coli.* Tube 2. *B. coli.* Tube 3. No growth.
Mitral valve	Tube 1. Hæmolytic streptococci, type 27. Tube 2. Hæmolytic streptococci, type 27, and *B. coli.* Tube 3. *B. coli.*
Aortic valve	Tubes 1, 2 and 3. No growth.
Pulmonary valve ..	Tube 1. *B. coli.* Tube 2. No growth.
Pericardial exudate ..	Tube 1. Hæmolytic streptococci, type 27. Tube 2. Hæmolytic streptococci, type 27.

Microscopic Examination.—Sections of mitral valve, stained by hæmatoxylin and eosin, showed fibrous scarring with persistent vascularisation. There was superficial necrosis and new formation of vegetations, but little or no cellular reaction. Sections of myocardium showed a few small areas of fibrosis, but no Aschoff bodies. Sections of mitral valve and myocardium, stained Gram, showed no organisms.

CASE 2.—G. B., male, aged twenty-two years.

Clinical Diagnosis.—Rheumatic carditis, mitral stenosis and incompetence.

Clinical Features.—Rheumatic fever had occurred at the age of eight years. Two years before present attack patient had been treated for auricular fibrillation. He was admitted to hospital with mitral stenosis and incompetence, and, on improvement, was transferred to a convalescent home. He continued to progress favourably until he "caught a cold," and had then to be readmitted to hospital. At this time a throat swab yielded a heavy growth of hæmolytic streptococci, type 14. He then developed the typical rheumatic syndrome with severe pains in both wrists, ankles, and knees. Pericarditis supervened, and the additional stress on an already failing heart ended in death.

Post-mortem Findings.—The peritoneal cavity contained more than a pint of clear serous fluid. The pericardial sac was grossly distended, containing a quart of fluid. Both parietal and visceral layers of the pericardium were covered with fresh fibrinous exudate. Posteriorly the sac was obliterated by adhesions between the two layers. All chambers of the heart were dilated, particularly the left auricle and ventricle.

Tricuspid valve: Apparently healthy.

Mitral valve: Both cusps slightly thickened, and the chordæ greatly shortened. There was a complete line of vegetations along the margin of the valve.

Pulmonary valve: One small area of fibrosis.

Aortic valve: Old-standing fibrosis, but no recent lesions.

Cultural Results:

Heart blood	Tube 1. No growth. Tube 2. No growth.
Pericardial fluid ..	Tube 1. No growth. Tube 2. No growth.
Pericardial exudate ..	Tube 1. Hæmolytic streptococci, type 14. Tube 2. Hæmolytic streptococci, type 14.
Tricuspid valve ..	Tube 1. No growth. Tube 2. No growth.
Mitral valve	Tube 1. Hæmolytic streptococci, type 14, and *B. coli.* Tube 2. *B. coli.*
Aortic valve	Tube 1. *B. coli.* Tube 2. No growth.

CASE 3.—D. F., female, aged thirty-three years.

Clinical Diagnosis.—Acute rheumatic fever.

Clinical Features.—Ten days after recovering from an attack of tonsillitis, which lasted one week, acute polyarthritis of the limbs appeared. This continued for five weeks, when acute endocarditis was manifest. After admission to hospital hæmolytic streptococci, type 18, were isolated from the throat. The patient became increasingly breathless, and died after a period of respiratory distress.

Post-mortem Findings.—The pericardial sac contained about 2 c.c. of fluid, but the two layers of the pericardium were gummed together by fresh fibrinous exudate, and tore apart to leave the shaggy surfaces typical of an acute rheumatic pericarditis. The pleural sacs contained considerable quantities of serous effusion.

Tricuspid valve: No macroscopic lesions.

Mitral valve: Typical minute vegetations along the line of closure, and a slight degree of older thickening of the posterior cusp.

Aortic valve: Complete ring of minute fresh vegetations.

Pulmonary valve: No macroscopic lesions.

The right upper lobe of the lung showed a patch of confluent bronchopneumonia which was apparently terminal.

Cultural Results :

Heart blood	Tubes 1 and 2. *B. coli.* Tube 3. No growth.
Mitral valve	Tube 1. Hæmolytic streptococci, type 18, and *B. coli.* Tube 2. Hæmolytic streptococci, type 18, and *B. coli.*
Aortic valve	Tube 1. Hæmolytic streptococci, type 18, and *B. coli.* Tube 2. Hæmolytic streptococci, type 18, and *B. coli.*
Pulmonary valve ..	Tube 1. *B. coli.* Tube 2. *B. coli.*
Pericardial exudate ..	Tube 1. Hæmolytic streptococci, type 18. Tube 2. Hæmolytic streptococci, type 18.
Pericardial fluid ..	Tubes 1 and 2. No growth.

CASE 4.—E. S., female, aged fourteen years.

Clinical Diagnosis.—Rheumatic endocarditis, terminal ? meningitis.

Clinical Features.—This girl had acute rheumatism at the ages eleven and thirteen years. After the second attack mitral stenosis and incompetence appeared. In a convalescent home patient continued to have frequent pains in her legs and arms. Septic tonsils were removed, but the increasing dyspnœa and œdema of the legs resulted in readmission to hospital. On the second night she complained of headaches, and there was slight neck rigidity. She died at 10.30 a.m. the following morning.

Post-mortem Findings.—The pericardial sac contained 2 c.c. fluid, and in the abdominal cavity was a considerable volume of free fluid. The heart was greatly enlarged, both right and left ventricles being affected.

Tricuspid valve: Typical line of minute vegetations.

Mitral valve: Minute vegetations with older fibrous thickening.

Aortic valve: Many minute vegetations with older fibrous thickening.

Pulmonary valve: Apparently healthy.

Kidneys: Both organs showed chronic venous congestion. No evidence of meningitis was found, and the brain, middle ears and accessory sinuses appeared healthy.

Cultural Results :

Heart blood	Tubes 1 and 2. No growth.
Tricuspid valve ..	Tube 1. Hæmolytic streptococci, type 6. Tube 2. No growth.
Mitral valve	Tube 1. Hæmolytic streptococci, type 6, and *B. coli.* Tube 2. Hæmolytic streptococci, type 6.
Aortic valve	Tube 1. Hæmolytic streptococci, type 6. Tube 2. Hæmolytic streptococci, type 6.
Pulmonary valve ..	Tubes 1 and 2. No growth.

Microscopic Examination.—Sections of mitral and aortic valves showed typical rheumatic, non-ulcerative vegetations with little cellular response. No organisms were seen in sections stained by Gram's method.

CASE 5.—T. T., male, aged four years.

Clinical Diagnosis.—Acute polyarthritis and endocarditis.

Clinical Features.—Within six weeks of scarlatina the patient, who had appeared to have completely recovered, suddenly became ill with pyrexia and swelling of several joints, which were painful and extremely tender. Endocarditis supervened with a fatal result.

Post-mortem Findings.—The pleural cavity contained 5 c.c. serous fluid. The pericardial sac was dry, the walls being adherent with recently formed exudate. The left ventricle was considerably dilated.

Tricuspid valve: A number of minute rheumatic vegetations were present.

Mitral valve: A large number of recent vegetations bordered the free edge.

Aortic and pulmonary valves: Apparently healthy.

The lower lobe of the left lung showed a pale infarct of some standing, being separated from neighbouring tissue by well-formed fibrous tissue. The right middle lobe was the seat of a chronic inflammatory process, with diffuse interstitial fibrosis, atrophy of alveoli, partial or complete obliteration of some bronchi and enlargement of others.

Cultural Results.—A post-mortem throat swab yielded *Streptococcus viridans*, pneumococci and *Staphylococcus albus*.

Heart blood	Tubes 1 and 2. No growth.
Tricuspid valve ..	Tubes 1 and 2. No growth.
Mitral valve	Tube 1. *Streptococcus viridans* in pure culture. Tube 2. *Streptococcus viridans* in pure culture.
Pulmonary valve ..	Tubes 1 and 2. *Streptococcus viridans* in pure culture.
Pericardial exudate ..	Tubes 1 and 2. No growth on culture.
Peritoneal fluid ..	Tubes 1 and 2. No growth on culture.

Microscopic Examination.—Sections of the left ventricle showed rheumatic nodules at a late stage. No organisms were seen in sections stained by Gram's method.

CASE 6.—N. P., male, aged six years.

Clinical Diagnosis.—Acute rheumatic fever.

Clinical Features.—This patient was admitted to hospital with a history of polyarthritis of only one week's duration. Acute endocarditis followed, and death occurred within three weeks of onset of symptoms.

Post-mortem Findings.—There was a large serous effusion on both sides of the thoracic cavity. A typical organising pericarditis was present, with only a small volume of free fluid.

Tricuspid valve: Apparently healthy.

Mitral valve: Minute rheumatic vegetations, with slight fibrous thickening, indicating that the lesions were probably of longer duration than the history indicated.

Aortic valve: As in the case of mitral valve.

Pulmonary valve: Apparently healthy.

Cultural Results.—In my absence Dr. A. R. Macgregor, Pathologist to the Royal Hospital for Sick Children, Edinburgh, made the primary cultures.

Pericardial fluid: Hæmolytic streptococci, type 2, and *Streptococcus viridans.*

Mitral valve: Hæmolytic streptococci, type 2, and *Streptococcus viridans.*

Microscopic Examination.—No organisms were seen in Gram-stained sections of pericardial exudate or mitral valve.

CASE 7.—F. H., female, aged fourteen years.

Clinical Diagnosis.—Acute rheumatic endocarditis.

Clinical Features.—This patient had a severe attack of rheumatic fever. Convalescence was slow, and six months later she began to complain of breathlessness. A sudden exacerbation of the respiratory distress was followed by flitting pains in the limbs, and the reappearance of pyrexia. On admission to hospital she collapsed with marked tachycardia. A routine throat examination during life yielded hæmolytic streptococci, type 4.

Post-mortem Findings.—The pleural sacs contained considerable quantities of serous fluid. The pericardial cavity contained a small volume of free fluid, but there was no pericarditis.

Tricuspid valve: Rheumatic vegetations extended along the line of closure of all cusps.

Mitral valve: Many fresh vegetations were present.

Aortic valve: Many recent vegetations were present and, in addition, the fibrous thickening of an older lesion was noted.

There was no macroscopic evidence of subacute bacterial endocarditis.

Cultural Results :

Heart blood	Tube 1. No growth. Tube 2. No growth.
Tricuspid valve ..	Tube 1. Hæmolytic streptococci, type 14, isolated. Tube 2. Hæmolytic streptococci, type 14, isolated.
Mitral valve	Tubes 1 and 2. Hæmolytic streptococci, type 14, isolated.
Aortic valve	Tube 1. Hæmolytic streptococci, type 14, isolated.
Pulmonary valve ..	Tubes 1 and 2. No growth.

Microscopic Examination.—Sections of aortic, mitral and tricuspid valves showed recent rheumatic vegetations, and many Aschoff nodules throughout the heart muscle. No organisms were seen in Gram-stained films.

CASE 8.—W. P., female, aged nine years.

Clinical Diagnosis.—Rheumatic endocarditis and chorea.

Clinical Features.—The initial symptoms in this case were those of chorea. After slight trauma of the knee following a fall from a car, patient returned to school, but was sent home because of sickness and "raving." She commenced to kick her right foot against objects, and violent shrugging movements of the right shoulder followed. Later the left side of the body became involved. Acute endocarditis then developed, and at this stage hæmolytic streptococci, type 1, were isolated from the throat. Death occurred within three weeks of the onset of endocarditis.

Post-mortem Findings.—The serous sacs were all apparently healthy.

Tricuspid valve: No lesions were detected.

Mitral valve: Numerous minute lesions were present along the line of closure.

Aortic valve: A few vegetations along the ventricular aspect.

Pulmonary valve: Apparently healthy.

Cultural Results:

Heart blood ..	..	Tubes 1 and 2. No growth.
Tricuspid valve	..	Tubes 1 and 2. No growth.
Mitral valve ..	..	Tubes 1 and 2. Hæmolytic streptococci, type 1.
Aortic valve ..	..	Tubes 1 and 2. No growth.
Pulmonary valve	..	Tubes 1 and 2. No growth.

Microscopic Examination.—Sections of the left and right sides of heart were thoroughly examined, but no Aschoff bodies were seen. No specific or focal changes in the brain were found other than hyperæmia and ganglion cell chromatolysis.

No organisms were seen in Gram-stained sections of heart valve and muscle.

CASE 9.—E. S., female, aged nine years.

Clinical Diagnosis.—This patient was admitted to hospital with a history of pyrexia and flitting pains in the joints. On admission an active heart lesion was already present. She was later sent to a convalescent home with mitral and aortic incompetence. An attack of tonsillitis preceded a relapse, and she was readmitted to hospital with severe præcordial pain, but no evidence of endocarditis. No hæmolytic streptococci were recovered from the throat. Signs of consolidation of the left lower lobe appeared, and a terminal broncho-pneumonia hastened death.

Post-mortem Findings.—The sérous sacs all contained an excess of clear fluid, but there was no pericarditis. The heart was much enlarged, being both dilated and hypertrophied.

Tricuspid valve: Apparently healthy.

Mitral valve: Almost completely encircled by recent small vegetations.

Aortic valve: Several recent vegetations present, and also some older thickening of the cusps.

Pulmonary valve: Apparently healthy.

Cultural Results:

Heart blood ..	..	Tubes 1 and 2. No growth.
Tricuspid valve	..	Tubes 1 and 2. No growth.
Mitral valve ..	..	Tube 1. Hæmolytic streptococci, type 1. Tube 2. No growth.
Aortic valve ..	..	Tubes 1 and 2. No growth.

Microscopical Examination.—Numerous Aschoff bodies were seen in the interlobular septa of the myocardium, but no organisms were found in Gram-stained sections.

Summarising the above results, Table I. shows that from eight of this series of nine cases of rheumatic carditis hæmolytic streptococci were recovered from the heart valves with vegetations and from the pericardial lesions. This organism was

TABLE I.—RESULTS OF POST-MORTEM BACTERIOLOGICAL EXAMINATION ON NINE CONSECUTIVE CASES OF RHEUMATIC CARDITIS

Case.	*Clinical Diagnosis.*	*Pathological State and Result of Culture.*							*Notes.*
		Tube.	*Heart Blood.*	*Tricuspid Valve.*	*Mitral Valve.*	*Aortic Valve.*	*Pulmonary Valve.*	*Pericardium.*	
1	Acute rheumatic endocarditis	1	*B. coli*	+ Hæmolytic streptococci, type 27	+ Hæmolytic streptococci, type 27	− No growth	− *B. coli*	+ Hæmolytic streptococci, type 27	Hæmolytic streptococci, type 27, isolated from throat during life.
		2	*B. coli*	*B. coli*	Hæmolytic streptococci, type 27, and *B. coli*	No growth	No growth	Hæmolytic streptococci, type 27	
		3		No growth	*B. coli*	No growth			
2	Mitral stenosis and incompetence	1	No growth	− No growth	+ Hæmolytic streptococci, type 14, and *B. coli*	− *B. coli*	−	+ Hæmolytic streptococci, type 14	Hæmolytic streptococci, type 14, isolated from throat during life.
		2	No growth	No growth	*B. coli*	No growth		Hæmolytic streptococci, type 14	
		3			No growth				
3	Acute rheumatic fever	1	*B. coli*	− No growth	+ Hæmolytic streptococci, type 18, and *B. coli*	+ Hæmolytic streptococci, type 18, and *B. coli*	− *B. coli*	+ Hæmolytic streptococci, type 18	Hæmolytic streptococci, type 18, isolated from throat during life.
		2	*B. coli*	No growth	Hæmolytic streptococci, type 18, and *B. coli*	Hæmolytic streptococci, type 18, and *B. coli*	*B. coli*	Hæmolytic streptococci, type 18	
		3	No growth						
4	Rheumatic endocarditis	1	No growth	+ Hæmolytic streptococci, type 6	+ Hæmolytic streptococci, type 6, and *B. coli*	+ Hæmolytic streptococci, type 6	− No growth	+ No growth	

		2	No growth	No growth	Hæmolytic streptococci, type 6	Hæmolytic streptococci, type 6	No growth	No growth	
5	Acute polyarthritis and endocarditis	1	No growth	+ No growth	+ *Streptococcus viridans*	−	− *Streptococcus viridans*	+ No growth	Pneumococci, *Streptococcus viridans* and *Staphylococcus albus*, isolated on culture from throat at post-mortem.
		2	No growth	No growth	*Streptococcus viridans*		*Streptococcus viridans*	No growth	
6	Acute rheumatic fever				+ Hæmolytic streptococci, type 2, and *Streptococcus viridans*	+	−	+	
7	Acute rheumatic fever	1	No growth	+ Hæmolytic streptococci, type 4	+ Hæmolytic streptococci, type 4	+ Hæmolytic streptococci, type 4	− No growth	−	Hæmolytic streptococci, type 4, isolated from throat during life.
		2	No growth	Hæmolytic streptococci, type 4	Hæmolytic streptococci, type 4	No growth	No growth		
8	Rheumatic endocarditis	1	No growth	− No growth	+ Hæmolytic streptococci, type 1	+ No growth	− No growth	−	Hæmolytic streptococci, type 1, isolated from throat during life.
		2	No growth	No growth	Hæmolytic streptococci, type 1	No growth	No growth		
9	Subacute rheumatism	1	No growth	− No growth	+ Hæmolytic streptococci, type 1	+ No growth	−	−	
		2	No growth	No growth	No growth	No growth			

+ = macroscopic lesions of recent origin present. − = no macroscopic lesions of recent origin present.

present in pure culture in seven valves. In six others coliform organisms were also present, and in one case *Streptococcus viridans* and *Streptococcus hæmolyticus* were both obtained. No growth was obtained from three of the remaining five valves with vegetations, one yielded *Streptococcus viridans*, and one was not cultured. As controls, twelve valves without macroscopic lesions from these same hearts were cultured, and in no instance were hæmolytic streptococci recovered. Coliform organisms were obtained in three valve cultures and *Streptococcus viridans* in one, the remaining eight being sterile. The heart blood was sterile in six cases of the rheumatic series, coliform organisms were present in two, and in one instance this control was omitted.

NON-RHEUMATIC SERIES.—The results obtained in the twenty-two non-rheumatic cases are summarised in Table II. Coliform organisms and hæmolytic streptococci were both recovered from the heart valves of a case of post-operative peritonitis, while in one case of broncho-pneumonia hæmolytic streptococci were obtained in pure culture from the heart blood and heart valves. In both cases the pericardial cultures remained sterile, and *all* the heart-valve cultures yielded growths of hæmolytic streptococci. As the valve inocula were not washed free of blood, the presence of hæmolytic streptococci was attributed to traces of infected blood on the valve surfaces.

TABLE II.—RESULTS OF POST-MORTEM BACTERIOLOGICAL EXAMINATION OF TWENTY-TWO NON-RHEUMATIC CONTROL CASES.

Number of Cases.	*Result of Culture.*		
	Heart Blood.	*Heart Valves.*	*Pericardium.*
15	Sterile	Sterile	Sterile.
3	Coliform organisms	Sterile	Sterile.
2	Coliform organisms	Coliform organisms	Sterile.
1	Coliform organisms and hæmolytic streptococci	Coliform organisms and hæmolytic streptococci	Sterile.
1	Hæmolytic streptococci	Hæmolytic streptococci	Sterile.

Discussion

The distribution of hæmolytic streptococci in cultures from rheumatic and non-rheumatic hearts in the above series was striking. Unless a phenomenal chance distribution of hæmolytic streptococci in the heart valves of the various cases were postulated, the results indicated that agonal or post-mortem blood invasion did not explain the appearance of hæmolytic streptococci in only valves with macroscopic lesions. Coliform organisms were also isolated under the same conditions, but were found in the heart blood and in cultures from both healthy and diseased valves. Careful examination of serial sections of vegetations excluded the possibility that the positive findings were the result of subacute bacterial endocarditis. The pathological manifestations were entirely those of rheumatic endocarditis, and no organisms were found in sections stained by the routine Gram's method. Any possibility that the presence of hæmolytic streptococci was the result of contamination from some source other than the tissues of the bodies under examination was completely excluded by the fact that in five cases the streptococcus recovered from the cardiac lesion, in the individual case, was of the same serological type as the strain isolated from the patient's throat before death. Further, in those cases where hæmolytic streptococci were isolated from more than one valve the strains were serologically identical. Indirect evidence has already been reported as to the part played by hæmolytic streptococci in acute rheumatic infections by Green, 1938 (*a*) (*b*). The observations now presented greatly strengthen this association, and strongly support the view that these organisms bear a causal relationship to the lesions of the disease. Although the number of cases in this series is too limited to be conclusive, they are recorded in order to encourage further work on the same lines.

Summary and Conclusions

1. The pericardial and valvular lesions in nine cases of acute rheumatic endocarditis were examined bacteriologically.

2. Hæmolytic streptococci were cultivated from valves with macroscopic lesions in eight cases, and *Streptococcus viridans* in one case.

3. Hæmolytic streptococci could not be cultivated from valves without macroscopic lesions, nor from heart blood, in the same cases.

4. In five cases hæmolytic streptococci were recovered from the throat during life, and in each case the strain was serologically identical with that isolated from the cardiac lesions.

5. Hæmolytic streptococci were cultivated from both heart blood and heart valves in two of twenty-two non-rheumatic control cases.

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