A N K Y L O S I N G S P O N D Y L I T I S

A CLINICAL STUDY

by

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C O N T E N T S

1. INTRODUCTION

Ankylosing spondylitis is a disease of long duration, notoriously difficult to diagnose in its early stages, which produces crippling deformity as its end results. The classic descriptions of the disorder are of the late, advanced condition so well known and so easily recognised at a glance in the street. Diagnosis in the stage of ankylosed crippledom is academic and treatment is merely palliative. Deformity and disability can be prevented or minimised by active treatment if the condition is recognised in time. But timely recognition is difficult for many reasons, the chief being lack of knowledge of the earlier clinical features, and of the natural history of the disease. This remarkable gap in medical knowledge is well illustrated by the poverty of descriptions in the standard text-books, which have varied little from those of the masters of the late 19th century. The existence of this gap has only been realised in the past few years and many authors have contributed much information, but knowledge is still

incomplete and such as is known, is inadequately disseminated. Until the early symptomatology is fully and widely known, delay in diagnosis will occur with inevitable reduction in the efficiency of treatment.

Certain difficulties are, however, inherent in the disease process itself with its variable and unpredictable course. Acute onset and rapid ankylosis within a few months may occur or slow insidious onset and almost imperceptible progression may develop over many years. Between these two extremes are clinical syndromes of all degrees and varieties, no two patients behaving alike. The earliest symptoms often appear trivial to the patient and the inconvenience slight; therefore in civil life advice may not be sought and the condition remains unrecognised. The active physical requirements of military service, however, bring minor disabilities to light and the soldier may present with the condition unrecognisable, although suspected. The practice of military medicine gives an unrivalled opportunity to study the earliest manifestations of this disease.

The clinical work forming the basis of this thesis was carried out between November, 1951 and March, 1956, in the Queen Alexandra Military Hospital, London, when it was possible to examine and observe personally one hundred patients suffering from ankylosing spondylitis, many being in a very early stage. The number represents practically all the cases diagnosed in the Army during that period. When ankylosing spondylitis is recognised or suspected at any station at home or abroad, it is usual for the patient to be referred to the Queen Alexandra Military Hospital. Radiotherapy is undertaken at the Westminster Hospital, London, since this is not available in military hospitals. Some cases, however, diagnosed in the United Kingdom, near centres with facilities for radiotherapy, may be referred direct to civilian hospitals. The total number of patients recognised in the Army during 1951-1956 is probably higher than the number personally seen. All the patients have been admitted to hospital on at least one occasion when investigation and treatment have been carried out, allowing of closer observation than is possible if patients are seen only as

out-patients.

This group of patients, many of them in a very early phase, allowed me to study the onset of symptoms, the early development and the diagnostic difficulties encountered in this disorder. My thesis consists of a review of the historical literature with reference to the clinical picture, a description of the clinical features observed and the treatment given, with a discussion of the nature, aetiology, and clinical features, and the results of treatment.

2. HISTORICAL

Knowledge of the natural history of ankylosing spondylitis has been built up slowly and laboriously over the past century and a half, firstly by deduction from skeletal remains, then by observation and description of gross advanced clinical disease, and finally by recognition and definition of the clinical picture from the onset of symptoms through the earlier phases of the long disease process.

Evidence that ankylosing spondylitis is a disease of great antiquity is found in descriptions in the literature and museum specimens taken from ancient burial places. The earliest specimen is probably that discovered by Flinders Petrie and described by Ruffer (1918), the skeleton of a man of the third dynasty (2980 - 2900 B.C.) whose spinal column from the fourth cervical vertebra to the coccyx was transformed into a solid block by new bone formation in the longitudinal ligaments. Similar changes reported by Arnold were found in a skeleton of about 400 B.C. unearthed at Nordpfalz, (Boland, ~~1855~~ 1953).

In 1907-08 Elliot Smith and Wood Jones (1908-1910) took part in a complete archaelogical survey of lower Nubia, organised by the Survey Department of the Egyptian Government. This survey was conducted over a large tract of land lying immediately south of the First Cataract of the river Nile, which was to be flooded by the enlarged reservoir resulting from raising the Aswan Dam. Graves and burial places dating from early pre-dynastic times down to the fifth century after Christ, were revealed by the excavations and opened, the remains of some six thousand bodies being examined. In the vertebral columns of a number of these, changes described as "spondylitis deformans" were found. As the result of the confusion of terminology existing in the early years of this century many of these changes appear on closer examination to be osteo-arthritis, but one illustration (Plate XLV Figs.1 & 2 of the report) shows ankylosing spondylitis. Wood Jones made a footnote, "In the body of a man of the Ancient Empire (Hearst's Expedition, Excavations at the Giza Pyramids) I have seen the whole spinal column fused into one rigid mass of spondylitis

deformans." Though no further details of this skeleton are available, it may date back to about 3700 B.C. Some of the specimens brought back to the Royal College of Surgeons in London from the Nubian expedition have survived the disasters of the 1939-45 war, and have been examined* with the records of the survey. A fragment of about six vertebrae does show bony ankylosis of the apophyseal joints and smooth bony bridging of the intervertebral space (Specimen 182B). This specimen, although damaged, seems to correspond with plate XLV of the original records. The museum cataloguing system has been so disorganised by war damage that it is impossible to be certain of this identification.

From Biblical times too, comes a brief description of a sufferer who may well have had ankylosing spondylitis, - "and behold there was a woman which had a spirit of infirmity eighteen years and could in no wise lift herself up" (St. Luke's Gospel).

The earliest detailed acceptable account of the morbid anatomy is that of Bernard Connor (1666-1698) who described in his thesis for the degree of Doctor of Medicine of Rheims

* (Through the courtesy of The President and Council, Royal College of Surgeons, England)

University (Copeman, 1955) an extraordinary skeleton found in a charnel house. His accurate observations are preserved (Connor, 1700) in a letter to Lord Stanhope. "I have lately seen in France, part of a human skeleton, consisting of the Os Ilium, the Os Sacrum, the five Vertebrae of the Loins, ten of the back, five entire Ribs on the Right Side, and three on the left; the Bottoms or Ends of the other were closely united to the transverse Apophyses of their Vertebrae ..... All these Bones which naturally are 38 each separate and distinct from another were so straightly and intimately joined, their ligaments perfectly Bony and their articulations so effaced, that they really made but one uniform continuous Bone . . . " After some further description, he goes on to say, "The Figure of this trunk was crooked and making Part of a circle, the spine making the Convex, and the Inside of the Vertebrae the Concave Part of this Segment". The cause for this extraordinary phenomenon is then discussed and Connor logically disposes of the possibility of the bones having become "united after the death of the person", but then erroneously assumes that the

"crooked and bending shape of this skeleton . . . proceeded from the first formation of the Foetus in the Womb from the Egg's not having sufficient Room, or being accidentally pressed by some Abscess in the Womb or elsewhere . . ." This old physician's guess that we may have to look to the womb for a cause was a remarkably shrewd one in the light of modern knowledge of the heredity factor in this disease. He then goes on to deduce extremely accurately the condition in life and the symptoms caused - a clinico-pathological exercise in reverse. ". . . the Body of this Person must have been immoveable; that he could neither bend nor stretch himself out, rise up nor lie down, nor turn upon his Side, having only the Head, Feet and Hands moveable." Then noting that the thorax must have been fixed and most of the respiration undertaken by the diaphragm, he considered it likely that the person had been short of breath.

~~Half~~ A century and a half elapsed before clinical descriptions of the condition in living persons were written by Davies Colley (1855), Brodhurst, (1866), Hilton Fagge (1877) and Sturge (1879).

Fagge's classic report of a case, with autopsy findings, is clear and lucid. It is interesting that this young patient, admitted to Guy's Hospital on 15th July, 1874, under the care of Dr. Wilks, was taken over by Dr. Hilton Fagge "during the absence of Dr. Wilks from London." Then as now, August was the holiday month for the Senior Consultants - the juniors remaining to undertake the care of the patients. Certain clinical observations may be noted. The patient was unable to lie down on account of dyspnoea, the dorsal vertebrae were immobile, there was little neck movement, the ribs were quite fixed and respiration was entirely abdominal while the right hip was fixed. The patient died of pulmonary consolidation just four weeks after admission, the autopsy being performed by Dr. Fagge the same day. The pathological state of the spine is described and illustrated by a beautiful woodcut. Rarefaction of the vertebral bodies and ankylosis of the heads of the ribs with the vertebrae is noted, the latter being illustrated by a second woodcut. The right hip joint was removed "en masse" and found to be firmly ankylosed. The head of the femur showed some

absorption of bone and only some remains of the synovial cavity of the hip joint could be found. In his discussion Fagge states the case to be unique and while recognising the inflammation of the lungs and dilatation of the bronchial tree to be the immediate case of death, thought "the immobility of the dorsal vertebrae and ribs must have played a very important part in the clinical history". That severely crippled patients often die of a pulmonary complication is now well known. Fagge could find no similar pathological specimen in the museums of the Royal College of Surgeons, of Saint Bartholomews, or of Saint Thomas's Hospital. He considered that cases described by Wood (1856) and Lawrence (1827) bore some relation to his, although Wood (1856) thought that the ankylosis was congenital. Lawrence (1827) referred to an early specimen - now indeed considered ankylosing spondylitis described by Sandifort (1793). Fagge had no opinion to offer as to the cause of the condition but concluded that it was a disease process very different from osteo-arthritis.

The brief but clear descriptions by Sturge (1879) of his

case leads to easy diagnosis. He noted the stiff neck and rigid thorax, the old adhesions of the iris of the right eye which had been inflamed before and the resemblance of the clinical features to those of Fagge's case. Marsh (1895) described bony ankylosis of the spine without suppuration, quoting Fagge's case and recognising this condition as an entity, although others suggested the diagnosis of "quiet tuberculosis". Earlier however, Bradford (1883) of Boston, had recognised many important clinical features in his description of ankylosis of the spine; three cases following rheumatism, two being of gonococcal origin. In this paper is an illustration of a patient (a drawing from a photograph) immediately recognisable as an advanced spondylitic. His case I aged 36 had a 16 year history starting with gonorrhoea and rheumatism of various joints, but resulted in complete recovery except for the back which remained stiff. Subsequent innumerable attacks of urethritis and rheumatism led to increased back stiffness, causing the patient to give up his job as a plumber since he was unable to straighten up and reach to work

above his head. The ribs were noted to be fixed, there was no chest expansion and the breathing was entirely diaphragmatic. Bradford's case 2 aged 30 had had several attacks of gonorrhoea and rheumatism, the back becoming rigid and the spine inflexible, but could still stoop by free movement at the hip joints. Again there was no chest expansion and breathing was diaphragmatic. In his case 3, a female aged 31, spinal stiffness and neck pains followed rheumatism of the peripheral joints of three years' duration.

It is an interesting illustration of the apparent rarity of the disease that Pierre Marie (1898) having seen and recognised his first case in 1886, had to wait for ten years to find his second case. The first case, who was under the care of Marie's chief, Charcot, was a patient with a singular rigidity of the spine, thought at first to be Paget's disease. This young man, aged 28, complained first of pain in the groins and dyspepsia when aged 18 and, when aged 26, after a fall into water while hunting, developed a stiff neck, fixed spine, poor chest movement and girdle pains. His second

case seen in 1896, a man of 31, is carefully and accurately described - a model of clinical observation. The onset was in the peripheral joints at the age of 12, the hands being affected, and later the left knee and left hip, severe pain being the only complaint. At the age of 18 his left hip was ankylosed and at 21 his spinal and tempero-mandibular joints began to stiffen. By 24 he had had a resection of the left hip joint and manipulation of the spine under anaesthesia to break down the adhesions - both of which procedures he had survived. Marie describes the posture well, ". . . le tronc se trouve considerablement incliné en avant. . la face regarde par terre à deux ou trois métres en avant des pieds." He noticed the difficulty in getting up, in dressing and in putting on the shoes, the fixed thorax with abdominal respiration and limited shoulder joint movement. He was aware also of the trick of flexing the knee joints, to hold the trunk upright. Like others he searched the museums for help and found a fragment of a spine in the museum Dupuytren, which he considered to show the likely causative pathology. Marie gave the name "spondylose rhizomelique" to the disease which

converted his patients into "des mannequins en bois". Marie quotes Brigon's (1884) report of a cat with a similar disease "chat barre de ferre" whose spine was so rigid that it could not catch mice, being unable to pounce upon them. The classic descriptions in the German literature (von Bechterew 1893, 1897; Strumpell, 1884, 1897) with the contributions of Marie and his colleagues (Marie, 1898; Marie & Astie, 1897; Marie & Leri, 1906) in the French literature, dominated medical thought for the first 30-40 years of this century.

Dana (1899) in his paper on "chronic ankylosing spondylitis" reviewed earlier descriptions of the condition and reported three personal cases.

Goldthwait's (1899) masterly review contains many points of interest. He noted that thirty-five cases had been previously described, and realised that most, if not all, of these referred to the terminal irreparable stage of the disease. His words on early diagnosis have a modern ring and cannot be improved upon - "Early diagnosis is .. of the first

importance as it is at this time before the deformity has taken place that the most can be accomplished." He realised too that early symptoms were often ignored by the patient and overlooked by the physician - "When quiet the pain is so much relieved that the patient does not seek treatment until the disease is far advanced, or if treatment is asked it is often excused without examination as a 'touch of rheumatism' and the therapeutic suggestions made accordingly." From the clear clinical descriptions of his ten cases it is possible to identify five as definite ankylosing spondylitis (cases 4, 5, 6, 8 & 9). His case 9 is of particular interest since the patient complained of an acute pain in the right heel which had caused him considerable and prolonged trouble. This is the earliest reference found to the painful heel of spondylitis. The remaining five cases are probably examples of other conditions, which, at that time, could not be distinguished from ankylosing spondylitis.

Miller (1934) lamented the dearth of American literature on the subject of ankylosing spondylitis, but quoted the

contribution of Elliot (1905) as an exception. In this essay on rigid spine Elliot clearly divides his cases into osteo-arthritis and chronic ankylotic inflammation of the spine. In his five cases of the latter condition he noted that the disease occurred in younger subjects and that the small vertebral joints and the vertebral ligaments were mainly affected; that the condition ran a prolonged course with increasing vertebral rigidity with or without root symptoms, often with involvement of the large and small joints of the extremities and there was a tendency to bony ankylosis of the vertebral column. He recorded that pain was the leading symptom, often radiating down the thighs and that pain was severe during progression, often diminishing when the stage of ankylosis is reached. His cases 1 & 4 had pulmonary tuberculosis, the former dying of this infection. In case 2 there was a previous history of gonorrhoea and pain was relieved by a spinal plaster. Ankylosis of the hip was noticed in case 3 and his case 5 presented with a history of 22 years' duration.

In 1906 Llewellyn Jones showed from the histories of his cases that the disease could commence with polyarticular arthritis and later or coincidentally the vertebral joints became affected. In some the spine appeared to recover leaving peripheral arthritis whereas in others the limb joints recovered, leaving the spine wholly or partially stiff.

For the next twenty-five years, apart from the contribution by Stockman (1926) on "ossifying spondylitis", there is little or no evidence in the English literature of any interest in or progression of knowledge of the disease, until Buckley (1931) reported his series of 60 cases.

But even then advanced disease only was recognised. The beginning of knowledge of the earlier phases resulted from the classic monograph of Gilbert Scott (1942) in which he referred to a pre-spondylitic syndrome with wandering pains.

* * * *

3. CLINICAL FEATURES

The patients examined number one hundred, ninety-nine being males and one being female, and were unselected. Patients in whom the diagnosis was definite, or became definite after a period of observation have been included in the series, but those in whom a tentative diagnosis only without confirmation could be made have been excluded. Acceptable diagnostic criteria have been a suggestive history with, on physical examination, limitation of spinal movement and, on radiological examination, abnormality of the sacro-iliac joints at least. Confirmatory evidence has been tenderness of bony points, limitation of chest expansion, limitation of hip joint movement, a raised erythrocyte sedimentation rate, and radiological evidence of calcification in the spinal ligaments.

A careful history was taken from each patient, particular attention being paid to the date and manner of the onset of symptoms. Since a large proportion of patients (73%) were diagnosed within five years of the onset, (See Fig. 3, p.27) it was considered that the recollection of these patients would be good and their story accurate. In such a series the account of how the disease started and progressed in the earlier phases is likely to be more accurate than in series containing many advanced cases. Particular attention was paid to symptomatic features known to be characteristic, such for example, as periodicity of pain and relation to the time of day and movement or exercise. The previous history was carefully recorded, and in particular any other illness or injury which was related in time, or in the patient's mind, to the onset of symptoms. A family history was taken with reference to ankylosing spondylitis and other rheumatic disease. A general physical examination was

performed, attention being paid to spinal movement and hip joint movement. The chest expansion was recorded to the nearest $\frac{1}{4}$" at the nipple line. Complications or accompaniments of the condition were noted. The results of radiological examination and of the first erythrocyte sedimentation rate (E.S.R.) haemoglobin, red and white blood cell counts, were recorded, as was the type of treatment given. The results of initial treatment were assessed after about three months and were recorded as the patient's fitness for military duty.

These clinical findings were recorded on a simple pro-forma (Table I. Appendix (G),) for each patient, and from these records I have made my observations, analysis has been assisted by a clinical summary chart (Table 2, Appendix (G)). The stage of the disease has been assessed by the criteria of West (1949) who divided patients into three groups according to clinical

features and radiological findings.

1. Early.

Acute attacks of pain with free intervals. Some limitation of spinal movement. X-Ray changes limited to sacro-iliac joints.

2. Moderate.

More constant pain with acute exacerbations. Considerable spinal stiffness. X-Ray changes marked in sacro-iliac joints, and evidence of ligamentous calcification.

3. Advanced.

Minor relapses of pain. Fixed spine with some flexion. X-Ray changes of sclerosed sacro-iliac joints and "Bamboo" Spine".

AGE.

It was considered important to establish as accurately as possible the time of onset of symptoms and therefore the duration of the disease prior to diagnosis. Three factors were recorded :-

1. The age of the patient when seen;
2. The age of the patient at the onset of symptoms;
3. The duration from the onset to the time of diagnosis.

Fig. 1.

The ages of the patients when seen is shown in Figure 1. 35 patients (35%) were aged 19-22 years old, and 50 patients (50%) were seen up to the age of 26 years. Only 8 patients (8%) were aged 45 years or more.

Fig. 2.

The ages of the patients at the onset of symptoms is shown in Fig. 2. This illustrates well the marked tendency of the disease to commence at an early age. Between the ages of 12 and 22 years, symptoms had begun in 59 patients (59%). The age of 19 years seems in this series, to be by far the commonest time of onset - 21 patients (21%).

Fig. 3.

The duration in years from the time of onset to the time of diagnosis is recorded in Figure 3, showing a wide variation from less than one year to 21 years. The diagnosis was made in under one year in 29 patients (29%), and in under five years in 73 patients (73%), and compares

favourably with the time taken to diagnose in previously recorded series of cases.

Fig. 1.

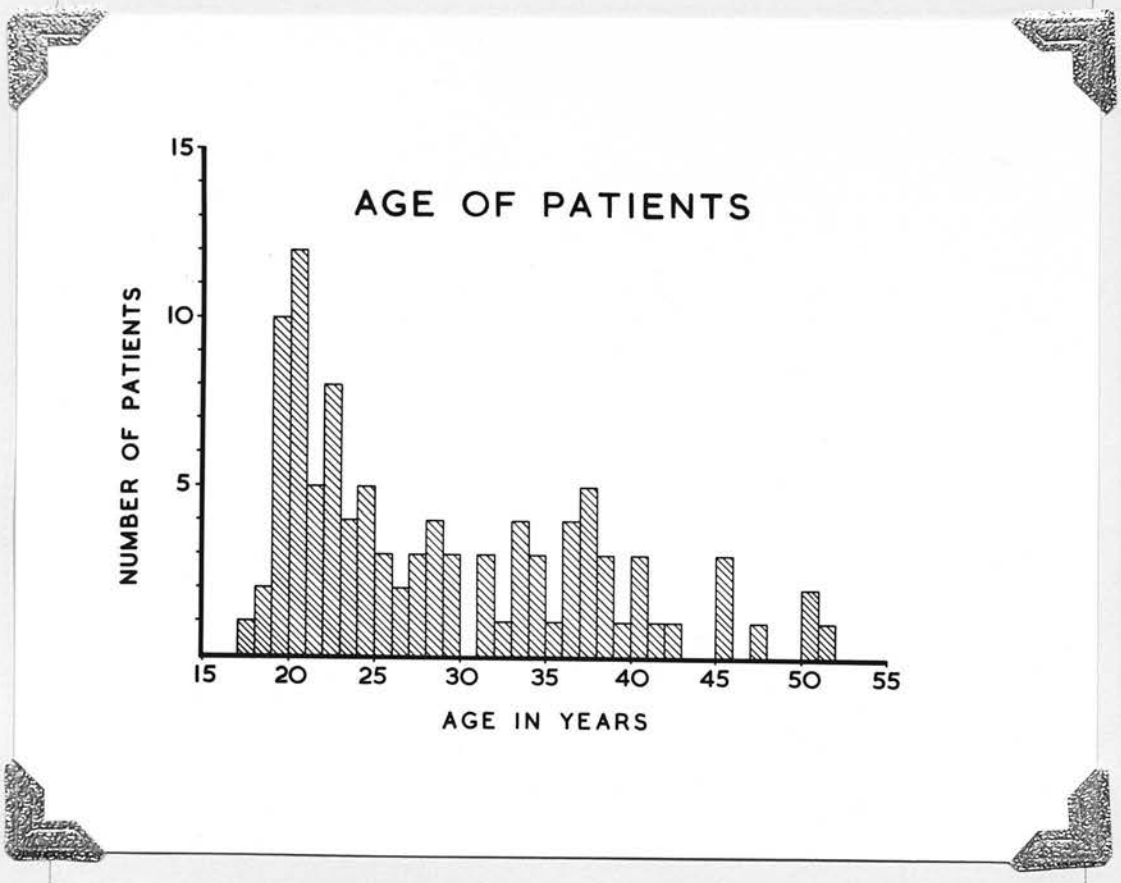

AGE OF PATIENTS
NUMBER OF PATIENTS
15
10
5
15
20
25
30
35
40
45
50
55
AGE IN YEARS

Fig. 2.

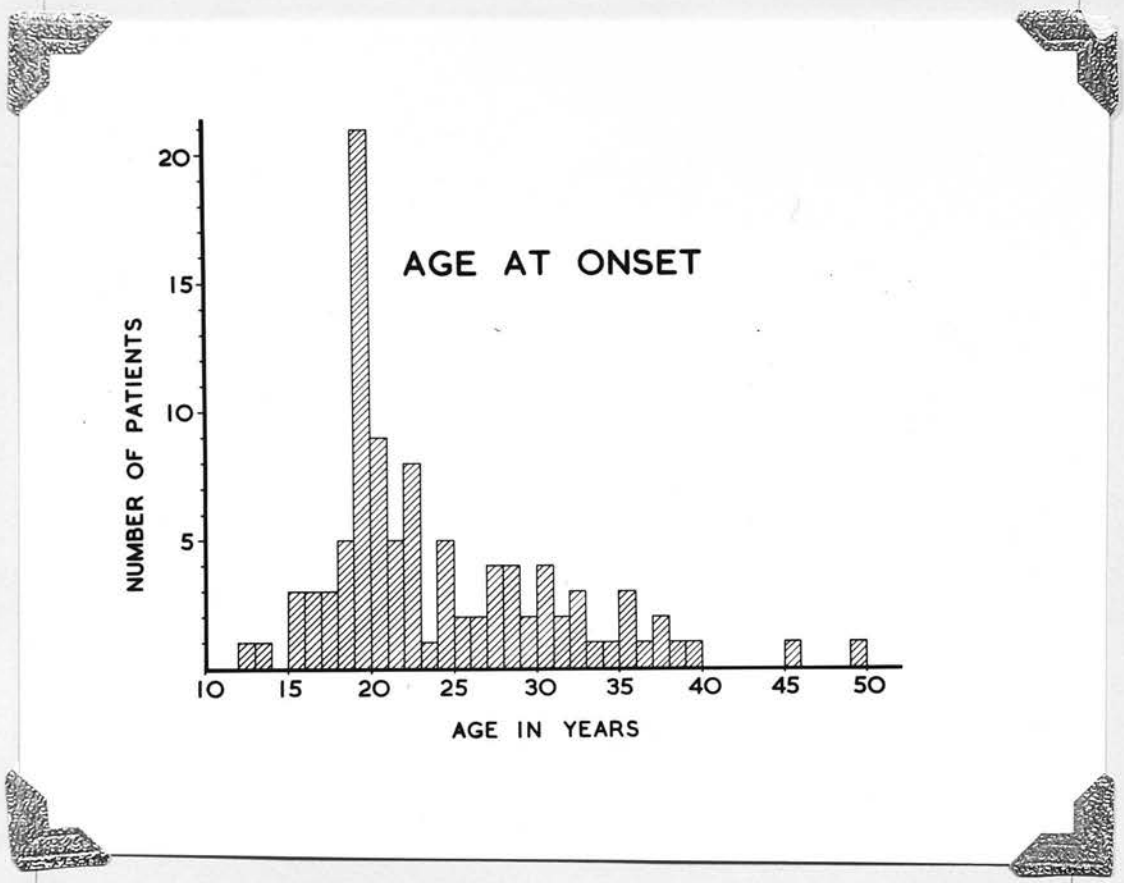
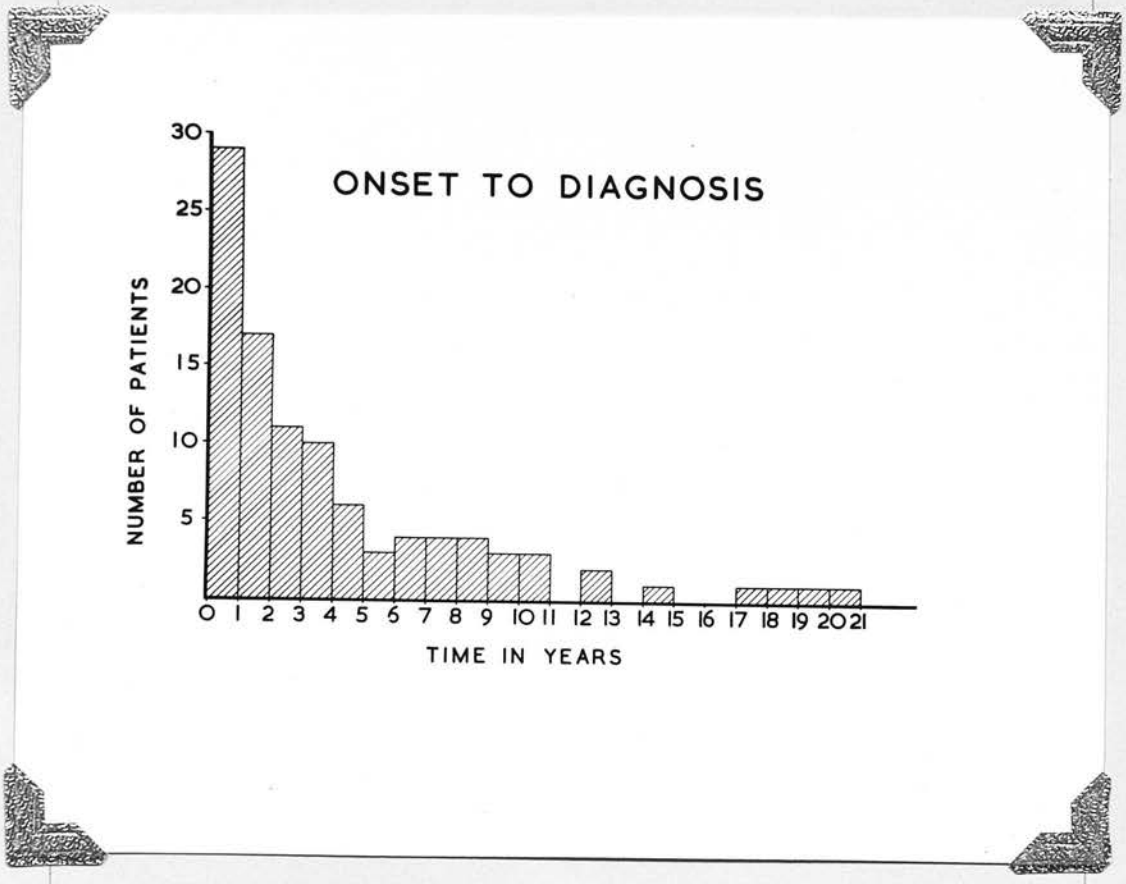

AGE AT ONSET
NUMBER OF PATIENTS
20
15
10
5
10
15
20
25
30
35
40
45
50
AGE IN YEARS

Fig. 3.


ONSET TO DIAGNOSIS
NUMBER OF PATIENTS
30
25
20
15
10
5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
TIME IN YEARS

PREVIOUS HISTORY

The previous history was studied with reference to all previous illnesses and injuries, particular attention being paid to any condition or accident occurring prior to or at the onset of the disease and which could have any relationship to or bearing upon its onset. The patient's own impression and that of his medical attendant at the time were considered in addition to my personal views.

TRAUMA

A surprising number of patients gave a history of accidents and injuries; 22 patients were injured accidentally and 3 suffered battle wounds, but all were asked about these occurrences specifically. The results are shown in Table 1, the injuries being classified into regions with an attempt to define the severity. Severe injuries are those with fractures, dislocations or large wounds, requiring hospital admission or bed rest. Slight injuries are those without recognised bony injury, slight wounds and not requiring admission or bed rest.

TABLE I.

TRAUMA

Trauma - Site & Severity			No. of cases	No. related to onset
Spine	-	Severe	7	6
	-	Slight	11	1
Thorax	-	Severe	1	1
	-	Slight	0	0
Pelvis	-	Severe	0	0
	-	Slight	1	0
Limbs	-	Severe	2	1
	-	Slight	3	0
			25	9

In a number of instances the patient considered his condition related to the trauma but in 9 (9%) only did an injury seem related in time to the onset of symptoms. In 7 (7%) there was a history of an injury (Severe in 6 and Slight in 1) to the spine and in 4 radiological evidence of old

fractures of the vertebral bodies was seen. All 7 patients were convinced that their symptoms dated from the injury and that their condition was caused by it. In the other patients, although some thought the injury to be the cause, enquiry showed that some recognisable symptoms had preceded the occurrence and this merely led the patient to report sick when otherwise he might not have done so. In several cases when the accident was a fall, it seemed that the injury was the result of ankylosing spondylitis, since some stiffness had preceded the accident and may have caused it by rendering the patient less agile in his movements. The normal life of a soldier requires considerable climbing and clambering in and out of tanks and trucks, often carried out at high speed during training, and therefore a man of slightly impaired agility or balance is much more likely to sustain falling accidents (which are common enough among fully fit men) than he is in civilian life.

INFECTION.

Apart from childhood infections, the infections of

various types suffered by the patients were recorded and studied in relation to the onset of spondylitic symptoms. These are classified as (1) bacterial and viral, and (2) protozoal.

TABLE 2 - INFECTION

1. Bacterial and viral infections.

	Disease	No. of cases	No. related to onset
	Dysentery (Bacillary)	4	0
✱	Diarrhoea (unspecified)	2	2
	Rheumatic Fever	4	0
✱	Tonsillitis	1	0
	Urethritis (non-specific)	6	2
	Urethritis (Gonococcal)	2	1
	Respiratory infections	11	0
	Surgical infections	3	2
	Infective Hepatitis	3	0
		36	7

2. Protozoal infections.

Malaria	8	3
Dysentery (amoebic)	2	0
	10	3

Notes:

✱ = patient admitted primarily with this complaint.

Several patients had suffered from two or more of these conditions, therefore the total of the figures does not represent the number of patients involved. So far as infection is concerned, four conditions seem related to the onset of ankylosing spondylitis - diarrhoea (non-specific), urethritis (non-specific and gonococcal), malaria and surgical infection.

Diarrhoea in which an organism is not identified is an extremely common condition in the tropics and subtropics, and is the type of illness often treated outside hospital with sulphonamide drugs. Identification of the causal organism is much more usual in hospital. In one of the two patients (to be described later) the onset of arthritis in the peripheral joints was so closely linked with the diarrhoea in time and as part of the illness that it was thought to be the cause - by those in charge of the patient. The relationship in the other patient is not so clear, being purely a time relationship, not recorded by medical observers.

Malaria was related in time to the onset of symptoms in three of eight patients who suffered from the infection. In one patient the infection occurred in two attacks which were closely related to the commencement of peripheral arthritis. The related surgical infections consisted of an abscess of the thigh in one patient and a septic wound of the leg followed by a series of boils in the other patient. Symptoms seemed to begin while the patients were being treated in bed for the surgical conditions and in one case affected the peripheral joints first.
Therefore of ten patients in whom infection seemed to be related to the onset, the symptoms commenced in four in the peripheral joints (related, in addition to urethritis in one patient.)

Pulmonary and urethral conditions will be described fully later.

FAMILY HISTORY.

A routine family history has been taken from each patient with regard to any rheumatic disorder or to any disorder similar to that of the patient. It has been impossible to question and examine relatives since the homes of these soldiers are scattered far and wide throughout the country and in some cases are abroad. Although the percentage cannot be a true index therefore of the familial incidence, which can be discovered only by close and thorough investigation of all members of each family, a certain family association has been noticed in some cases. 23 patients (23%) gave a history of a rheumatic disorder in close relatives, 5 patients admitting to more than one relative affected.

Three patients knew that a relative had been treated for ankylosing spondylitis, the father of the patient in two instances (these had been treated at the Charterhouse Clinic and the Mayo Clinic) and a brother in the third instance, so these three relatives can be accepted as definite cases.

Four patients told of a relative (the father of three and a brother of one) who had the same disease or a similar disease or "arthritis of the spine like mine" without knowing the actual diagnosis or precisely what treatment had been given. It seems likely that the incidence in this series is at least 7% of near relatives affected.

The incidence of the other rheumatic diseases was found to be :-

TABLE 3.

INCIDENCE OF OTHER RHEUMATIC DISEASES

Rheumatoid arthritis	4%
Gout	1%
Osteo-arthritis	1%
"Rheumatism" or "Arthritis" .	10%

THE WAY IN WHICH PATIENTS PRESENTED

The diverse manifestations of ankylosing spondylitis are well illustrated by the various ways in which patients may come to the physician, apart from those who are referred to him direct. A very large number of patients in this series had been referred firstly for the opinion of an orthopoedic surgeon (or of a specialist in physical medicine) because of low back or hip joint pain. Quite an appreciable number were referred from the ophthalmologist and a few from the venereal disease specialist. One was referred by a genito-urinary surgeon. Four cases were discovered when admitted to surgical wards for operations or septic surgical conditions and three cases were discovered in medical wards when admitted with malaria, tonsillitis and dysentery. Three were discovered on routine examinations required for military service. 10% of patients were discovered, therefore, by chance, and did not present primarily complaining of any symptom of ankylosing spondylitis, the true history of the disorder only being revealed by further questioning. The

small group (3%) found on routine medical examination illustrates that this procedure is of value since it permits observation of a physical disability and gives the individual an opportunity to mention minor symptoms which he had previously considered insufficient to justify his reporting sick.

The Symptoms of Onset

Analysis of early symptoms with a view to determining the clinical characteristics of the onset of the disease is of interest. In order to study these symptoms the sites at which symptoms first appeared have been grouped in order of frequency as follows:

TABLE 4.

ONSET OF SYMPTOMS

Site	Number of Patients
Lumbar-pelvic	73
Peripheral joints	12
Thoraco-lumbar	5
Thoracic	5
Shoulder girdle	3
Cervical	2

The term "peripheral joints" has been used to denote all joints of the limbs, excluding the shoulder joints and hip joints, as the latter are considered to be axial joints and part of the shoulder and pelvic girdles. It is noted that Forestier, Jacqueline and Rotes-Querol (1956), include these joints as peripheral joints.

By far the commonest site of onset of symptoms is the lumbar-pelvic region (73%). The term lumbar-pelvic region is used to describe the areas of the lumbar spine, sacro-iliac joints, buttocks, thighs and hip joints. So many patients complain of low back pain radiating into the buttocks and down the thighs and it is generally difficult to distinguish from the history exactly where the symptoms did commence. These patients, with three exceptions, complained of pains or pain as the major disability with stiffness as a lesser disability. One patient complained of stiffness only and denied ever having had any pain; two patients complained of stiffness as the main disability having had very little pain.

It was, however, possible to differentiate a sub-group in which the first pain was localised, or appeared to be

localised to the region of one or both hip joints or one or both buttocks, but this sub-group will be described later.

An extremely common complaint was of lumbar pain radiating down one buttock and down the back or side of the thigh, aching in character, like "toothache" or like "neuritis", the patients said. This pain, however, did not often extend below the knee - an important point in differentiating the pain from that of a prolapsed lumbar intervertebral disc. After a persistent period, the pain would disappear to recur in a similar distribution, but affecting the other thigh. Less commonly the pain was bilateral and only infrequently was it distributed down the front of the thigh.

PAIN LOCALISED TO THE HIP JOINTS AT AN EARLY STAGE

The group in which pain appeared to be localised to the hip joint initially has been of particular interest, and in all cases of the series the clinical state of the hip joint has been considered carefully.

The reasons for this interest are twofold. Firstly it is well known that a patient with a stiff spine suffers remarkably little functional disability if the hip joints are fully mobile, and secondly, that pain localised to one hip joint can cause great difficulty in diagnosis, in the absence of other symptoms.

In this group are ten patients. In three an erroneous diagnosis of tuberculous disease of the hip joint was made.

Case 69.

The left hip joint was affected for five months, and for two months he was treated for tuberculous disease of the hip. Pain in the right hip joint then called for a revision of the diagnosis.

Case 72.

The earliest symptom was localised pain in the right hip joint made worse by movement. For three months he was treated for tuberculous hip disease by rest and streptomycin injections combined with isoniazid orally.

Case 80.

This patient complained of pain in the right hip joint only for five months, a diagnosis of tuberculous hip disease being made. The diagnosis was not questioned and corrected until an effusion into the right knee joint appeared.

A fourth case also illustrates erroneous diagnosis.

Case 71.

The complaint of recurrent pain in the region of the right hip only for a year or so led to an X-Ray of the hip joint being taken. The patient was told that he had a "bony sclerosis" of the hip joint. The true diagnosis of ankylosing spondylitis was made seven years after the onset of symptoms.

Although in these four cases it is easy to see how the errors in diagnosis were made, when the diagnosis of ankylosing spondylitis was considered it was easily proved.

Six patients remain of this group. One patient had pain and stiffness of the left hip joint, so severely painful was the joint that he could not lie upon it in bed. Shortly

afterwards he had similar symptoms in the other hip and, as this was followed soon by backache, the correct diagnosis was made quickly. Two patients had hip joint symptoms only, in one of them bilateral, for six months before backache. Two patients had hip symptoms for one year before backache, although in one of these the pain was also referred from one hip to the knee on the same side. The last patient had localised bilateral hip joint symptoms for two years before the appearance of backache.

PAIN LOCALISED TO THE BUTTOCKS

Pains in the buttocks were the first complaint of five patients. This symptom varied in duration from a few months to eight years, and occurred characteristically in short attacks of spasmodic sharp stabbing pains in one buttock more than the other or moving from one to the other, but generally tending to recur more frequently on one side. In one instance the pains were bilateral and equal in intensity. Two of these patients were officers who suffered the symptoms for one year and eight years including active service during

the 1939-45 war. They both felt that to report sick with such a complaint alone might be the cause of ridicule if it became known and they preferred to suffer in silence rather than report with what appeared to them a rather ludicrous complaint. Painful stiff hips in one and painful shoulders in the other finally made them seek medical advice. A third, a senior non-commissioned officer only admitted to buttock pains of long duration when referred from the ophthalmologist, in his second attack of acute irido-cyclitis, for advice as to the possibility of ankylosing spondylitis. These three excellent soldiers were much relieved when the diagnosis was made and an explanation given for their curious and previously inexplicable symptoms.

ONSET WITH PERIPHERAL JOINT INVOLVEMENT

In the present series the peripheral joints were affected in twenty-three patients (23%) at some stage of the illness. This type of joint involvement has been considered definite when pain, with swelling or stiffness or both these features, has been observed in one or more joints, or when a

clear and unmistakable history of these clinical features has been obtained. Twelve patients (12%) had peripheral arthritis as the first and presenting sign of the illness and in five of these twelve the arthritis was accompanied by a fever.

When the disease presents with peripheral arthritis and fever, confusion arises as to the diagnosis. This is illustrated by the case notes of the five patients in this group.

Case II.

A lance-corporal, aged 23, complained of pain and stiffness of the right elbow, and right ankle joint with some aching in the region of the right hip of three days' duration. He also complained of anorexia, constipation, dysuria and vomiting.

On examination he was febrile (fever persisted for two weeks), with tender and swollen right elbow joint and right ankle joint. A urethral discharge was present in which no organisms were found on smear or culture. A diagnosis of

Reiter's syndrome was made, although gonococcal arthritis was also considered possible.

The true diagnosis was only made later when a history of some minor attacks of backache each of a few days' duration was revealed.

Comment: The diagnosis of Reiter's syndrome seemed reasonable, particularly as the patient presented in Germany, where the condition is seen not uncommonly, although conjunctivitis was absent, since the classical triad is not necessarily present in every case. It is essential to be aware of non-specific urethritis as a concomitant of ankylosing spondylitis. Some authorities consider that X-Rays of the sacro-iliac joints should be taken in all cases of Reiter's syndrome.

Case 33.

A private soldier, aged 18, had had $4\frac{1}{2}$ years previously, a febrile illness starting with pain and swelling of the right ankle followed by a similar arthritis of all joints of the legs, the joints of the fingers and the left shoulder joint. This was diagnosed as rheumatic fever and lasted about

six months. One year previously the right knee began to become painful and swollen.

For two weeks he had noticed stiffness and pain in the left knee, then swelling. He had always observed that after the pain disappeared from a joint, the joint became swollen.

On examination he was febrile (T - 100°F.) Movement was limited in the thoracic and lumbar areas of the spine, in both hip joints, and in the left knee joint. Chest expansion was two inches. E.S.R. = 40 mm. in one hour. X-Rays revealed early changes in the inferior halves of both sacro-iliac joints.

Comment: The previous illness, called rheumatic fever may have seemed genuine enough at the time but in retrospect as the natural history of the disease unfolded the true diagnosis appeared obvious.

Case 39.

An Officer, aged 27, complained of stiffness, pain and swelling of the left knee for eleven days and of the right

knee for three days with some pain in the left shoulder, left arm and in the left side of the chest, associated with a recurrence of diarrhoea from which he had suffered six months previously. On admission to hospital he was febrile.

A diagnosis of post dysenteric arthritis was made, and only some months later was ankylosing spondylitis considered.

Comments: A diagnosis of post dysenteric arthritis seemed likely, particularly as the arthritis was related to a recurrence of diarrhoea, although no bacillary organisms were isolated from the stools. It is generally considered that post dysenteric arthritis is more liable to occur in association with a second infection, than in the primary attack. In this particular instance one wonders in the light of some theories relating bowel infection to ankylosing spondylitis, what effect the bowel infection may have had in initiating the disease, or if the association was purely fortuitous.

Case 63.

A quartermaster sergeant, aged 39, was re-admitted to

hospital in East Africa (where he had been posted from Malta) two weeks after an attack of benign tertian malaria, complaining of fever, backache, sore throat, pain and swelling of both knees, left wrist, left shoulder and the meta-carpophalangeal joint of the left thumb and pains in the chest. The chest pains were made worse by coughing and he had night sweats. On examination he was ill with a temperature of 103°F. and an acutely painful arthritis of the joints mentioned. Benign tertian malarial parasites were again found in his blood, but the fever and arthritis persisted in spite of anti-malarial treatment. He remained febrile and ill for three weeks with loss of weight and muscular wasting of the legs, being regarded as a typical undulant fever, although no laboratory confirmation of this diagnosis was forthcoming.

Much later, in apparent convalescence on return to England, persistent back pain, stooped posture, restricted spinal and chest movement with abnormal radiological appearances of the sacro-iliac joints, led to the true

diagnosis of an acute form of ankylosing spondylitis.

Comment: This case undoubtedly presented an extremely difficult problem since two diseases existed, a malarial infection and another which at an early stage had not declared itself. When the lack of complete response to anti-malarial treatment became obvious, the clinical features with a history of a recent sojourn in Malta made brucellosis appear certain. The lack of laboratory confirmation did not exclude the diagnosis since the blood agglutinations and cultures may remain negative for a long period, and brucellae may be cultured only from the urine at a late stage; nor does failure to respond to appropriate treatment necessarily exclude the diagnosis.

Case 80.

A gunner, aged 19, complained for one month of aching in the right hip, pain and swelling of the right knee and both ankle joints with loss of weight and latterly some fever.

On examination his temperature was 101°F. and he remained febrile for three weeks. There was an effusion into

the right knee joint which was painful while both ankles were hot and swollen. Movement of the right hip joint was painful. His chest expansion was reduced to $1\frac{3}{4}$ inches. The only radiological abnormality was in the right sacro-iliac joint.

This group of five cases is most instructive and illustrates the extreme difficulty in diagnosis when ankylosing spondylitis presents in its acute febrile form with peripheral arthritis, and when diseases peculiar to tropical or sub-tropical areas have to be considered.

Apart from these five patients, only two others were febrile when first seen in hospital, but the onset was of the more usual lumbo-sacral type. It is reasonable to conclude that a febrile illness is commoner when the disease commences with a peripheral, rather than with a more central involvement of joints.

Of the remaining group of six patients in whom the onset though peripheral was febrile, four may be considered here briefly, since diagnosis was also difficult.

Case 9.

An officer, aged 45, was referred in 1954 by a genito-urinary surgeon whom he had consulted for treatment of a long standing urethral stricture. In 1937 his left ankle joint and left knee joint had been painful and swollen for some time. Early in 1942 he had a "conjunctivitis" affecting one eye, then the other. In 1943 the eye condition recurred, with painful swollen knee, ankle and wrist joints and with a non-specific urethritis. A diagnosis of Reiter's syndrome was made but urethral strictures developed later. Inflammation of one or other eye recurred each six months until 1949, although the joint condition remained quiescent until 1945, when pain returned in various joints, mainly the knees, wrists, shoulders and toe joints, persisting on and off until 1947. From that date he had no further trouble with the peripheral joints, but suffered from periodic attacks of pain and stiffness of the back and neck until 1954 when he was found to have a rigid spine. X-Rays revealed sclerosed sacro-iliac joints and ossification of the whole spine.

Case 31.

A civilian, aged 20, had an effusion into the right knee joint lasting for two weeks in 1951, followed later that year by attacks of aching pain in both thighs, particularly when sitting down, and also in bed at night. In 1953, aching lumbar pain began and the diagnosis of ankylosing spondylitis was made. In this case the diagnosis in 1951 may have been obscured by the finding of considerable wasting of the gluteal, quadriceps and calf muscles, which was the result of acute anterior poliomyelitis in 1947.

Case 56.

An officer, aged 36, had - 12 years previously - while in North Africa, an illness with pain and swelling of the ankle and knee joints lasting for almost four months, diagnosed as gout. Five years previously severe lumbar pain was considered due to a prolapsed intervertebral disc. Three years previously and a few months previously, he was again treated for prolapsed intervertebral disc, latterly being placed in a plaster of paris jacket, although he had

pain in the back most of the time with acute exacerbations and pain down both thighs, with painful heels and band-like chest pains. When the diagnosis was made, the lumbar and thoracic regions of the spine were stiff, and X-Rays showed grossly abnormal sacro-iliac joints and calcification of the spinous ligaments.

Case 60.

A private soldier, aged 22, had suffered for two years from recurrent attacks of pain, swelling and redness of many joints which were affected in the following order - metacarpo-phalangeal and phalangeal joints of the fingers, right shoulder, the metatarso-phalangeal joint of the right great toe, and the joints of the third left toe (the particular joints involved are well documented in the opinions of various consultants by whom he was seen). Three months previously he had suffered from lumbar pain with sciatic-like pain down the right leg. The attacks were often precipitated by cold and wet climatic conditions. He was treated first for rheumatoid arthritis, then for gout. His father suffered

from gout.

On examination he was found to have swelling of the right carpus and limited extension of the right wrist joint, an effusion into the left knee joint, swollen tender ankle joints and a swollen tender metatarso-phalangeal joint of the right great toe. Clinically there was little limitation of spinal movement, but both sacro-iliac joints showed abnormal radiological appearances consistent with ankylosing spondylitis.

PERIPHERAL ARTHRITIS DEVELOPING AT A LATER STAGE.

In the group of twenty-three patients (23%) in whom the peripheral joints were affected, eleven patients (11%) in whom these features developed at a later stage remain to be considered.

Although in the case of one patient recurrent pain and stiffness in the knee joints appeared to usher in his "rheumatic" illness, a history of recurrent bilateral iritis in the previous four years was obtained. Therefore he was not placed in the "peripheral type of onset" group. Pains in the hip joint areas were the first symptoms in three

patients, followed at a variable interval by arthritis of the other joints of the legs. In one instance the knee joints became affected soon after the hip joint symptoms, while lumbar backache appeared much later; in another swelling and effusion of the right knee joint, then pain and swelling of both ankle joints followed soon after the onset of symptoms in the right hip joints region; in the third instance, pain and swelling of the right knee followed two years after the onset of intermittent aching pain in both hip areas. This relationship of knee and ankle arthritis to a hip joint disability is interesting, since in none of these three patients was there a peripheral arthritis of the upper limbs, suggesting cause and effect. It is noticeable that of the eleven patients with peripheral arthritis developing after other symptoms, in only one instance were the knee joints not affected.

An association between peripheral joint arthritis and irido-cyclitis has been noticed in this series, since in the group of twenty-three patients, five patients suffered from

irido-cyclitis (21.7%), while the incidence of irido-cyclitis in the whole series is sixteen of one hundred patients (16%). The ocular manifestations or complications of the disease will be discussed later.

The average age of the patients at the onset of symptoms shows a slight variation. In the cases with initial symptoms in peripheral joints, the average age at onset is 21.7 years (twelve cases) and in all cases with peripheral joint symptoms, the average age at onset is 21.6 (twenty-three cases). The average age at onset of the whole series is 23.6 (one hundred cases).

ONSET IN THORACO-LUMBAR AREA.

Symptoms commencing in the thoracic and lumbar areas were noted in five patients. Two of these patients gave a very similar history in that they first noticed pains in the thoracic and lumbar areas of the spine with girdle pains round the thorax, on one or both sides. In both the chest pains were aggravated by sneezing and coughing. One patient, however, noticed some stiffness of the spine in addition to

pain, and after six months the disease spread to involve the neck and shoulder girdle; but the second patient had no stiffness at all and no spread was noticed while he was under observation. Characteristic in the other three patients was that stiffness appeared to be a major symptom. One patient denied having had any pain at all, complaining of stiffness of the thoracic and lumbar spine, while on examination little spinal mobility remained, and radiologically the disease was far advanced. The two remaining patients had very little pain, stiffness being the main complaint, but in only one of these was the spine rigid and were the radiological changes advanced. It does appear that if the disease first affects the thoracic and lumbar segments of the spine together at the onset, stiffness predominates over pain, in contrast to the predomination of pain over stiffness so characteristic of onset in the more usual pelvic-lumbar distribution.

ONSET IN THE THORACIC SEGMENT

Five patients first complained of symptoms referable to

the thorax and thoracic spine. The descriptions of the pains varied. Some described pains in the spine between the shoulder blades coming round the chest and causing a tightness of the chest. "Tearing" pains around the chest or more vague pain with "stiffness" of the chest were described, as were pains "round the lower ribs" and also pains localised to one side of the chest. The pain was usually increased by coughing, sneezing, deep breathing or on movement, and initially upon exercise, but could generally be relieved by deep breathing exercises or persistent movements if the pains were not too severe. With this type of onset, symptoms always developed fairly soon afterwards in both cervical and lumbar regions or in the lumbar region alone.

ONSET IN THE SHOULDER GIRDLE REGION

When pain began in one or both shoulder joints (three patients) it was invariably accompanied by pain in the scapular or interscapular regions and was followed soon after in each patient by symptoms in the lumbar region.

ONSET IN THE CERVICAL REGION

Two patients only complained first of symptoms in the cervical region. Pain, which was slight, and stiffness of the neck was present in one instance for one year before lumbar backache. The diagnosis was made $3\frac{1}{2}$ years after the onset of symptoms when this soldier reported for a routine chest X-Ray as his wife had developed pulmonary tuberculosis. The second patient noticed rapid stiffening of the neck, later followed by lumbar stiffness, but denied any pain at all. Onset of the disease in the neck may be associated with stiffness rather than pain.

CASES IN WHICH STIFFNESS WAS THE PRESENTING OR MAIN FEATURE

There are seven patients in this group. Three denied ever having had any pain at all and complained of stiffness of the spine only. Four had little pain or more brief attacks of pain which had passed off rapidly and to which little attention was paid. The symptoms had in fact caused so little trouble at all to two patients that the condition was only discovered at routine examination and the stiffness of

the spine was noticed by the medical observers who enquired into the cause, and had X-Rays taken. The average age of these patients is noted to be higher - 34.1 years - than the average age for the whole series and in this group are found two oldest patients, aged 50 years and 56 years.

The average duration of symptoms was 3.6 years, although in two instances rapid stiffening had occurred in a few months only. Radiological changes were found to be advanced in all except one patient.

The clinical features of this group are worth detailing more fully, and are summarised in Appendix (6) (Table III).

CERTAIN FEATURES OF PAIN.

The most striking feature of spondylitic pain is its intermittent character. In all cases with pain, acute exacerbations or attacks lasting a brief period with intervals of little or no pain, were noted. A definite relationship to the hour of day or night is also present. Pain was noticed to be worse first thing in the morning by 48 patients, and was particularly troublesome on getting out of bed. Many of these patients had discovered that by exercise the pain could be relieved, or that the pain would diminish as the day wore on and as they became more active. Some gained relief from taking a hot bath on rising in the morning.

Pain was experienced during the night or in the early hours (2 - 4 a.m.) in 36 patients. These patients would be wakened by severe pain and find themselves almost unable to move, but all discovered that by gradually moving about in bed they would be able to rise, take some exercise and then return to rest comfortably. Some on rising in the night

found relief in a hot bath. One patient found his bed so uncomfortable at night that for periods he would take to sleeping in a chair.

The increase of pain which was often associated with increase of stiffness was noticed not only in bed at night, but after sitting or resting without changing the position for any appreciable period. Moving or change of position would help to ease the pain. Only six patients complained that pain was worse on exercise, and only three stated that pain was worse when they were tired. One patient noticed that his stiffness alone was worse in the morning, while his pain was worse in the evening.

It is noticeable that in most of the early cases pain predominates greatly over stiffness.

Loss of Weight.

The great majority of patients were found to be rather lean, only two being noted as obese. Thirty-two patients (32%) had noticed a definite weight loss since the onset of the disease. The greatest reduction in weight was in one

who lost two stones in a year.

Hip Joint Movement.

In all cases hip joint movement has been examined by flexion, abduction, and lateral rotation, and some limitation has been found in 49 patients (49%). No particular measurement of the degree of limitation was recorded, this observation therefore is merely a clinical assessment.

Spinal Movement.

Spinal mobility has been assessed clinically only, by flexion and extension, lateral bending and by rotation. This does not give such accurate measurement as is possible by instrumental methods (Dunham, 1949). Limitation of movement apparent to the eye has been noted in each of the spinal segments - cervical, thoracic and lumbar, without assessment of degree. It was found that movement was limited in the cervical region in 41 patients, the thoracic region in 41 patients and the lumbar region in 88 patients.

The degree of limitation was assessed over the whole spine and has been grouped into four grades -
Grade I = normal movement; Grade 2 some limitation; Grade 3 definite or marked limitation; and Grade 4 little or no movement (poker back).

On the basis of this classification the total spinal movement was assessed as follows. (Table 5).

TABLE 5.

SPINAL MOVEMENT

Grade	Number of Patients
1	10
2	53
3	23
4	14

It is interesting to note that in the group of 10 Grade 1 patients were 7 (70%) who had appreciable limitation of hip joint movement. Both hip joints were affected in four patients, and one hip joint only in three patients. The percentage of hip joint involvement in this group (70%) is much higher than that found in the series as a whole (49%). In addition all had complained of pain in the region of the hip joint. The fact that they were seen early before spinal stiffening had commenced lends weight to a clinical impression that hip joint symptoms are much more disabling and urgent than are spinal symptoms.

CHEST EXPANSION

It is well known that the chest expansion is limited in ankylosing spondylitis and that this sign is most useful in diagnosis. The chest expansion has been recorded in each case at the initial examination when the diagnosis was made, and recorded to the nearest quarter of an inch as shown in Table 6.

TABLE 6.

CHEST EXPANSION

EXPANSION IN INCHES	NIL	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3
NO. OF CASES	2	4	10	9	7	9	16	6	13	4	9	2	9

The chest expansion was, therefore, one inch or less in 32% of patients; one and one quarter to two and a quarter inches in 48% of patients; and two and one half to three inches in 20% of patients. When the chest expansion is correlated with the clinical stage of the disease as judged by physical and radiological examination, it is found that a high proportion of the more advanced cases have a very small chest expansion, whereas a considerable number of early cases have a normal chest expansion. The distribution is shown in Table 7 :-

TABLE 7.

CHEST EXPANSION / STAGE OF DISEASE

EXPANSION - INCHES		0 - 1	$1\frac{1}{4} - 2\frac{1}{4}$	$2\frac{1}{2}$ +
No. of cases	Early	11	28	16
	Moderate	11	13	3
	Advanced	10	7	1
Total %age		32%	48%	20%

In the early group of cases expansion was less than one inch in 20% of cases, between one and a quarter and two and a quarter inches in just over 50%, and two and a half inches or more in just under 30%. In the moderately advanced group expansion was less than one inch in 40.7% of cases, between one and a quarter and two and a quarter inches in 48.1% of cases and two and a half inches or more in 11.2%. In the advanced group of cases expansion was less than one inch in 55.6% of cases, between one and a quarter and two inches in 38.8% and two and a quarter inches or more in 5.6%.

This most useful clinical sign is therefore much less constant in the early stage of the disease when in just under 30% of the patients a normal measurement is found, than in the later stage, when the measurement is reduced in a very high proportion of cases (95%).

PAINFUL HEELS

The curious symptom, painful heel, occurred in six (6%) patients. This can be most distressing and if appearing as an early symptom can be most difficult to diagnose. The pain is usually felt, and tenderness is elicited on the plantar surface of the os calcis at or posterior to the attachment of the spring ligament. Three patients complained of pain in one heel only, severe enough to cause a limp, one of them noticing that the pain was worse in bed at night. The other three patients had severe intractable pain in both heels of long duration, being so crippled on occasions that they could hardly walk. The pain in all cases was greatly increased by weight bearing on the heels. A sergeant of the Corps of Military Police tip-toed about the hospital in gym shoes for nearly three months, so acute was the pain if his heels touched the ground, and so resistant was the pain to all forms of treatment which were tried. The cause of this symptom is not obvious, but the pain and site of tenderness indicate that

the pain has a bony origin. In all cases X-Rays of the os calcis has been normal where the pain was bilateral and no difference could be detected between the two X-Ray pictures in cases where the pain was unilateral. In one case, tenderness was elicited first at the attachment of the spring ligament to the os calcis, but was greater on backward pressure against the bone rather than upwards against the ligament, leaving no doubt in one's mind that the pain had a bony origin. When this type of pain occurs it tends to be persistent for weeks or months, not occurring in attacks as do the pains in other parts of the body, but may clear up to recur weeks, months or years later, again being persistent in the recurrence.

THE ERYTHROCYTE SEDIMENTATION RATE (E.S.R.)

In all cases this test has been carried out by the Wintrobe method and the first recorded estimation has been noted, (Table 8).

TABLE 8.

E.S.R. in one hour	< 9	9-20	21-30	31-40	41-50	51-60	61+
No. of cases	13	21	22	22	8	7	6

Not recorded - 1

Thirteen patients, therefore (13%) presented with a normal reading while eighty-six (86%) presented with an increased reading.

An attempt has been made in this series to correlate the E.S.R. with age, duration of the disease and the stage of the disease assessed clinically (Table 9).

TABLE 9

E.S.R. ANALYSIS

	< 9	9.20	21.30	31.40	41+
AVERAGE AGE	36.3	25.2	26.1	25.7	30.7
DURATION	8.6	5.4	2.6	3.3	2.5
EARLY CASES	38.5%	52.4%	59.1%	68.2%	61.9%

The thirteen patients in whom the E.S.R. was normal fall into an older age group, the average age being 36.3 years. Nine patients were over the age of 24 and four below this age. The average duration of symptoms was 8.6 years; eight patients having had the disease for over five years, and five for less than five years; two had symptoms for less than one year and were aged 19 and 20 years. Eight patients were assessed as having advanced or moderately advanced disease, but these do not coincide exactly with the eight who had the disease for the longest period. One patient with moderately

advanced disease on clinical and X-Ray evidence complained of symptoms for only one year; while one assessed as 'early' had had symptoms for ten years. There is a clear tendency therefore for a normal E.S.R. to be found in the older patients, with disease of long symptomatic duration and showing advanced clinical and radiological signs, but a normal E.S.R. may occasionally and more rarely be found in a young patient with early disease of short symptomatic duration.

The patients at the other end of the scale with the higher E.S.R. readings of 41 mm. in an hour and over, were twenty-one in number and fell into a somewhat younger age group, the average age being 30.7 years (as opposed to 36.3 years in the group with normal E.S.R.) Sixteen were, however, over the age of 24 and five were below this age. The average duration of symptoms, however, was much shorter being only 2.5 years (compared with 8.6 years in the group with normal E.S.R.); eighteen patients having had symptoms for less than five years and only three for more than five years. Thirteen patients were assessed as having early disease on

objective examination while eight were considered to have advanced or moderately advanced disease, although six of the latter eight patients had had symptoms for less than five years. The higher ranges of the E.S.R. reading have been found, therefore, in patients with disease of short symptomatic duration, and often, though not always, of early clinical and radiological state, and also in a slightly older age group.

The table of analysis of E.S.R. readings indicates that the higher ranges of E.S.R. readings, 21 mm in an hour and upwards are found in patients with shorter symptomatic history. It is further seen that as the range of E.S.R. increases so does the proportion of early cases in the group, the range 31 - 40 showing the highest proportion of early cases. In the higher range 41 or more, the proportion of early cases was somewhat less.

ASSOCIATED CLINICAL FEATURES

The main associated clinical features, some of which are so common as to form part of the disease picture rather than to be classed as complications are ophthalmic, haematological, gastro-intestinal, pulmonary, genito-urinary, and cardio-vascular. The frequency of these features is shown in Table 10 :-

Associated Clinical Features

TABLE 10.

	Per Cent
Anaemia	17
Irido-cyclitis	16
Broncho-pulmonary	14
Dyspepsia (including proven ulcer)	10
Urethritis	8
Hypertension	2
Endocarditis	2

A N A E M I A

This is well known and referred to as a common feature and occurred in 17 patients (17%) of this series.

ANAEMIA

TABLE II.

Haemoglobin (Grams. %)	Number of Cases
10 - 13	14
7.3 - 10	2
under 7.3	1

No correlation was found with the age of the patient, the duration of the disease nor the stage of the illness. Quite definite loss of weight had been noticed by 11 (64.7%) of the anaemic patients which seems significantly higher than in the whole series of cases (32%). In 6 of the 17 patients, however, other

causes were found which could explain the anaemia. Complicated chronic peptic ulcer was present in two patients, in one case with a five year history complicated by operations for perforation and adhesions; in the other with a five year history complicated by recurrent melaena. An active duodenal ulcer of eighteen months duration was found in a third case, but no history of haemorrhage was obtained. Malarial infection had existed in two patients shortly before the anaemia was noted, and one of these two had been a prisoner of war in Communist China under conditions of privation, when his symptoms began. Active pulmonary tuberculosis was found in one patient. In only 11 cases (11%) therefore, was anaemia found in association with uncomplicated ankylosing spondylitis and it is considered that this figure represents the true incidence of anaemia in the disease.

IRIDO - CYCLITIS

In the total series this condition has occurred in

16 patients (16%). In one of the 16 patients signs of old irido-cyclitis were found on routine examination by the physician, and confirmed by the ophthalmologist, though no definite history of iritis could be obtained.

In 15 patients, however, the history was quite definite or the ocular inflammation was observed. Iritis preceded other symptoms of the disease in four patients. In one of these patients the first attack of iritis antedated any other recognisable symptom by eighteen years. The condition recurred frequently in nine patients and attacked one or other eye, but only in one instance was a history obtained of bilateral simultaneous involvement. Bilateral simultaneous involvement has not, however, been observed in this series. In this group with eye complications the average duration of the disease is long (9.2 years), and the age at which these patients came under observation is much higher than that of the remainder.

With regard to the clinical and X-Ray stage of the

disease, six were considered advanced, five moderately advanced and only five were assessed as early cases. In one patient with spinal symptoms of five years duration, the first attack of iritis began immediately after a course of deep X-Ray therapy; in another the first iritis appeared actually while he was undergoing the second course of such treatment after an interval of six years. Attacks of iritis became more frequent in two patients after courses of deep X-Ray therapy.

Seven patients with iritis have had other complications. One had had urethritis, urethral stricture and bronchitis. The second had duodenal ulcer with melaena, and anaemia. A third had evidence of healed pulmonary tuberculosis on X-Ray of the chest. A fourth had endocarditis mainly affecting the aortic valve with progressive cardiac failure. A fifth showed also anaemia. A sixth had dyspepsia with haemorrhage. A seventh had dyspepsia and eczema.

RESPIRATORY COMPLICATIONS

Fourteen patients (14%) were found to have broncho-pulmonary complications. (Table 12).

Respiratory Complications

TABLE 12.

X Recurrent Bronchitis	.....	6
Asthma	.....	2
Pulmonary Tuberculosis (1 active)	.....	2
Asthma, Recurrent Bronchitis and Pneumonia	.....	1
Pneumonia and Recurrent Bronchitis	.....	1
Recurrent Pneumonia	.....	1
Pleural thickening	.....	1

These patients have been selected as having evidence of pulmonary disease in addition to respiratory symptoms. Patients regarded as having symptoms and signs of the spondylitic thorax only have been excluded. Two patients were found to have a normal chest expansion and twelve to have a reduced measurement.

X with Bronchiectasis in 1 case.

DYSPEPSIA AND PEPTIC ULCER

Ten patients (10%) were affected with dyspepsia. These patients fall into an older group, the average age when seen first being 33.2 years. The stage of the disease was considered advanced in four, moderately advanced in three and early in only three. So there is a marked preponderance of more advanced cases. In seven patients duodenal ulcer was or had been diagnosed from the history with positive X-Ray findings, or with complication such as perforation or haemorrhage.

The remaining three patients gave a history of ulcer type dyspepsia, but in two, no further evidence of peptic ulcer was found, and one patient had his dyspepsia cured by appendicectomy. Haemorrhage from peptic ulcer either haematemesis or melaena alone had occurred in four of the ten cases (40%), and perforation in one case. Anaemia was found in three patients with proven peptic ulcer and was considered to be attributable to the ulcer rather than to the spondylitis. Iritis had occurred in three (30%) of

this dyspeptic group - an incidence higher than that in the whole series (16%). Bronchitis with asthma occurred in one case, and inactive pulmonary tuberculosis in another.

An appreciable incidence of peptic ulcer, often complicated by haemorrhage and anaemia is found in spondylitis in the older age groups and more advanced cases. These patients are more likely to have other complications, particularly iritis, than are the eupeptic patients. The presence of peptic ulcer more especially with anaemia, or a suggestive history of dyspepsia places difficulties in the way of suitable treatment.

U R E T H R I T I S

Urethritis or a history of urethritis was found in eight patients (8%). In two, however, the infection was stated to be gonococcal, but in six (6%) non-specific urethritis was diagnosed.

In five patients a single attack had occurred and in three patients two or more attacks had occurred, leading in one of the latter group to urethral stricture. Two patients gave a very similar history of two attacks of non-specific urethritis closely associated with the onset of recognisable spondylitic symptoms. One patient had urethritis a month previously and his second attack coincided with the onset of other symptoms; the other had his first attack at the onset of symptoms and a recurrence three weeks later. In both these cases the urethritis was the predominant symptom causing the patient to report sick thus leading to very early diagnosis of the spondylitis. Four patients had urethritis following the onset of other

recognisable symptoms at later periods varying from six months to eight years, but in only one patient were the attacks recurrent and in this patient alone was there an associated iritis. In two patients only was disease ~~of~~ commencing in the peripheral ~~onset~~ joints associated with non-specific urethritis.

Two patients gave a history of single attacks of gonococcal urethritis, though no actual documentary proof of this type of infection was obtained in either case. The urethritis coincided with the onset of spondylitic symptoms, during the war, in one instance and in view of the association of proved non-specific urethritis with the onset in two other cases, one wonders if this diagnosis could have been erroneous. Urethritis appeared two years after the onset of spondylitic symptoms in the other instance of gonorrhoeal infection.

HYPERTENSION

Two patients (2%) were noted to have raised blood pressure.

Case 24.

A private soldier, aged 45, complained of symptoms for one year. In addition to spondylitis he was found to have chronic bronchitis and bronchiectasis, early clubbing of the fingers, blood pressure raised to 185/110 mms of Hg. and some left ventricular enlargement.

Case 48.

An officer, aged 51, complained of spondylitic symptoms for 19 years. On examination he was plethoric obese, weighing 254 lbs., and in addition to advanced spondylitis he had generalised arterio-sclerosis, blood pressure raised to 210/150 mm. of Hg. and marked arterial changes in the fundi. A degree of finger clubbing was also present but no evidence of pulmonary infection.

E N D O C A R D I T I S

Endocarditis was found in two patients (2%), neither of whom gave any previous history of acute rheumatism or of recurrent streptococcal infection.

Case 40.

An officer, aged 45, was seen in 1954. He had suffered from spondylitic symptoms since 1946, the diagnosis being made in 1948. Clinical and X-Ray examination revealed advanced ankylosed spondylitis and systolic and faint diastolic aortic murmurs with some left ventricular enlargement.

During two years' observation until April, 1956, the cardiac condition progressed with increasing dyspnoea, further cardiac enlargement, increasing intensity of murmurs and congestive heart failure. He died in March, 1957. (See Appendix IV for further case notes).

Case 100.

A craftsman aged 19 with eight months' history, was

found to have very early ankylosing spondylitis. In addition he had a mitral systolic murmur and a doubtful short mid-diastolic mitral murmur. There was moderate enlargement of the left auricle and left ventricle on X-Ray screening, but the electro-cardiogram was normal. He was considered to have a "rheumatic" mitral incompetence.

These two cases illustrate the association of a "rheumatic' type of endocarditis complicating ankylosing spondylitis and presumably part of the disease. Although no history suggestive of rheumatic fever or other streptococcal disease could be obtained, it is not impossible that these are examples of rheumatic endocarditis co-existing with spondylitis since obvious rheumatic endocarditis is found sometimes with no previous history. The progress of the condition in Case 40 with the progression and change in the murmurs gave rise to a strong suspicion that a subacute bacterial infection was complicating the original endocarditis.

No proof of this infection was found on prolonged observation and repeated investigation.

DISCUSSION

CLINICAL FEATURES

The early symptoms are often so mild and transient that the condition may well be overlooked for years. In many cases the patient himself has had little disability over a prolonged period, and has paid little attention to his symptoms, finding that he can work off the discomfort by exercise or by taking a few aspirins. His symptoms seem so vague, evanescent and variable and so little is found at an early stage on physical examination that doctors may be pardoned for failing to associate this condition with the more familiar "poker-back" disease. Little or no knowledge of the early symptoms existed until Golding (1936) and Scott (1937 and 1942) drew attention to the significance of certain symptoms, the latter describing the "pre-spondylitic stage of wandering pains", "pre-spondylitic symptoms (or syndrome)". Though Boland (1953) considers there is no evidence to justify the description of a pre-spondylitic stage, these apt names have done a great service in focussing thought upon the period before

easily recognisable spinal symptoms have appeared. Hart (1955) does not use these terms but believes that certain premonitory symptoms do exist.

The symptoms and physical findings depend upon several factors; the severity, rate of progression and duration of the disease; the extent of spinal involvement; the activity of the disease process at various levels of the spine and the amount of extra-articular soft-tissue involvement, (Boland and Shebesta 1946).

The primary complaint of the patients is usually of pain or pains. The character of spondylitic pain has been described frequently, (Buckley 1931, 1935; Herrick and Tyson, 1941; Scott 1942; Hench, Slocumb and Polley 1947; Polley and Slocumb 1947a, 1947b; Hart and others 1949; Turney, 1952; Hart, 1955), and in particular the pain associated with involvement of various spinal segments has been detailed by Boland (1946). The pain occurs in attacks of aching or sharp transient pains or catches which last a few days at a time and then subside completely or almost

completely for a long period, perhaps for months. These attacks may be induced by lifting, twisting or jolting and the discomfort is increased by coughing, sneezing or any sudden movement. Pain is increased at this stage by resting or physical inactivity, tending to be worse first thing in the morning on getting out of bed, at which time the patient may have learned to perform some mild physical exercises which give relief. Again increase of pain is noticed after sitting in a chair.

As the condition progresses attacks tend to become much more frequent and the intervals of complete freedom shorter or replaced by periods of partial remission only when constant dull discomfort is always present. This discomfort may be described as a "deep ache", "tired feeling", or "soreness". In this phase physical activity or work, entailing use of the back, may well increase the symptoms.

This discomfort is often worst in the early hours of the morning (3 - 4 a.m.) when the patient is awakened by it or by severe pain, and he must get up and move about to gain relief or he may take a hot bath. This pain in bed may be so severe

that he may give up sleeping in bed, and take to sleeping in a chair at night.

West (1949) differentiated the clinical progress into three phases:

1. Isolated attacks of pain and stiffness becoming more frequent;
2. A florid phase of continuous symptoms and constitutional upset;
3. Phase of declining activity and minor relapses.

He considers that in severe cases stage 2 is prolonged and in mild cases, stage 2 is never reached.

The marked effect of bad weather and change of weather in causing a worsening of the symptoms and the effect of hot dry weather in producing improvement (Boland and Present, 1945; Query, 1949) has not, however, been a common feature, since only four patients (4%) complained that the symptoms were adversely affected by cold damp weather.

The Symptoms of Onset

The onset is considered to be insidious in 82% of patients (Boland and Present, 1945); insidious in 86% and acute in 14% (Hench, Slocumb and Polley, 1947); acute in 10% (Tyson, 1937). Fletcher (1944) details four ways in which the condition presents - girdle pains, pain in the back, pains all over the body, and pain referred to peripheral joints, to which Birkbeck and others (1951) have added a fifth - iritis. In my patients the onset was insidious in 91 and acute in 9, and of these with acute onset 5 appeared with peripheral joint involvement and fever. In only 4 was the onset in the spine acute and progression rapid. If pain is severe, persistent and with rapid progression and localised to the spine, a diagnosis of ankylosing spondylitis must be regarded with suspicion. Two such cases have been seen which turned out to be tuberculosis of the spine and sarcoma of a transverse process.

LUMBAR - PELVIC ONSET

Onset with low back pain was recorded in 75% of patients by Boland and Shebesta (1946) while Polley and Slocumb (1947a and b) found the first symptoms in the torso in 72% and Graham and Ogryzlo (1947) noted pain in the back to be first in 82% of patients. In this series onset was in the lumbar-pelvic area in 73% of patients and of those pain was predominant in 68% with stiffness as a secondary and much less noticeable feature. In 5% of patients stiffness was the predominant symptom. The low back pain has been found to be aching and mild in character at first, of a few days' duration and at varying intervals as described by Query (1949) in his description of the early diagnostic features of ankylosing spondylitis. Similarly the acute attacks of sharp stabbing pains in the thighs and buttocks have been found. Although in a patient with lumbar-pelvic distribution of pains at an early stage the diagnosis may be difficult enough, it is not so great as when the pain appears to be localised to one hip joint since early joint involvement may be considered

tuberculous (British Medical Journal, 1954). The main cause of the difficulty is that the symptoms and signs may be similar and that the X-Ray of a hip joint in early ankylosing spondylitis with hip involvement does resemble that of early tuberculous disease. Radiographs taken of both hip joints in ankylosing spondylitis may show one abnormal and the other apparently normal. Even if a full view of the pelvis is taken for both hip joints the sacro-iliac joints are included but may not be properly in focus and abnormality of the latter joints may be missed. In one of my cases, however, this view showed obvious sacro-iliac abnormality, which was overlooked since attention was concentrated on the hip joints. Even if the whole view of the pelvis does include the sacro-iliac joints in focus a minor abnormality may escape notice until the special oblique X-Ray views are taken. The error is tragic since conventional treatment for tuberculous disease with complete immobility of the hip joint allows rapid ankylosis and loss of movement of one or both joints. This immobility of the hip joints is a particularly severe disability for a young man whose spine may already be commencing

to stiffen and is a major disability, even though considerable spinal movement is maintained. Attacks of pain localised to the buttocks as noted at the onset in 5% of patients, can also cause considerable difficulty in diagnosis. In 3% of the patients this symptom had persisted alone in recurrent attacks for a long period of time. This persistence without extension is difficult to explain but although the attacks were acute and severe each was of short duration with complete pain-free intervals. The reluctance of the patients to report such symptoms is more comprehensible than is the cause of their pain.

Onset in Peripheral Joints

When considering peripheral joint involvement certain differences in terminology have been noticed. Forestier and others (1956) use the term to denote all joints of the limbs including the shoulder joints and hip joints, classifying the sacro-iliac joints with the spinal or axial joints. Hench, Slocumb and Polley (1947), Tanberg (1950), Romanus (1953) and Hart (1955) clearly, however, exclude the shoulder and hip

joints, and this classification has been followed in that these joints are considered integral parts of the shoulder and pelvic girdles. Reference to peripheral joints in this thesis is therefore intended to include the elbows, wrists, small joints of the hands, knees, ankles and small joints of the feet. This difference in terminology explains the high figures given by Forestier and others (1956) for peripheral involvement on first examination - 75% and for peripheral involvement preceding any spinal involvement - 21%.

In other recent reports peripheral joint symptoms were first to appear in 25% of cases (Milligan and Parry, 1954), and in 10% of cases (Hart, 1955) whereas in older series the figures are 23%, (Golding, 1936) 13%, (Boland and Present, 1945) and 12%, (Graham and Ogryzlo, 1947). In this series 12% of patients had peripheral arthritis as the first and presenting sign of the illness. This was most commonly an arthritis of the knees, ankles or small joints of the foot and less commonly of the elbows, wrists and hands.

In some patients, however, a polyarthritis involved the

peripheral joints of all four limbs and in one or two instances involved the shoulders and hips also. In 5% the onset was acute with fever and general systemic symptoms rendering the diagnosis confusing and difficult as the resemblance to other diseases was quite striking. Hart (1955) points out that 8 of his 184 cases had been diagnosed as rheumatic fever in some phase of the illness, while Tyson (1937) considered that 10% of cases may begin with an illness of this nature. A previous history of rheumatic fever was given by 4% of my patients in addition to the 12% in whom the recognisable illness had commenced in the peripheral joints.

When the patient presents with an acute febrile polyarthritis in the tropics, the difficulties are increased. The syndrome has been noted to be linked with dysenteric or malarial infection. Polyarthritis as a complication of bacillary dysentery is well known (Manson-Bahr, 1954), and the symptom complex of arthritis, conjunctivitis, and urethritis was one of the commonest complications of bacillary dysentery in the Middle East theatre during the 1939-45 war (Medical

diseases in Tropical and Sub-tropical areas - 1946), Harkness (1950) considers this probably the same as Reiter's Syndrome. Recurrent malaria has been found to confuse the diagnosis at the onset, and the resemblance of the clinical picture to an acute brucella infection has been previously illustrated. The onset with a symptom complex resembling Reiter's Syndrome has been well illustrated by two cases. Reiter's Syndrome seems to be more common in soldiers serving in Germany than it does in this country and therefore it is not surprising that this diagnosis is made in Germany when the classical syndrome is seen or any partial variant of it. No patient has been seen with a classical rheumatoid arthritis developing spinal symptoms at a later stage, although such cases are described, more particularly in American literature. In some patients, however, the diagnosis of rheumatoid arthritis had been entertained for lack of a better descriptive term. The disease has been observed to progress, however, in one patient from a classical spinal form to the development of typical rheumatoid deformity of the

peripheral joints. Another patient, months after treatment of the spinal condition, developed persistent arthritis of the ankles and one knee indistinguishable from rheumatoid arthritis. The observation period, however, is short since no patient has been observed for more than five years and many for a much shorter period. The true incidence of peripheral rheumatoid arthritis developing in ankylosing spondylitis can only be determined by observation of the patients over many years.

PAINFUL HEELS

This disabling symptom, which occurred in 6% of my patients and is recorded by Forestier et al. (1956) in 3.5% of 200 patients, may merely be another expression of the "painful, tender, bony points" described by Hart et al.(1949). Apart from the description of the symptom by Goldthwait (1899) and mention by Scott (1942) of recurrent attacks of pain in the heels, no reference has been discovered prior to the full discussion by Davis and Blair (1950). They found bilateral acutely painful heels in three patients with ankylosing spondylitis, and in each the X-Rays of the heels were normal. Radiotherapy to the spine only relieved the pain in the heels and the condition was considered due to periostitis of the os calcis. One of these patients, however, had recurrence of heel pain two years later and X-Rays then showed early calcaneal spur formation. Chronically painful heels were found also in 12 patients by Davis and Blair (1950), a dull pain on weight bearing, relieved by rest, of 1 - 3 years' duration. In each, spur formation was present

but no relief resulted from radiation of the spine, nor from radiation of the spurs, as described by Liberson (1932). The pain was considered first due to spur formation in the attachment of the plantar fascia, and later due to pressure on a subserous bursa between the spur and the sole of the foot. Metal arch supports gave relief in 9 of 12 patients, and surgical resection of the spur in two intractable cases, while Sorbo rubber pads were not found useful. Tanberg (1950) considered that pain in the heels was due either to periostitis ~~and~~ or an affection of the tendinous insertions to the calcaneus.

Attention has been drawn to the clinical features of painful heels as presenting in these six patients which differ so markedly from the features of spondylitic pain in general. The explanation given by Davis and Blair (1950) seems a valid one and the persistence of the symptom is explained by weight-bearing directly on a bony prominence. The analogy with the persistent pain in the ischial tuberosities on sitting is a close one. The treatment used in these patients will be described later.

Hip Joint Movement

Abnormality of hip joint movement has been found in 49% of patients. The patients in whom pain was severe and a presenting symptom (10%) have already been discussed. In 39% of patients without particular pain, hip joint movement has been limited. Hart et al. (1949) found the hip joints affected in 10 of 30 cases, in 5 slightly and in 5 severely but comment that this is not an early sign, as the disease had been present for months or years before these joints were affected. One or both joints were affected or ankylosed in 20% of cases (Turney, 1952). Hip joint involvement with obvious arthritis was noted in 28% of cases (Polley and Slocumb, 1947a and b), and these joints may be affected in 15-60% of cases (Hench, Slocumb and Polley, 1947). Miller (1936) quotes Geilinger as giving the figure of 61% for hip joint involvement. Since this abnormality is frequent and minor abnormalities can be detected at an early stage, it is considered that very great attention should be paid to these joints in all cases, even though spontaneous pain is not a

feature. The unfortunate results of ankylosis have previously been illustrated in the severely affected patients, and I have been impressed by the apparent slightness of the disability in many patients with fixed spines but with fully mobile hip joints.

CHEST EXPANSION

It has been shown (Historical introduction) that limitation of movement of the thoracic cage has been deduced or noted in the earliest observations upon ankylosing spondylitis, but the importance of this feature has only recently been fully appreciated. Swaim & Kuhns (1930) gave a good clinical description of the thorax with reduced expansion but also described poor diaphragmatic movement. Miller (1936) noted the thoracic immobility especially if the dorsal area of the spine was involved. Herrick and Tyson (1941) gave a full description of thoracic cage rigidity with lack of expansion, ribs fixed in expansion, diaphragmatic respiration and reduced vital capacity. Graham and Ogryzlo (1947) found the measured chest expansion reduced below $1\frac{1}{2}$ inches in 70% of patients, while others (Simpson and Stevenson, 1949) reported reduction below one inch in 41%. Knowledge of the thoracic and respiratory abnormalities has been greatly advanced by the researches of Hart and his colleagues (Hart et al. 1949; Hart 1950; Hart et al. 1950) and by their emphasis on

thoracic symptoms and signs as diagnostic features of the disease, often occurring in an early stage. Considering the minimum normal range to be 6 centimetres, Forestier et al. (1956) found the measurement reduced in 91% of patients; a slight reduction at the beginning of the disease gradually became greater in more advanced cases so that in cases of more than 20 years' duration, an expansion of more than 2 centimetres was very rare. The main effect is to reduce the vital capacity and to cause an abdominal type of respiration with greatly increased excursion of the diaphragm.

The lowest normal chest expansion has been taken as $2\frac{1}{2}$ inches (6.25 cms.) which compares closely with the minimum normal of 6 cms. = 2.4 inches (Forestier et al. 1956). It has been noted on analysis (Table 7) of the figures obtained that expansion was normal in 20% ofpatients and reduced in 80% of patients at the initial examination. Although by far the greatest number (16 of 20) of the patients with normal chest expansion were in an early stage of the disease, yet quite a number (11 of 32) showing grossly

limited expansion of less than one inch were in an early stage. 28 of 48 patients showing moderate reduction ($1\frac{1}{2}$ - $2\frac{1}{4}$") were in an early stage. This does support the belief that reduced chest expansion is a most useful diagnostic and early sign in many cases, although in almost 30% of early cases a normal measurement may be found.

ERYTHROCYTE SEDIMENTATION RATE (E.S.R.)

It is generally agreed that the erythrocyte sedimentation rate (E.S.R.) is increased in about 75 - 82% of patients (Polley and Slocumb, 1947a and b;) Graham and Ogryzlo, 1947; Hart et al, 1949; Boland, 1953; Forestier et al. 1956) and that the reading is raised in 75% of patients regardless of the stage of the disease (Forestier et al. 1956). There is also agreement as to the value of an increased E.S.R. as a diagnostic aid, provided it is realised that normal values may be found in 20 - 25% of cases. Certain differences of opinion exist as to its further value. The E.S.R. was considered to be useless as a measure of clinical improvement and response to treatment (Hart et al. 1949) and bore little relationship to the radiological state (Mobray et al. 1949) and presumably the clinical state. The E.S.R. was considered to increase with exacerbations and subside with remission of symptoms (Forestier et al. 1956; Romanus, 1953) in most cases, and was useful as a guide to treatment (Romanus, 1953). Cases in which the E.S.R. remains

persistently high for years in the absence of symptoms have been recorded, and are not considered to require further treatment (Forestier et al. 1956) but are liable to sudden exacerbations without obvious cause (Parr et al. 1951) and may be found on observation to be in a quietly advancing state or to have focal infection (Romanus, 1953).

In this group of patients the initial E.S.R. has been recorded and found to be normal in 13%, raised in 86% (and not recorded in one patient), and analysed (Table 9). It has been seen that normal readings tend to be found in older patients with longer symptomatic histories and with more advanced disease. As the range of the E.S.R. increases, so does the proportion of early cases, but 5 of 13 patients with a normal E.S.R. were in an early stage of the disease. The test has been found to be most useful in the diagnosis of early and doubtful cases - a raised reading being of particular value in a patient presenting with vague, possibly spondylitic symptoms, but a normal reading is not considered to exclude the diagnosis even in an early case. The value of

the test as a guide to treatment has not been assessed, but on several occasions the E.S.R. has increased considerably after radiotherapy and has remained at a higher level when the patient's symptoms have subsided. In all patients with onset of symptoms in the peripheral joints, the E.S.R. was considerably raised.

ASSOCIATED CLINICAL FEATURES

ANAEMIA

Anaemia was noted to occur in this series in 17% of patients, (slight in 14%, moderate in 2% and severe in only 1%), but in only 11% was the anaemia considered to be a true complication of the ankylosing spondylitis. This is a much smaller incidence than others have found - 17% anaemia (Parr et al, 1951); 25% moderate anaemia with severe anaemia rare (Boland and Shebesta, 1946); 25% secondary anaemia (Graham and Ogryzlo, 1947); 30% hypochromic anaemia (Boland, 1953); 30% slight anaemia may occur (Forestier et al. 1956).

It was thought that the explanation might be in the high proportion of early cases in the series, but when the stage of the disease was assessed in the 17 anaemic patients, 11 were found to be in an early clinical stage.

In all cases the anaemia appeared to be of the simple iron deficiency type, but no more complicated investigation than haemoglobin estimation, and red blood

cell counts were performed. Where the anaemia was related to the otherwise uncomplicated disease, it was cured by oral iron therapy; in the complicated cases except one, by treatment of the underlying condition in association with iron therapy; in a case complicated by previous surgical operations, partial gastrectomy with resection of a short-circuited loop of small bowel and intravenous iron were required before the patient's blood condition was considered suitable to tolerate radiotherapy. The E.S.R. was found to be raised considerably in all the anaemic patients, after correction for the anaemia.

I R I D O - C Y C L I T I S
(IRITIS)

The ophthalmic features in the first 68 of the 100 patients have been described by Morrison (1955) who stressed that iritis is such an integral part of the clinical picture that the use of the term ophthalmic complications is incorrect. The association of iritis with spondylitis is now so well known that the ophthalmologist frequently unmasks an unrecognised spondylitis by enquiring into general symptoms in his patient with iritis, thus presenting the physician with a case already diagnosed, (Sorsby, 1951), and the condition has been called a "pointing sign" to ankylosing spondylitis (Sorsby and Gormaz, 1946); Birbeck et al. (1951) reported 11 patients seen in the course of a year who presented first with iritis, but do not indicate the proportion in which this occurred.

In the present series iritis preceded any other symptom of the disease in 4% of patients, while Romanus (1953)

reported this sequence of events in 6% of 117 patients.

The percentage incidence has been reported as follows. (Table 13).

INCIDENCE OF IRITIS - TABLE 13.

AUTHOR	INCIDENCE PERCENTAGE
Romanus (1953)	28%
Blumberg and Ragan (1956)	25
Dunham and Kautz (1941)	25
Campbell (1947)	24
Bernstein (1951)	20
Present Series	16
West (1949)	15
Hart (1955)	13.5
Hench et al. (1947)	11.6
Buckley (1943)	10
Forestier et al. (1956)	8.5
Scott (1942)	7
Sharp and Easson (1954)	7
Birbeck et al. (1951)	6.5
Simpson and Stevenson (1949)	6
Golding (1936)	5.6
Mowbray et al. (1949)	2

This Table shows a wide variation in the incidence for which no explanation is obvious, while Hughes

(1952) gives a figure "about 50%".

It has been emphasised by Hart (1951 and 1954) that the incidence of iritis may be expected to increase with the age of the group of patients, since the duration of observation is greater, and yet in a series with a large proportion of early cases such as the present one a comparatively high incidence was found.

The patients in whom the symptom occurred were grouped and studied together and this showed that only five were early cases, while five were moderate cases and six were advanced cases. These patients were also found to be of an average age considerably greater than that of the whole series. The average duration of the disease was 9.2 years, much higher than that of the remainder. This does seem to confirm the statement made by Hart (1951 and 1954) as do the figures of Blumberg and Ragan (1956) since they observed patients over a long span of years. It was found that iritis was recurrent in nine of our patients (56%) which coincides with the findings of

Hench et al. (1947) that in half the patients affected it was recurrent. No reference has been found to any adverse affect of radiotherapy upon irido-cyclitis, therefore the relationship in time to this form of treatment was considered worth recording. In four patients (25%) an adverse effect seemed to result - onset of the first attack during and just after treatment in two, and more frequent attacks after treatment in two.

The acute phase of inflammation in all cases appeared to respond rapidly to treatment with cortisone instillation and generally cleared up without disability although residual signs could be detected in the eye, in some cases, for long periods afterwards. Bernstein (1951) however, points out that recurrent iritis leads eventually in a few cases to blindness.

An association of iritis with pericarditis at the same time was reported in two patients (Dunham and Kautz, 1941).

U R E T H R I T I S

The association of gonococcal urethritis with ankylosing spondylitis has been stressed throughout the literature since the earliest recognition of the disease, so much so that spondylitis was considered at one time a consequence of gonorrhoea. Forestier et al. (1956) found a previous history of this infection in 31 of 200 cases and infection immediately preceding the onset of the disease in 7 (3.5%) cases, in 6 of which the first symptom was an acute attack of peripheral arthritis followed by a long remission and then involvement of the spine, but non-specific urethritis is not mentioned and onset resembling Reiter's Syndrome was not seen. Infections, including gonorrhoea, are however, regarded as precipitating factors. The views of Romanus (1953) have raised again the question of related genito-urinary

infection, noted to be associated with onset in the peripheral joints in the form of an acute urethral infection by Graham and Ogryzlo (1947).

A relationship between ankylosing spondylitis with polyarthritis and gonococcal and non-specific urethritis is considered to exist (Ford, 1953). Lennon and Chalmers (1948) however, on specific investigation of this point found no evidence of infection in prostatic smears carried out on most of a series of 32 patients.

The presentation of ankylosing spondylitis with an illness resembling Reiter's Syndrome has been observed in two patients of my series and this type of onset has aroused some interest. When patients suffering from Reiter's Syndrome have been kept under observation, some have developed classical ankylosing spondylitis (Marche, 1950; Romanus, 1953).

From the evidence in the histories of the patients in my series non-specific urethritis of a recurrent form

was closely associated with the onset of spondylitic symptoms in two patients and an alleged gonococcal urethritis in one patient.

In five patients urethritis (non-specific in four and gonococcal in one) appeared after the onset of symptoms but in only one patient was the condition recurrent.

Non-specific urethritis is believed to be another manifestation of ankylosing spondylitis and part of the disease process as is iritis and not to be related to the causation of the disease.

ENDOCARDITIS.

The association of endocarditis with ankylosing spondylitis has now been recorded frequently, (Tyson, 1937; Edstrom, 1940; Herrick & Tyson, 1941; Dunham & Kautz, 1941; Bayles, 1943; Bernstein & Broch, 1949; Bywaters, 1950; Bauer, Clark & Kulka, 1951; Bernstein, 1951; Fraser, 1951; Glecker, 1954; Forestier et al. 1956; Blumberg & Ragan, 1956), and in this series two patients were found to have endocarditis. The aetiology of this type of endocarditis is not clear. Edstrom (1940) presumed that the organic heart disease found in four of seven patients with ankylosing spondylitis must be due to a previous rheumatic fever, although Tyson (1937) considered that the acute form of spondylitis with fever and peripheral joint involvement in a young person could be associated with mitral stenosis.

Bernstein & Broch, (1949), and Bernstein, (1951), found clinical and electro-cardiographic evidence of heart

disease in 11.9% of 352 patients, and that peripheral arthritis was twice as common in those with cardiac abnormalities as in the others.

They believed that the abnormalities resembled those of rheumatic fever, although acute carditis was not seen and they concluded that the cardiac complications were benign. Bauer, Clark and Kulka (1951), held quite definitely that the clinical and pathological features excluded both syphilis and rheumatic fever as the cause of the lesions in aortitis and aortic endocarditis.

There is, however, evidence to suggest that the endocarditis of ankylosing spondylitis is similar to that of rheumatoid arthritis and a concept of "rheumatoid heart disease" as specific to the latter disease has evolved, (Bagenstoss and Rosenberg, 1941; Bywaters, 1950; Sokoloff, 1953; Glecker, 1954). But differentiation of endocarditis in spondylitis and rheumatoid arthritis is difficult since these conditions are considered as one in

the American literature.

Both our patients had clinical signs - one of aortic insufficiency and one of mitral insufficiency - indistinguishable from those of rheumatic endocarditis when first seen and were considered benign.
The further development of the clinical condition, however, in the patient with aortic insufficiency was quite unlike an uncomplicated rheumatic endocarditis.
It did, in fact, resemble the condition described in association with the "malignant" form of rheumatoid arthritis, (Bevans, et al. 1954).
These authors state that valvulitis and other stigmata of rheumatic endocarditis are infrequent (in rheumatoid arthritis), except when a history of rheumatic fever is obtained, but describe the visceral lesions in two patients dying of "fulminating rheumatoid arthritis" as quite different from the lesions of those dying of rheumatic fever.

Sokoloff (1953), reviewing a large number of autopsies, found heart disease twice as common in rheumatoid arthritis as in unselected autopsies, but no evidence of endocarditis in 17 autopsies in ankylosing spondylitis. Endocarditis has been noted to be commoner in patients with peripheral joint involvement (Bauer et al. 1951; Bernstein and Broch, 1949; Tyson, 1937), but not only in those with peripheral involvement (Bauer et al. 1951).

Although one can never be certain that a previous rheumatic fever or "rheumatic" infection has not occurred, the evidence favours the conclusion that endocarditis in association with ankylosing spondylitis is of "rheumatoid" aetiology. The progress of one patient in this series is thought to resemble "rheumatoid" as opposed to "rheumatic" heart disease.
No conclusion can be drawn from the features of the other patient.

4. DIFFERENTIAL DIAGNOSIS

The difficulties in the diagnosis of ankylosing spondylitis vary with the stage of the disease.
In an early stage the diagnosis may be quite impossible and in the late stage only too obvious at a glance.

It has been emphasised previously that the clinical features of the earlier stages have been recognised only comparatively recently, and the symptoms may be of no great severity and of brief duration.
In addition, the symptoms and signs may not direct attention to the spine but rather to the peripheral joints.
Tanberg (1950) believed that no other rheumatic disease could be misdiagnosed so easily in the early stages, and advised that the "usual text book picture" be forgotten and attention paid to early minor symptoms.
Forestier (1939) pointed out that 80% of his cases, seen over a period of three years, were wrongly diagnosed.

The possibility of error in differentiating early ankylosing spondylitis from atypical prolapse of an intervertebral disc has been stressed, particularly (Key 1951), and this differentiation will be shown later to be one of the main difficulties in my cases.

If reliance is placed upon X-Ray appearances rather than clinical features, mistakes will be made, since the characteristic X-Ray changes may not develop until months after the onset of symptoms and a negative X-Ray does not exclude the diagnosis until three years after symptoms have appeared (Boland and Shebesta, 1946; Crenshaw and Hamilton, 1952).

Ankylosing spondylitis may supervene upon other conditions of the spinal column and cause great difficulty, (Buckley, 1931), and this has been noticed particularly in the case of injury with radiological evidence of a previous fracture, when a long delay in diagnosis may result, (Baird, 1955).

In the present series the erroneous diagnoses, made before the correct one was established, illustrate many of the difficulties and are listed in the Table with the number of instances in which the diagnosis was made.

Some patients have had several conditions considered and therefore the total number does not represent the number of patients in whom an incorrect diagnosis was made.

TABLE 14 - INCORRECT DIAGNOSES

Diagnosis	Number of Instances
Prolapsed intervertebral disc 17	20
Sciatica 3	
"Rheumatism", Fibrositis, Neuritis	6
Old fracture of vertebra	4
Tuberculosis of hip joint	4
Reiter's Syndrome	2
Gout	2
Sacro-iliac strain	2
Psychoneurosis	2
Torticollis	1
Pleurisy	1
Post-dysenteric arthritis	1
Undulant Fever	1
Rheumatoid arthritis	1
Rheumatic Fever	1
Tuberculosis of spine	1
Osteoid tumour of femur	1
Calcified ligaments of shoulder	1
Lumbo-sacral joint instability	1
Diagnosis not known	6

The greatest difficulty in these cases has therefore been differentiation from prolapsed intervertebral disc (P.I.D.) of an atypical nature, since it seems unlikely that ankylosing spondylitis could be confused with the P.I.D. of a sudden onset when bending or lifting, and with abnormal neurological signs.
Certain characteristics of spondylitic pain are not found with disc lesions.
One of the most important is the tendency to frequent brief attacks with relatively pain-free intervals, the pain accompanied by stiffness being worst after inactivity, rest or in the early hours of the morning.
The relief gained from mild exercise, activity or a hot bath is usually very definite, whereas the pain of a disc lesion is increased by activity, relieved by rest and getting into a bath may be impossible.
When lumbar pain is accompanied by thigh or buttock pain moving from side to side spondylitis is much more

likely.

The main features on examination are the difference in gait and posture; in chest expansion and leg movement, since rotation of the flexed hip with flexed knee causes maximum pain in ankylosing spondylitis, while straight leg-raising manoeuvres cause maximum unilateral pain in disc lesions.

General symptoms such as fever, loss of weight or anaemia, and extra articular lesions such as iritis or urethritis, and tender bony areas point to ankylosing spondylitis. A raised E.S.R. will often clinch the diagnosis but a normal reading is unhelpful. It is noticeable that if the history and clinical examination have given rise to a suspicion of spondylitis and appropriate X-Rays taken, the diagnosis has been quickly corrected.

The old classical misnomer, - "Rheumatism, fibrositis and neuritis" had been given on only six occasions and seems to have been replaced largely by the

more fashionable "prolapsed intervertebral disc".

A mistaken diagnosis of tuberculosis of the hip joint has been shown to be serious and it is disturbing that in two of the four patients, the possibility of ankylosing spondylitis was fully and carefully considered as an alternative, and yet the wrong decision to treat as tuberculosis was taken.

The difficulties associated with peripheral arthritis and differentiation from Reiter's Syndrome, gout, post-dysenteric arthritis, undulant fever, rheumatoid arthritis and rheumatic fever, have been commented upon previously. It may be impossible at an early stage in such cases to make a correct diagnosis but it has been found helpful to bear the possibility of ankylosing spondylitis in mind, when dealing with young men suffering from arthritis of obscure aetiology. The appearance of any pain or stiffness in the back or chest or failure to respond satisfactorily to specific

treatment should arouse suspicion.

Confusion between tuberculosis and ankylosing spondylitis has been seen, one case of each disease being diagnosed initially as the other.

Since early tuberculous disease of the vertebrae may not be evident on X-Ray films (Traut, 1952), too great reliance may be placed on negative radiological findings rather than on positive clinical features, such as localised and persistent pain and tenderness.

Although a patient having a sarcoma of a vertebral transverse process was originally considered to have ankylosing spondylitis, no intramedullary tumour has been found to cause confusion.

With regard to intramedullary lesions, it is important to remember the possibility of elevation of the cerebro-spinal fluid protein in ankylosing spondylitis

(Boland et al. 1948).

From the radiological point of view the diagnosis may be difficult when changes are localised to the sacro-iliac joints only. The appearance of the normal adolescent joints may be impossible to distinguish from the appearance of ankylosing spondylitis. The changes may be so early as to be doubtful and may be unilateral, as in 2 of the present series.

In females a similar appearance may be seen in osteitis condensans ilii (Shipp and Haggart, 1950). If any changes can be found elsewhere than in the sacro-iliac joints the doubt is usually resolved quickly.

It is considered, therefore, that erroneous diagnoses tend to arise from insufficient concentration upon the symptoms and signs and from lack of awareness of the early clinical picture in ankylosing spondylitis, but even with careful consideration and knowledge mistakes can be made.

If the condition is considered in all young people presenting with pain and stiffness affecting the trunk, neck, shoulders or thighs, or with peripheral joint arthritis, or with iritis, then signs of limited movement, bony tenderness and reduced chest expansion should be sought especially. If the erythrocyte sedimentation rate is raised or X-Rays show abnormality of the sacro-iliac joints, the diagnosis can be established beyond doubt.

In some instances an early diagnosis can be attained only by a period of observation.

5. CORRELATION OF CLINICAL AND RADIOLOGICAL FINDINGS.

The basis upon which the stage of the disease has been assessed has been given previously. When making this assessment, for description of patients in the section of clinical features, it became obvious that in many instances the clinical disability and X-Ray picture were difficult to reconcile. In spite of this it was generally possible to decide on the stage.
It was considered worth while, however, to compare the discrepancies by grouping the patients on the basis of radiological findings alone into four groups :-

Group 1. - No demonstrable change.

Group 2. - Early cases in which changes were limited to the sacro-iliac joints.

Group 3. - Moderately advanced cases in which sacro-iliac changes were accompanied by calcification in the spinal ligaments.

Group 4. - Advanced cases showing sacro-iliac obliteration and bamboo spine.

These Groups were then assessed clinically on the basis of the duration of symptoms and physical disability (generally excluding pain, if this could be relieved or improved after treatment) into early, moderate and advanced cases.

Group 1.

In two patients were no appreciable X-Ray changes found, where the history and clinical features appeared definite. Both patients were aged 20 years at the onset and the duration of symptoms was four months in one and one year in the other.

Group 2.

This Group consisted of 53 patients with X-Ray changes limited to the sacro-iliac joints but only in 17 of them did the disease appear to be early as judged by

clinical examination, although in 21 the duration was less than one year. Of the four patients showing advanced physical disease of duration less than one year, two had severe involvement of the hip joints and two had little or no spinal mobility.
In all four the chest expansion was diminished below normal.
In the 32 patients remaining in this total Group 22 were considered early as regards the disability, although the duration of the disease varied from $1\frac{1}{2}$ to 10 years.
10 were judged to have moderate disability but the duration of the disease was $1\frac{1}{2}$ to 12 years.

Group 3.

This Group consisted of 27 patients with some degree of calcification in the spinal ligaments in addition to sacro-iliac changes. In only five did the clinical disability appear to be slight and in three of these the history was less than one year.
In two with slight disability, the duration was 7 years

and 28 years. Four patients, however, had a history of less than one year but moderate disability.

Group 4.

There were 18 patients in this Group with gross X-Ray changes and advanced physical signs of the disease but in two cases the history was less than one year. The duration of symptoms of the remainder varied from 2 to 28 years.

This comparison shows well that the clinical disability is often more advanced than the radiological changes would suggest, particularly if the hip joints are involved. It illustrates how radiological changes may remain localised to the sacro-iliac joints even though the disability is moderately advanced and of long duration (up to 12 years) and that "bamboo spine" may not have developed even after 28 years.

On the other hand, moderately advanced and advanced X-Ray changes are found in disease of short symptomatic

history, revealing quite clearly that the disease process must be of much longer duration than the symptoms suggest. When fully developed "bamboo spine" is seen, the disability conforms in degree to the state of the X-Ray picture, but the symptomatic history is occasionally of extraordinarily short duration.

6. TREATMENT

It is not proposed to discuss the treatment of ankylosing spondylitis in detail. The type of treatment was advised elsewhere, but was carried out under my supervision and observation in hospital.

Certain principles were observed.

1. Patients were kept up and about and active.

2. Exercises were given to retain maximum mobility and to increase mobility if possible, of the spine, thorax and all joints affected, or likely to be affected. This was first under the supervision of physiotherapists and patients were advised and encouraged to continue these exercises indefinitely. No forcible attempts were made, however, to increase markedly limited movement. This form of therapy was advised in addition to other methods, with only a few exceptions which are discussed later.

3. Pain was relieved by simple analgesics of the aspirin, phenacetin and codeine group of drugs, by phenyl-

butazone, by cortisone or by X-Ray therapy, singly or in combination.

4. Local pain was relieved by local injections.

5. No form of immobilization or spinal support was advised.

1. No treatment was advised in 9 patients who could be divided into two groups.

(a) Six patients had disease of many years' duration resulting in complete ankylosis of the spine in reasonably good position, troubled a little by stiffness but with comparatively little pain, or only infrequent attacks of slight pain. Each patient had a classical "bamboo" spine on X-Ray. Two patients had been treated with X-irradiation, 14 years and 3 years previously. There was no clinical evidence of recent advance in the clinical state and it was considered in these patients that the disease had "burned out", therefore no benefit would result from any form of treatment.

(b) Three patients had disease of less than one year's duration with mild symptoms not apparently increasing in severity. The joint involvement was mainly peripheral in one patient. The radiological changes, limited to the sacro-iliac joints, were doubtful in the second patient. In the third patient, a minor X-Ray change was

found in one sacro-iliac joint. The three patients were kept under observation only.

2. Exercises and simple analgesics.

Thirteen patients were considered to require regular exercises to maintain movement and analgesics to control attacks of pain of moderate severity only. It had been found that patients in this Group improve greatly, and can live normal lives provided they continue mild exercises and provided they use aspirin liberally to control attacks of pain. Mild analgesics by relieving pain, allow muscular relaxation which in turn enables fuller benefit to be had from exercises.

3. Cortisone and A.C.T.H.

Cortisone was used in four patients. In one patient with complete ankylosis and severe pain, some relief was gained. In another severe and painful ankylosis of both hips was present and cortisone treatment gave relief over a period of some weeks. The third patient was given short courses of cortisone for attacks of pain, subsequent to X-Ray

therapy some years previously for advanced disease, with most satisfying relief of pain.

Cortisone was tried first in the female patient, with complete failure to relieve pain but improvement resulted subsequently from X-Ray therapy and phenylbutazone.

A.C.T.H. was used once only for the treatment of persistently painful heels, and did finally improve the condition. (To be discussed later).

4. Phenylbutazone.

This drug has been found most useful, being used in the treatment of twelve patients. It has undoubtedly a powerful analgesic effect and may be used in short courses of a few days for acute excerbations of pain or over longer periods in maintenance doses for more chronic persistent pain. It has been found very useful in the period following irradiation in tiding the patient over his pain until the full benefit from X-Ray therapy is gained. In some instances the use of this drug has produced such improvement that a second course of X-Rays could be

avoided and in a few instances X-Ray therapy could be omitted completely. Phenylbutazone has been used in the following combinations in long term management :-

Therapy	No. of Cases
Exercises + phenylbutazone	3
P. + Cortisone	1
P. + deep X-Ray therapy	5
P. + D.X.T. + Cortisone	2
P. + D.X.T. + A.C.T.H.	1

P = phenylbutazone
DXT = deep X-Ray therapy

5. Deep X-Ray Therapy

This form of treatment was used in 69 patients, the main indication for its use being pain, not relieved by other methods, in active disease.

Relief of pain is undoubted in most patients. This relief is noticed in many soon after the commencement of treatment and increases progressively for long after the end of the course. Some patients experience little or no relief until after the cessation of treatment. Many have gained complete relief of a permanent nature, or lasting for

many months. In others the pain is reduced to a much lower level of intensity so that it can be relieved easily by simple analgesics or by short courses of phenylbutazone. Some patients find the intensity of pain so reduced that it is replaced more by stiffness and easily tolerable mild aches or aching, which can be eased by exercise.
In addition to conventional radiation of the spine, sacro-iliac and hip joints, radiation of particularly painful bony prominences such as ischial tuberosities and calcaneal bones has been necessary.

6. Local Injection.

Infiltration of a local anaesthetic or ~~by~~ of hydrocortisone was used in three patients with severe intractable pain in bony prominences. The extremely tender ischial tuberosities of one patient were infiltrated once only by sub-periosteal injection with complete relief of the symptom. The painful heels of the other two required more prolonged and intensive treatment.

Treatment of Painful Heels.

It is considered worth while to mention the treatment of this interesting complication in some detail since it can present considerable difficulty. No treatment was necessary in one instance since the pain had already gone by the time the patient came under observation. He gave, however, a clear and rather rueful account of the trouble he had had and the lack of relief from previous treatment. The condition was cured apparently permanently in three patients by application of deep X-Ray therapy.

One patient (Case 23) was given injections of hydrocortisone subperiosteally to and around his painful left heel. This gave considerable but not complete relief, the cure being completed by his wearing an appliance for relief of painful heel described by Rose (1955). Hyrdocortisone injections have been used in painful heels of undetermined cause by Blockley (1956).

The most intractable heel pain, which was bilateral,

was experienced by a sergeant of the military police, (Case 88), this being his main complaint.
Deep X-Ray therapy gave no relief, nor did procaine, nor hydrocortisone by local injection. Procaine and Xylocaine were injected subperiosteally with considerable pressure under general anaesthesia without effect. Phenylbutazone in maximum doses was tried, but only had a slight easing effect. Finally systemic injections of A.C.T.H. slowly and gradually improved the condition. After many months he was able again to wear his Army boots, though still with "sorbo" rubber heel pads inside them.

The Results of Treatment.

From the Service point of view, the results of treatment were assessed according to the fitness of the patient to return to full or modified duty or unfitness requiring invaliding from the Service. But in addition to the purely clinical assessment, certain other factors of Service life have to be taken into consideration in

deciding whether retention in the Service or invaliding is indicated. Such factors are length of service already given, degree of training and skill in a technical speciality, the type of work the patient has done and is likely to do in the future. Whether the patient is a regular or National Service soldier, and the rank he holds. It occurs frequently, therefore, that a soldier of low rank serving his National Service but having lost the "will to serve" will be invalided from the Service.
His clinical condition may be similar to that of an officer or senior N.C.O. of long service, retaining the "will to serve" who can usefully be returned to duty.
A bias is therefore exerted towards invaliding from the Service, greater than that of the clinical state alone.

Return to Duty.

Eight patients were considered fit to return to duty without change in their medical category. Treatment with

X-Rays had been given to four patients and physiotherapy and exercises only were given to the other four. All had mild to moderate stiffness only, with slight or no pain as the result of treatment. Seven patients were officers or civilian executives of officer status, and one patient was a junior N.C.O.

Return to Modified Duty.

Fifty-four patients were considered fit to return to modified duty. Six of these appeared fit to serve in any part of the Army, except in the forward line, and forty-eight were retained on home service in the United Kingdom on modified light duty only. But many of these were retained in this country for observation and follow up initially, and were likely to be fit for less restricted service in the future.

Invaliding from the Service.

Thirty-seven patients were invalided from the Service after X-irradiation or institution of other treatment.

7. DISCUSSION

(a) INCIDENCE.

At the time of the 1914-18 war, ankylosing spondylitis was considered a rare disease (Buckley, 1948), although German writers had recorded an increased incidence in soldiers during that war (Miller, 1934). During the 1939-45 war, however, the incidence of cases in the British Forces appeared to be increasing (Savage, 1942; Fletcher, 1944) and finally showed the most striking increase of any of the rheumatic diseases, (Buckley, 1945).

It is not clear whether this was due to a true increase in incidence of the disease or due to better recognition and diagnosis, or due to segregation of patients in special clinics as West (1949) has suggested. Since the frequency of the disease has been shown to be 1:2000 on survey of a general population (West, 1949), it cannot now be considered a rare condition.

(b) NATURE OF THE DISEASE.

Since the time of Hilton Fagge (1877) controversy has raged about the exact position of ankylosing spondylitis in the classification of disease, though it is accepted as a condition of "rheumatic" aetiology.
Fagge's opponents were unwilling to accept the condition as separate from osteo-arthritis of the spine and Llewellyn Jones (1909) had to maintain in the face of opposition from no less an authority than Osler (1905), that the Strumpell - Marie - Bechterew varieties were closely allied to - if not identical with - "rheumatoid spondylitis". Osler maintained, at that time, that they were both types of arthritis deformans.

The controversy continues. The American Rheumatism Association (1941) classified the condition as one variant of rheumatoid arthritis and to this view most American authorities adhere, though Baker (1943) considered that this had not been determined. Boland and Present (1945)

defined the condition as a chronic progressive disease of the spine with the fundamental lesions affecting the diarthrodial or synovial joints, the intervertebral discs being unaffected; the bodies of the vertebrae are affected by secondary demineralisation only while calcification and osseous changes in the paravertebral ligaments lead to the radiological appearance of "bamboo" spine.

They consider that ankylosing spondylitis is a variant of rheumatoid arthritis on the basis of three main arguments :-

1. Typical rheumatoid arthritis involving the peripheral joints co-exists. This is acceptable and has been described by most observers. Boland and Present (1945) recorded the co-existence of typical rheumatoid arthritis of the peripheral joints in 18% of cases - 100 soldiers under observation in whom diagnosis was definite.

2. The erythrocyte sedimentation rate is raised, and there is constitutional disturbance in both diseases. Again this is true, but the E.S.R. is a non-specific test

and the rate may be increased in many conditions.

3. The pathological changes in the diarthrodial joints of the spine in ankylosing spondylitis are the same as in the peripheral joints of rheumatoid arthritis. This argument is challenged by Van Swaay (1950) and Cruikshank (1951). Van Swaay states that the histological picture is quite different from that of rheumatoid arthritis.

Boland and Present (1945) consider the main arguments that ankylosing spondylitis is a different disease to be :-

1. Ligamentous calcification is not a feature of rheumatoid arthritis;

2. The two conditions affect the male and female sex in different proportions, ankylosing spondylitis being found predominantly in males, while rheumatoid arthritis is found predominantly in females;

3. As regards therapy, gold is found to induce remissions in certain cases of rheumatoid arthritis, but not in ankylosing spondylitis;

4. Ankylosing spondylitis responds to radio-therapy, while rheumatoid arthritis does not.

These weighty arguments have, as yet, been neither destroyed nor challenged.

Hench, Slocumb and Polley (1947) in a paper based on experience of 1035 cases, more cautiously assume that "in the light of present knowledge . . . rheumatoid spondylitis is the spinal equivalent of rheumatoid arthritis". They add to the clinical differences given by Boland and Present (1945) these further points:

5. Age distribution.
Rheumatoid arthritis commences between the ages of 25 and 40, whereas ankylosing spondylitis commences between the ages of 15 and 30;

6. The sub-chondral osteitis seen radiographically is rarefying in rheumatoid arthritis but sclerosing in ankylosing spondylitis;

7. Rheumatic nodules are found in rheumatoid arthritis, but not in ankylosing spondylitis unless peripheral joint involvement co-exists;

8. Iritis presents an incidence two or three times greater in ankylosing spondylitis than in rheumatoid

arthritis.

9. The titre of agglutinins to haemolytic streptococci is lower, while the plasma phosphatase is increased more often, in ankylosing spondylitis;

10. There are more complete remissions in ankylosing spondylitis than in rheumatoid arthritis. Hench and others (1947) see essential similarities to be :-

    1) Cases of ankylosing spondylitis develop peripheral rheumatoid arthritis;

    2) The pathology in the hip joints and the peripheral joints is identical in both conditions;

    3) If peripheral joints are first affected, spondylitis may develop later;

    4) The pathology of the apophyseal joints in ankylosing spondylitis resembles that of the peripheral joints in rheumatoid arthritis.

Their opinion is finally based on pathological similarities despite clinical differences.

Hare (1940) analysing 1179 cases of arthritis, found 357 to be of rheumatoid type, of which 21 (6%) were

ankylosing spondylitis.

In four of these 21 patients, peripheral joints were involved. As the result of his study he presumed that ankylosing spondylitis was a form of rheumatoid arthritis.

The relation of ankylosing spondylitis to rheumatoid arthritis is also discussed by Lennon and Chalmers (1948), who share the American view point. They found that two cases of typical ankylosing spondylitis later developed typical rheumatoid arthritis of the wrists, fingers, ankles and feet; and that in many cases of long standing and distinctive rheumatoid arthritis, there existed "bamboo spine" and sacro-iliac joint destruction on radiographs.

Lennon and Chalmers (1948) believe that they are one and the same disease, differing only in the pattern and in the order of the joints being affected.

The opposition to considering these two as one has not been confined to Great Britain, since Dunham and

Kautz (1941) in America conclude, in a study of 25 cases of ankylosing spondylitis found on examination of 2395 patients, that this disease is not the same as rheumatoid arthritis, though it belongs to the rheumatic group.

They believe that the predominance in the male sets it apart from rheumatoid arthritis.

Parr, White and Shipton (1951) in Australia, believe ankylosing spondylitis to be a disease entity and not rheumatoid arthritis of the spine.

Buckley (1943:1948) believed the two conditions to be separate. His views were based on clinical points of difference :-

1) The difference in sex ratio of males to females affected;

2) The definite and marked tendency to bony ankylosis in ankylosing spondylitis;

3) The centrifugal spread of the disease is quite different;

4) The failure of ankylosing spondylitis to respond to gold therapy.

In this latter publication, Buckley (1948) considers the argument that the condition is a variant of rheumatoid arthritis "not proven", and goes so far as to say that this unitarian view has done much to retard progress in the study of ankylosing spondylitis and to mask some of its most important features.

Fletcher (1951) on evidence available, believed the conditions should be regarded as quite separate.
Hart (1954) discussing Buckley's (1943) opinion, feels that more critical diagnostic tests are required in all rheumatic diseases and until such time as they are available, there is no object in assuming a similar unknown aetiology for two diseases whose differences are so much more marked than their similarities.
Hart (1954), like Buckley (1948), believes that by studying the two diseases as distinct entities presenting unsolved problems, a greater advance of knowledge will result.

McEwen and others (1949) concede that ankylosing

spondylitis may be a separate entity, though many regard it as rheumatoid arthritis of the spine and they classify spondylitis in the group "variants of rheumatoid arthritis".

The broad view of Miller (1936) is of interest in the light of recent research by Romanus (1953) and Ford (1953) into the role of infection in the causation of spondylitis.

Miller wrote that ankylosing spondylitis may develop as a complication of a number of infective diseases, one of which is rheumatoid arthritis.

Observation of one hundred cases in hospital has led me to believe that ankylosing spondylitis is a distinct disease entity for the following reasons, in addition to those quoted above :-

1. Where the disease commences in the peripheral joints the distribution and appearance of the joints affected does not conform with that of rheumatoid arthritis. The tendency has been to complete resolution of the peripheral arthritis before spinal involvement is obvious.

2. The response to treatment with the cortico-steroid group of drugs is different.
Though some relief of pain in the acute phase of ankylosing spondylitis may result, no dramatic response or remission is produced.

3. The relief of pain induced by radio-therapy is quite striking in ankylosing spondylitis - a method not used in rheumatoid arthritis.

(c) AETIOLOGY.

At present the cause of ankylosing spondylitis is quite unknown. Tuberculosis, syphilis, gonorrhoea, trauma, focal sepsis, endocrine upset and vitamin deficiency have been considered, according to the fashion of the day but have no basis of proof.

Certain features have been studied in an attempt to throw light on the cause. The findings, however, in such a series of cases, though factual, may not always be valid in view of the element of selection. But as Romanus (1953) points out, it is difficult to find any collection of cases

of ankylosing spondylitis in which the selection factor does not operate.

The most obvious factor is the preponderence of males to females in the Service population. In this series there are 99 males and one female, an obvious fallacy if computing sex incidence of the condition.

Another factor is that of the "shifting population", since a large proportion of the Army population is composed of National Service men serving two years, mainly aged 18 to 20 years.

On the other hand, this is a complete cross-section of the young population of the country coming under as close medical supervision as is ever likely. (British Medical Journal, 1955).

AGE.

The age factor must be of considerable importance.

It is agreed that this is a disease of young persons

and as more attention is paid to defining the age of the patient at the onset of symptoms, so the disorder is found to start within a younger age span.

The age at onset has been recorded by several authorities - (1) Fletcher, 1944; (2) Boland and Present, 1945; (3) McWhirter, 1945; (4) Polley and Slocumb, 1947; (5) Graham and Ogryzlo, 1947; (6) Lennon and Chalmers, 1948; and these records have been compared with the present series (7) as the percentage of cases arising in three age groups, (Table 15).

TABLE 15.

AGE AT ONSET COMPARISON (PERCENTAGE)

Author	Fletcher (1)	Boland & Present (2)	McWhirter (3)	Polley & Slocumb (4)	Graham & Ogryzlo (5)	Lennon & Chalmers (6)	Present Series (7)
No. of cases	68	100	168	1035	100	32	100
Age 20-	10	15	19	24	73	22	36
20 - 30	28	69	51	51		44	46
30+	62	16	30	24	27	34	18
Unknown		0		1			

Buckley (1945) found the great majority to arise between the ages of 15 and 30 years. Mobray, Latner and Middlemiss (1949) gave the ages of onset with a span of 15 - 65 years and the peak ages 16 - 35 years.
The average age at onset has been noted as 24 years (Graham and Ogryzlo, 1949) and 26 years (Parr, White and Shipton, 1951).

Though this age incidence is well known and accepted, little discussion upon its significance is to be found in the literature. Buckley (1943) relates the onset to an age when bone growth is active.
West (1949), considering the age and mode of onset, thought the disease began when growth has ceased or is ceasing in bone, when secondary epiphyses have appeared or are appearing and when articular cartilage is showing change.

These observations assume considerable importance, relating the condition to growth of bone and to change in articular cartilage. Ogilvie (1954) has pointed out in his dissertation upon "Ephebiatrics", that at this young

age the most striking physical characters are to be found in the skeleton, though of course his observations were not in connection with ankylosing spondylitis.

The chemical changes in relation to absorption of cartilage have been described by Blair (1942) in his hypothesis as to the cause of the disease.

SEX.

Ankylosing spondylitis predominantly affects males, although the male to female ratio has been found to vary from 20:1 (Bauer, 1939) to 5:4 (Parr et al. 1951).

Figures given in different countries show well that with the exception of Australia, male cases greatly outnumber female cases. (Table 16).

TABLE 16

SEX RATIO

	Author	Cases	Male	Female
Great Britain	McWhirter (1945)	168	10	1
	West (1949)	134	10	1
	Buckley (1935)	150	6½	1
	Mobray et al. (1949)	137	6	1
	Sharp & Easson (1954)	394	5½	1
	Fletcher (1951)	150	4	1
	Scott (1942)	555	2½	1
America	Bauer (1939)	?	20	1
	Boland (1946)	1000	20	1
	Hare (1940)	21	10	1
	Polley & Slocumb (1947)	1035	9	1
	Tyson et al. (1953)	510	7½	1
	Swaim (1939)	106	4	1
	Blumberg & Ragan (1956)	311	4	1
Australia	Parr et al. (1951)	100	5	4

The sex ratio with the ages of the persons affected led Buckley (1955) to ascribe a part in causation to sex gland influence. Parr, White and Shipton (1951) discussed their figures which show the highest proportion of female cases but offered no explanation, although stating that of all their patients, females represented 65%. If all cases seen were in the ratio of almost 1:2 males:females it could possibly reduce the proportion in cases of ankylosing spondylitis to 5:4 males: females. If, on the other hand, a series contains a number of service cases, there is a bias towards increase in the proportion of males as Graham and Ogryzlow (1947) point out when discussing their series of 110 cases - 66 from a service arthritis centre and 44 from a General Hospital giving a male to female ratio of 16:1. If the series consists entirely of service patients, the figures are completely biased by selection towards a preponderance of males, the present series of 100 patients including one female.

HEREDITY.

The factor of inheritance now appears to be of considerable importance. Although the original descriptions of Von Bechterew (1898) pointed to heredity, the diagnosis in some of these cases had been doubted by others, (Warrington 1906; Buckley, 1932; Dunham and Kautz, 1941; Turney, 1952). In Von Bechterew's group of cases is included a woman, whose mother and son had a similar affection, and another woman, whose son was also afflicted.

Again, Marie and Astie (1897) reported three members of a family - father, son and daughter, all definite cases, and considered heredity and trauma of such importance that they introduced the description term "la cyphose hérédo-traumatique" for the "Bechterew type" of disease. Further instances of familial incidence were recorded by Warrington (1906) - a brother and a sister; by Seguin (1905) - three children in the same family; while Bennett (1907) considered that chronic stiffness of the spine tended to affect more

than one member of the same family. Llewellyn Jones (1907) however, though aware of these findings, did not notice any family history in his cases and concluded that hereditary influences were unlikely to be of importance.

These early and probably accurate observations were lost sight of for many years, possibly in the confusion of ideas about terminology and definition of the various types of spinal disease and traumatic conditions. The apparent rarity or lack of recognition of ankylosing spondylitis for such a long period may have been partly responsible. Even in recent years eminent workers have remained silent upon the subject of heredity. Scott (1942) in his classic monograph compiled from experience of 300 cases, recorded a family association in no less than six instances with these groupings :- a brother and sister, twins both affected, two brothers, two sisters, a father and son, a patient whose uncle died of the disease - yet did not think these facts of importance with regard to aetiology.

The careful investigation of causal factors by Boland and Present (1945) revealed no familial factor, nor indeed is any mention of this possibility made. As late as 1936 Miller stated there was no evidence to suggest that heredity played a role in causation, though Tyson (1937) noted that the condition was known to affect two or more individuals in a family, and McWhirter (1945) was aware of familial transmission. In discussions following Polley & Slocumb's (1947) paper, Freyberg (1947) raised the question of family histories, quoting his personal experience of a father and three sons affected and of families in which females were sufferers as well as males. Polley and Slocumb (1947), though quoting 0.4% of positive family histories in 1035 cases, suspected the incidence to be greater. This 0.4% incidence was explained further by Polley (1948) in his description of a female spondylitic who had three spondylitic brothers and three sisters well.

Stecher and Hauser (1946) had appreciated the importance of heredity and recorded ankylosing spondylitis in two brothers, quoting two further pairs of brothers, cases of Reynolds and Ehrlich. A family with a patient in each of three successive generations was described by Stauffer and Moffett (1946) who deduced from the distribution that genic action was important, and that probably a dominant gene existed with low penetration in females, and further that the inheritance was probably sex-influenced. Rogoff and Freyberg (1948; 1949) considering that the family incidence was inadequately appreciated, questioned 114 patients with ankylosing spondylitis about similar symptoms in other members of their families. 24 suspected cases were found in 18 families, and of these 13 definite cases of ankylosing spondylitis were found in 10 families. It was clearly shown, therefore, that in 10 families one or more members in addition to the original patient, were affected. Even if no further undiscovered cases existed in the families of the 114 patients, the familial incidence would be 9%.

Among these individuals were the following interesting combinations :-

1. Patient + father + 2 brothers affected.
2. Patient + brother + sister affected.
3. A pair of identical male twins, both affected, the symptoms being of simultaneous onset.

The forthright statement that "the family history is significant and is inadequately emphasised in the English literature" had already been made by Campbell (1947) basing his opinion on the findings in 25 patients. Two of his patients were identical twins who developed ankylosing spondylitis at the same time, while residing in different countries; two further patients were brothers; a fifth patient had an uncle who died of the disease; a sixth had an uncle and a brother affected. Another pair of identical twins suffering from spondylitis had previously been described, (Ray, 1932).

Further examples of familial incidence have been given by Tegner and Lloyd (1949) who found three children of one

family affected, and Fraser (1951) who found two sisters affected, while Mason (1951) reported an extraordinarily high incidence in a family of three definite cases, one suspected and three presumptive cases.

Parr, White and Shipton (1951) in a series of 100 patients found 11% with a familial history.
As noted previously, this series contains a high proportion of female patients (male : female, 5:4). The grouping of these relatives was as follows :-

1. Mother and two sisters.
2. Two sisters.
3. Two pairs of brothers.

A similar proportion with a family history of the disease was noted by Tyson, Thompson and Ragan (1953), and by Sharp and Easson (1954). This incidence is confirmed, on systematic examination of the relatives of patients, by West (1949). The incidence tends to be higher in families with an affected female (West, 1949; Riecker and others, 1950). This increased family incidence is due to genetic factors according to the studies of Hersh et al. (1950) and

Riecker et al. (1950). Hersh et al. (1950) also produce evidence that the character concerned is not sex-linked, but is dominant with incomplete penetrance, the predominantly male incidence being due to a penetrance of the character of approximately 70% in males and 10% in females. West (1949) decided that there must be a local metabolic defect in articular structures and in bone - ligament attachments subject to continuous stress, but with heredity as a major factor. Buckley (1953) concluded that ample evidence existed to show that heredity was a predisposing factor, though not entirely the cause of ankylosing spondylitis. It would appear, therefore, that certain individuals are genetically predisposed and some develop the disease but others do not. The reason for this is not known, but if a "trigger mechanism" such as infection which is postulated by Boland and Present (1945) does, in fact, exist, an explanation is possible. Some genetically predisposed individuals may be susceptible to a "trigger" influence, while others may not be susceptible, and some genetically predisposed persons may

happen to avoid that initiating factor.

INFECTION.

All efforts to incriminate a specific infection in causation have failed. Tuberculosis in particular has been considered, (Scott, 1937; Buckley, 1935; Robinson, 1940), but no evidence has been produced to prove tuberculosis other than an incidental, complicating or terminal finding. Though gonorrhoea and non-specific urethritis are found in patients with ankylosing spondylitis, Boland (1953) stated that the incidence of gonorrhoea was the same in patients without arthritis, in those with rheumatoid arthritis and in those with ankylosing spondylitis, and that gonorrhoea is not uncommon in males at the age in which spondylitis is in an active phase. Although no specific organism has been identified, many writers have concluded that the condition behaves like an infectious disease process. Boland (1953) reaches this conclusion on the evidence of the general constitutional features, such as the increased E.S.R. with low grade fever, weight loss, hypochromic anaemia and fatigue

in association with the pathology of an inflammatory synovitis. Hart et al. (1949) and Lennon and Chalmers (1948) support this belief.

Forestier and Certonciny (1939) held the opinion that the primary focus was in the genito-urinary tract and that toxic products reached the pelvis and spine through the lymphatics. More recently the work of Romanus (1953) and Ford (1953) has lent support to that view. Lennon and Chalmers (1948), however, though finding tonsillar, bronchial, dental infection or other infection in 26 of 32 cases, found no evidence of local genito-urinary infection as judged by prostatic smear examination. In the examination of 100 patients, Parr, White and Shipton (1951) found no focal sepsis. Oppenheimer (1938) described 11 cases occurring after acute infections.

Faced with these conflicting views it is most difficult to come to any conclusion with regard to local infection, genito-urinary, colonic or other.

In the present series a careful history of the previous illnesses which could have been due to infection, has been taken from each patient in an attempt to find relationship to the onset of ankylosing spondylitis. The findings are recorded in Table 2 and indicate that there were 46 instances of infection or probable infection. For this purpose non-specific urethritis has been included as an infectious (possibly viral) condition. In ten instances the infection was related in time to the onset of spondylitic symptoms. Two patients had diarrhoea whilst serving in a tropical area, presumed to be dysenteric in origin but no such organism was cultured from the stools. Although therefore an infection was presumed, it was not proven. Non-specific urethritis was related to the onset in two patients, but although considered to be of infectious, possibly viral origin, the cause is unknown. I have preferred to regard this condition as part of the spondylitic syndrome in view of the frequent (6%) association at various stages of the illness, rather than as a factor in causation.

There remain six instances in which the infection was known - three cases of malaria, two cases of "surgical" staphylococcal infection, and one case of gonococcal urethritis. On study of these patients there is no evidence that the infection played a part in determining the onset of ankylosing spondylitis apart from the temporal relationship. Equally there is no evidence to show that the conditions did not act as "trigger" factors in predisposed individuals.

TRAUMA.

The role of trauma to the spine as a possible factor in causing ankylosing spondylitis has been discussed frequently, and is of considerable importance not only from the clinical but from the compensation and pension point of view.
In earlier writings trauma is listed as a cause, linked with heredity, "la cyphose hérédo-traumatique", but latterly the mass of opinion has swung against any relationship. Stockman (1926) records that cases occurred after injury but did not consider injury the cause, although it might encourage infection. By 1931 Buckley wrote that the injury theory was

losing ground, although conceding later (Buckley, 1945) in view of the large number of cases discovered in the Forces during the 1939-45 war, that minor trauma a few months before the onset might be worth investigating. Boland and Present (1945) found that 8% of patients dated the onset of symptoms to a minor back injury but they concluded that the injury probably brought the existing disease to light. In four patients with severe trauma they considered this to be unrelated. A number of cases in which symptoms followed a recent injury to the spine were described (Parr and Shipton, 1946) but in a later publication (Parr, White and Shipton, 1951) trauma was excluded as a cause. Graham and Ogryzlo (1947) found 13% of their patients to have had a back injury but thought this merely caused aggravation of the disease already present. Mowbray et al. (1949) considered that there was no evidence to support trauma as a cause. Evidence of spinal injury was obtained in 5% of cases by Forestier, Jacqueline and Rotes-Querol (1956) who considered this figure to be low as compared with other writers. They had excluded

many cases in which the patients themselves had related the onset of ankylosing spondylitis to injury, but do in fact state that trauma may play a precipitating role in the onset of a few cases.

Ankylosing spondylitis of traumatic origin has been described by Graber - Duvernay (1951) occurring in 9 of 118 cases. In each case there was a violent accident causing the patients to lie up and no free interval could be detected between the symptoms of the injury and the starting point of spondylitic symptoms. In this form it is considered that the patient must have a predisposition to the disease, the onset is about the age 34-35, there is little pain in neck, shoulders or hips, and no extra-articular complications occur.

When enquiring into previous injuries in this series, it was noted how ready the patients were to attribute the condition to an injury, however minor, particularly if the spine had been involved and how convinced they were that this was the cause. Apart from the fact that a spinal injury is regarded as a dramatic and serious occurrence by the lay

mind, it is also regarded as liable to produce longstanding disability and as a basis for financial compensation.

In nine of my patients an injury seemed to be related to the time of the onset - in seven instances the injury affected the spine (severe in six and slight in one).

A previous report (Baird, 1955) has shown that in a number of these patients the symptomatic history was of such long duration and the injury so many years previously, that it was impossible to separate the symptoms of injury from the onset of spondylitic symptoms. It is obvious, too, that after many years the patients' recollection of the insidious onset of ankylosing spondylitis is likely to be vague but the memory of a severe accident sharper and probably more accurate.

My conclusions as to the causation of ankylosing spondylitis are these :-

1. Unquestionably age is of importance, - the onset in young people soon after puberty when bony growth is ending is striking.

2. Males are affected more often and more severely than females, - therefore a sex bias exists.

3. Hereditary predisposition is of fundamental importance.

4. That a trigger mechanism initiates the condition in hereditarily predisposed young males seems likely, but I can find no evidence that this is trauma or infection, nor have I found any other initiating factor.

(d) Treatment

The place of X-Rays in treatment has been under careful consideration since Van Swaay (1950;1955) described the development of myeloid leukaemia in patients after this form of therapy. There is ample evidence from surveys of large numbers of cases that the death rate from leukaemia among patients with ankylosing spondylitis treated with X-Rays is much higher than the expected death rate from leukaemia in the general population (Court Brown and Abbatt, 1955; Medical Research Council Report, 1956). The incidence of leukaemia is higher still in patients receiving more than one course of X-Rays. A high incidence of leukaemia is found in patients with spondylitis treated with radiation when compared with similar cases not treated by radiation (Abbatt and Lea, 1956). Although bone marrow changes have been described in patients with and without irradiation (Pillers and Marks, 1956; Stewart and Dische, 1956) and although the research survey is not complete, there appears to be a relationship between ankylosing spondylitis, X-irradiation

and leukaemia. The conclusions are that no such treatment should be used unless the diagnosis is clearly established and no second treatment should be given unless absolutely necessary (Court Brown & Abbatt, 1955).

The practical problem in dealing with patients raises three questions -

1. Is the diagnosis clearly established?
2. Is X-irradiation to be used?
3. Is X-irradiation to be repeated?

Is the diagnosis clearly established? The certain diagnosis of the early case has been fully discussed before and is clearly of greater importance now than before the implications of irradiation were known. Delay to ascertain the diagnosis is permissible only if irremediable ankylosis or deformity does not occur and the patient is under close observation.

Is X-irradiation to be used? It is quite definite that X-Rays relieve pain. It is uncertain, although believed, that radiation halts the progression of the disease. Therefore the only absolute indication is pain unrelieved

by other means. Attention has been focussed upon the analgesic drugs, including phenylbutazone and the corticosteroid group, although they also have certain disadvantages and dangers, and upon active physiotherapy. I have been so impressed by the relief of pain and increase of mobility resulting from radiation, that I consider it should be used immediately on the failure of simple analgesics, and earlier in the course of the disease rather than later.

Is X-irradiation to be repeated? This is probably the most difficult decision of all. The reasoned surveys of the statisticians do not compare the sufferings of those dying of leukaemia - 46 patients (Medical Research Report, 1956), and the sufferings of the remaining 13,306. It may well be that it is better to risk the small chance of dying earlier of leukaemia to live relieved of spondylitic pain and misery. The clinician may have to accept this risk to relieve his patient by a second or third or further application of X-Rays. There are certainly many patients who have been so relieved and are grateful to have been treated by a clinician, rather than a statistician, whose courage has matched their own.

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APPENDIX

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(b) Tables

TABLE I.

ANKYLOSING SPONDYLITIS - PROFORMA

No. Rank Name Age

Service Unit

Service abroad

Date of Admission:- 1. To hospital
2. To Q.A.M.H.

Chief Complaint Duration

Symptoms Duration

Spine	Pain	Neck	thoracic spine	Lumbar spine	
	Stiffness	Neck	thoracic spine	Lumbar spine	
S.I. Joints					
Hip Joints					
Shoulder Joints					
Peripheral joints	Elbows	knees	Wrists Ankles	Hands Feet	
Chest	Pains Movement Other symptoms				
P.H.					
F.H.					
Examination	Fever				
	Appearance				

	Type of man	Posture
	eyes	
Movements:	Cervical spine Thoracic spine Lumber spine	Chest expansion Hip Joints
Pain	Cervical Lumbar Sacro-Iliac	Thoracic Hip Joints

X-rays

E.S.R.

Complications:

Treatment (briefly)

Disposal

Follow up

Mild Moderate Severe Active/Non-active.

Table II.

Case No	Age	Age at onset	Time to diagnosis	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree.
	In years															
1.	40½	32	8	L	Bronchitis Asthma	0		0	C.T.L.	½	Pneumonia Dyspepsia Glands	3	S.I. calc. sp.	D.X.T.	P7	Mod
2.	22	19	2½	L.T.S.	-	F-Gout		0	C.T.L.	½	Urethritis Epididymitis	12	S.I.	D.X.T.	P7	Mod
3.	40	37	3	L.H.S.	0	0		0	T.L. H.	¾	0	58	S.I.+ calc. spinal ligs.	D.X.T.	P7	Mod
4.	37	19	18	L.C.	0	0		0	L	1¼	0	35	S.I. + calc. spinal ligs.	D.X.T.	P7	Mod
5.	27	25	2	L	Hernia operation	0		0	T.L.	¾	0	20	S.I. + early sp. calc.	Physio -therapy	P7	Mod
6.	22	21	1	L. +H	0	0		0	L.H.	3"	0	20	S.I.	D.X.T.	P7	Severe
7.	35	30	< 1	T.C.	0	0		0	T.L.	2½	0	8	S.I. + bamboo	D.X.T.	P3	Severe
8.	24	20	< 1	L.H.	0	0		0	L.H.	2¼	0	50	S.I.	D.X.T.	P7	Mod
9.	45	28	17	Perip -heral	G.S.W. Bronchitis	0		0	C.L.T.	1¼	Iritis Urethritis Stricture Bronchitis	35	S.I. scl. bamboo	0	P7	Severe
10.	29	28	< 1	L.H.	0	0 n	Dysentery	0	C.T.L. H.	1¾	0	38	S.I. scl bamboo	D.X.T.	P7	Severe
11.	23	22	< 1	Perip -heral	0	0		+	L	1½	Urethritis	30	? S.I.	D.X.T.	P4(c)	Severe
12.	40	38	2	L.C.T.	D.U. perforation 2 operat -ions	0	Bed for operation	0	C.T.L. H.	2	D.U. Anaemia	60	S.I. scl. bamboo	D.X.T. + surgery	P7	Severe
13.	31	27	4	B.C.	Malaria Dysentery	0		0	L.C.	2½	0	18	S.I. scl. calc. spinal	D.X.T. 2	P7	Mod

Table II (contd).

Case No	Age	Age at onset	Time to diagnosis	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
	In years															
14.	34	28	6	L.H.	0	0		0	L + T	$2\frac{1}{2}$	0	10	S.I.	Physio	P3	Mod
15.	42	15	6	Iritis C.L.	Urticaria	0		0	C.T. H.	$1\frac{3}{4}$	Iritis	?	S.I. scl. bamboo	Physio	R.T.U.	Severe
16.	29	19	10	L.H.	0	0		0	L.H.	$1\frac{1}{2}$	Iritis	12	S.I. early	0	P7	Mod
17.	23	21	$1\frac{1}{2}$	H	Injury	0	Injury	0	?L	3	0	4	?L S.I.	D.X.T. Physio	P7	Mild
18.	41	20	21	L.B.S.	0	0	Adm for G.U.	0	C.L.T. fixed	$\frac{1}{4}$	G.U.	11	Scl. S.I. bamboo	Exercise	P7	Severe
19.	31	31	< 1	C.L. no pain	0	M- diabe -tes		0	C.T.L. rigid	$\frac{3}{8}$	Quadriplegia ?# Adontoid ? Atlanto - axial dislocation	49	All bamboo	Cortisone B.T.Z.	P8	Severe
20.	24	22	$1\frac{1}{2}$	T.L. little pain	0	0	Bed with abscess of leg	0	T.L. fixed	1	8	43	S.I.	D.X.T.	P7	Mod
21.	19	19	< 1	L.C.	0	0		0	C.L.	$\frac{1}{2}$	0	72	S.I.	D.X.T.	P7	Mild
22.	29	27	2	sciatic B.L.	0	Brother affected		0	T.L.	$\frac{1}{4}$	0	55	R. S.I. oblit. L. hazy	D.X.T. B.T.Z.	P8	Severe
23.	37	36	1	Perip -heral	0	0	Wet weather	0	C.L.	2	Iritis Heels	44	S.I.	D.X.T. Inj. Hydro-cort -isone	P8	Mod
24.	45	35	10	T.L.C.	0	0	Inj. back	0	C.T.L.	$\frac{1}{4}$	Recurrent resp infecti -on Hypertensive Clubbing	82	S.I.	D.X.T.	P8	Mod
25.	31	26	5	L.T.C.	0	GrM Severe RhArth	Wound Chest	0	C & H limited T.L. fixed	$\frac{3}{4}$	Urethritis	57	S.I. bamboo	D.X.T.	P7	Severe
26.	38	24	2	Stiff only back	Bronchitis	I.S. - RhArth	Fall on spine	0	T.L. fixed H - limited	$\frac{3}{4}$	Bronchitis	3	S.I. scl. bamboo	0	P3	Severe

Table II (contd).

Case No	Age	Age at onset	Time to diagnosis	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
	In years															
27.	50	49	<1	L.T. rapid mainly stiff	Jaundice	0		0	C.T.L. fixed	¼	D.U. Malaena Anaemia Iritis)1936)1946 T.B. healed	58	S.I. obl. calc. sp.	Physio & movements	R.T.U.	Severe
28.	33	30	3	Stiff spine only Pulheem Exam.	0	0		0	C.T.L. fixed	2	Conjunctivitis (prob Iritis) E.S.R. Increas-ed on D.X.T.	30	S.I. bamboo	D.X.T.	R.T.U.	Severe
29.	20	20	<1	L + H Heel	0	0		0	normal	3	0	35	normal	D.X.T.	R.T.U.	Mild
30.	19	15	4	L.B.	Rh fever aet 5	0		0	normal	3	0	17	S.I. only	D.X.T.	P7	Mod
31.	20	18	2	Perip-heral	Bronchitis Poliomyel-itis	0		0	C.T.L. H.	1	Anaemia Old Poliomyel-itis Obesity	24	S.I. Advanc-ed	D.X.T.	R.T.U.	Mod
32.	22	12	10	Perip-heral	Rh fever aet 9	0		0	L.H.	2	0	33	S.I. early	D.X.T.	P8	Mod
33.	18	14	4	Perip-heral	0	M-Rh GrM-Rh	Septic wound & boils	+	L.T. +H.	2	Wasted muscles	40	S.I. early	Exercises	P8	Mod
34.	20	20	<1	B (R+L) T + periph eral	0	M-Rh F-broken back		0	L.H.	¾	0	33	S.I. early	D.X.T. B.T.Z.	P8	Mild
35.	28	21	7	Sciatic B.	0	P.T.B. ++		0	H-Limit-ed	1½	0	12	S.I. obl. calc. L.V.	D.X.T.	P7	Mod
36.	18	16	2	L.T. + Knee	0	0		0	T.L. H.	1	0	35	S.I. normal	D.X.T.	P8	Mild
37.	21	19	2	Thighs Hips	Malaria	0	Injury P.O.W.	0	L.	2½	Anaemia gross	67	S.I.	D.X.T.	P8	Mod
38.	24	24	<1	L.B.S. H.	Malaria	0	Non-specific urethritis	0	L.H. C-slight	1	Urethritis (Non-specific)	22	S.I.#V. + calc. ant. lig.	D.X.T.	P7	Mod

Table II (contd).

Case No	Age	Age at onset (In years)	Time to diagnosis (In years)	Onset	Previous History	Family History	Predisposing factors	Fever	Movement limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
39.	27	27	<1	Periph -eral	0	0	Diarrhoea	+	L + wast -ing Left Quadrice -ps	1½	Psychosis	63	S.I. early	observat- ion	P7	Mod
40.	37	21	9	sciati -ca T.C.	Dislocat -ion Wound	0		0	C.T.L.	½	BP 160/100 1 Fit	28	S.I. obl. C & D. calc	D.X.T. 1957 54	P7 R.T.U.	Severe
41.	36	35	1	L	0	0		0	L.C. H.	½	E.S.R. + on D.X.T.	4	S.I. obl. + ant. lig. calc.	D.X.T. but drop in W.B.C.	P7	Mild
42.	37	30	7	L.H.	asthma	0		0	L.T. + some C.H.	1	0	40	S.I. + calc L.V.	D.X.T.	P7	Mod
43.	33	31	1½	Discov -ered when Dyspep -sia invest -igated	Dyspepsia	M-Arth F- "		0	L -limit -ed L.T. -fixed H	½	D.U. dyspeps -ia anaemia	42	S.I. calc ligs.	Exercises	P8	Mod
44.	19	19	<1	H.L. C. S.	0	0		0	L-limited LT-fixed H.	1½	0	50	S.I. early Symph pubis	D.X.T. fall in W.B.C. & Hb	P7	Mod
45.	21	17	4	Periph -eral H.K.L.	0	0		0	L-limited H.	1½	0	17	S.I. early	D.X.T.	P8	Severe
46.	45	37	2	L.C.S. K.	Iritis	0		0	C.T.L.	¾	Iritis aortic dis. RhA later	8	S.I. Ank. + bamboo	Exercises B.T.Z.	P7	Mod
47.	47	25	7	L.	0	0		0	C.T.L. fixed ++ H-limited	½	Iritis	24	S.I. obl. + bamboo	0	P8	Severe
48.	51	27	19	Fall L. sciatic	Accident	M-Rh	Accident	0	C.T.L. fixed H.	1¼	Hypertension clubbing obese	5	S.I. obl.+ bamboo ? old #	D.X.T. 1957	P8	Mod

Table II (contd).

Case No	Age	Age at onset	Time to diagnosis	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
		In years														
49.	36	35	<1	L.C.	# ankle	0		0	C.T.L. fixed H.	1½	Heels	30	S.I. + calc. ligs.	D.X.T.	P7	Mod
50.	25	22	3	Hip L. T.	Asthma	0		0	L. ? T. H.	3	0	13-25 after D.X.T.	S.I. early	D.X.T.	P7	Mild
51.	56	45	7	L. but little pain	Picked up on Med Board	0		0	Poker back	½	Ureteric calculus "coronary"1950 Chr bronchitis	2	S.I. obl. bamboo	0	P7 R.T.U.	Severe
52.	22	19	3	Thighs -L.	Bronchitis up to 7	0		0	L-limited	1½	0	10	Lower 2/3 S.I.'s	D.X.T.	P7	Mild
53.	36	32	3½	C.L.B.	Picked up on routine X-Ray	Wife P.T.B.		0	C-slight L-? H.	¼	Old pleural thickening Left	44	S.I. hips	D.X.T.	P7	Mod
54.	23	19	4	H.T.L. K.	0	F. has Arth of spine similar?	Accident	0	L-slight T.L. fixed	¼	Iritis Anaemia	26	S.I. + spine	D.X.T.	P7	Mod
55.	24	19	5	L + Sc	Chronic cough	0	? Accident	0	T.L. - slight	2	Iritis following D.X.T.	20	S.I. & D12 L.I.	D.X.T.	P8	Mod
56.	36	24	12	L + Sc Periph -eral	G.S.W. 1944 2 years after ∝	0		0	L.T. fixed	1¾	Heels	12	S.I.'s calc. ligs.	D.X.T.	P7	Mod
57.	20	19	<	L + Sc	0	0		+	C.L.T.	2	Anaemia	38	S.I.	D.X.T.	P8	Severe
58.	20	20	<	L	0	M- has 'Rheumati -cs'		0	L + H	2	Anaemia	26	S.I. early	D.X.T.	P7	Mod
59.	37	29	8	S.L.T.C.	0	0		0	C-limited L & T fixed	1¼	P.T.B. active ?	67	S.I. + L calc.	Strep + P.A.S. then D.X.T.	P8	Severe
60.	22	20	2	Periph -eral	0	F-Gout	Cold & Wet	0	normal	2½	? Anaemia	71	S.I. especi -ally R.	Exercises	P8	Mild
61.	20	18	1⅓	L-H	0	0		0	L-limited	1¼	# L.I.	3	S.I. & #	D.X.T.	P8	Mod

Table II (contd).

Case No	Age	Age at onset	Time to diagnosis	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
	In years															
62.	19	19	< 1	L-Sc	0	0		0	L-limited	1	0	1	? S.I.	0	P8	Mild
63.	39	39	< 1	F.L. Ch Periph -eral	P.I.D. 11 years before	0		++	C.T.L.	½	Malaria at ∝ diag. Undulant Anaemia	49	S.I.	D.X.T.	P7	Severe
64.	38	32	1	H.C.	Dyspepsia 3 years before	0		0	Rigid bowed H.	½	0	29	S.I. obl. bamboo	D.X.T. Vaccines Cortisone B.T.Z.	P7	Severe
65.	17	16	< 1	L-Sc	0	0	Accident	0	L-limited	1½	0	36	S.I. early	B.T.Z. D.X.T.	P7-8	Mild
66.	33	33	< 1	L.C. & H.	Dyspepsia	0	Fall brought to notice	0	C.T.L.	¾	Dyspepsia	23	S.I. +spinal calc.	D.X.T. B.T.Z.	P7-8	Severe
67.	50	22	14	H.L.C.	0	0	Injury	0	C.T.L. Fixed H.	1½	"Coronary"	2	S.I. obl. Bamboo	Physio	P7	Severe
68.	22	19	3	H.K. S. L.	Pneumonia Malaria	F- lumbago	Cold weather	0	L-slight ? H.	1½	G.C. 1953 1 yr before diag.	52	Lower ½ S.I.	D.X.T.	P8	Mild
69.	20	20	<1	H ++ Knees +	Injury	M-Rh GrF-RhA	"Flu"	0	Hips very restrict -ed	2½	Hips ++ Anaemia	27	S.I. hips	D.X.T.	P8	Severe
70.	22	21	1	L-T	Accident	0	Injury	0	L-fixed	3"	Anaemia	24	S.I. + square V.	D.X.T.	P7	Mild
71.	25	18	7	H.L.S.	0	0		0	L-limited	1½	0	18	S.I. scl.& early calc. L.	To civ Hosp	?	Mod
72.	19	19	<1	H++	Bronchitis Rickets Injury	M-Rh P.T.B.++	?	0	Hips++	3"	Malaria Pneumonia	25	S.I. hips	Cortiso -ne	P8	Mod
73.	26	17	9	L.K. Periph -eral	Accident "Rh fever"	GrF-RhA M-O.A.		+(hist) 0	G- somewhat L-fixed	2	Iritis Dyspepsia + Haemorrhage	13	S.I. + T 10 calc.	D.X.T.	P7	Mod
74.	20	15	<1	L.H.	D.X.T. 15 for Ank Spond	M-died P.T.B. B-back		0	L-fixed hips	1¾	Hips Wasting Iritis	35	Hips S.I. calc. ligs.	B.T.Z.	P8	Severe

Table II (contd).

Case No	Age	Age at onset	Time to diagnosis	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
	In years															
75.	38	28	10	L.T.	Injury G.C.	M-Rh	Injury	0	L-limited	1½	G.C.	5	S.I.'s	D.X.T.	P7	Mild
76.	23	22	<1	L.	Injury 1954	F-Rh fev -er	Injury	0	L-fixed hip	2	0	17	S.I. square V	D.X.T.	P8	Mild
77.	20	17	3	L.C. Periph -eral	0	0		0	L-limited Hip	2½	0	36	? R. S.I.	B.T.Z.	P8	Mild
78.	26	22	4	L - T	0	F-Rh		0	C.T. limited L-rigid	2	0	20	S.I. early	D.X.T.	P7	Mod
79.	20	19	<1	L Stiff ++	Back strain	0	Injury ?	0	L-fixed	1¼	0	18	S.I. + calc. Ligs.	D.X.T.	P8	Mod
80.	19	19	<1	H.K. Periph -eral	aet 7	F-lumbago		++	normal	1¾	0	21	? R. S.I.	aspirin	P7 or P8	Mild
81.	21	18	3	L -T		M-Rh		0	L-limited	1¼	Unilateral S.I.	64	L.S.I. early	D.X.T.	P7	Mild
82.	34	34	<1	L	0	0	Lifting weight	0	L-limited	1½	Anaemia	38	? Old inj. ? S.I.	D.X.T.	P7	Mild
83.	24	23	<1	H - T	Inf. Hepatitis	0		+	L-limited	1½	? evidence of old cyclitis	40	L.S.I. L. hip	B.T.Z.	?P7	Mild
84.	27	19	6	L.H.	Car Accident	0	Accident	0	C.T.L. limited H ++	¾	Anaemia	34	Scl.S.I. & calc. ofspine	D.X.T. Cortisone B.T.Z.	♀	Severe
85.	20	21	1	T.C.	Pneumonia 43-47	M-Arth	Parades adm with Tonsill -itis	0	C.T.L. limited	2¼	D.U.	9	normal	D.U. therapy + D.X.T.	P8	Mild
86.	32	24	8	L - T	0	M-leg pains		0	C.T.L. & H. limited	1½	0	35	S.I.	Aspirin only	P7	Mod
87.	28	22	6	B.	Iritis 1952 Malaria Jaundice Diarrhoea	0	Adm with Iritis	0	L.H.	2	Iritis	11	Slight S.I.	D.X.T.	P7	Mild
88.	28	26	1+	L - T H. Peri	0	0		0	L.H.	2¾	Heels Anaemia	32	S.I. early	L + Heels B.T.Z. Inj ACTH.	P7	Mod

Table II (contd).

Case No	Age	Age at onset (In years)	Time to diagnosis (In years)	Onset	Previous History	Family History	Predisposing factors	Fever	Movement Limited in areas	Chest Expansion	Complications	E.S.R.	X-Rays	Treatment	Disposal	Degree
89.	33	29	4	L.C.	Mastoid operat -ion	0	Damp	0	C+ L.T. +++	1	Iritis June 56 Irreg pupil Old Iritis Anaemia	33	S.I. early L-R	D.X.T.	P7	Mod
90.	34	22	12	Bed for Malaria B - T C.L.	Accident Dysentery Malaria	F-stiff back I.S. -Rh	Hospital with Malaria	0	C.T.L. hips+	$1\frac{1}{4}$	0	23	R. S.I. only	D.X.T.	P7	Mod
91.	19	16	3	Periph -eral	0	0		0	L-slight hips	$2\frac{3}{4}$	Dyspepsia	23	S.I. early	D.X.T.	P8	Mild
92.	19	19	<1	B	0	F- A.S. 25 yrs Charter -house.		0	L	$2\frac{1}{4}$	0	35	S.I. both	D.X.T.	P8	Mild
93.	19	19	<1	L - T	0	0		0	C.L. H.	$2\frac{1}{2}$	0	26	S.I. +	D.X.T.	P8	Mod
94.	25	20	5	L - T Periph -eral	Rh fever	0		0	C-limited L-rigid	$1\frac{1}{4}$	0	40	S.I. D 11-12 calc.	D.X.T.	P8	Mod
95.	21	18	3	L - T Heels	0	0		0	L-slight	$1\frac{3}{4}$	Heels Anaemia	37	L.S.I. only	D.X.T.	P8	Mod
96.	28	24	4	Hip-L.	Eczema Dyspepsia Rash foot	F-A.S. (Mayo)		0	R. Hip only	3	Iritis - presenting Dyspepsia Eczema	21	S.I. early	Exercises & Eye therapy	P3	Mild
97.	22	21	1+	L.T.B.	0	0		0	L-slight	$2\frac{1}{4}$	0	21	L.S.I. def.& minimal R.	D.X.T.	R.T.U.	MILD
98.	20	19	1+	L - B	0	0	Accident	0	L-slight	$2\frac{1}{2}$	0	28	Both S.I.	Symptomat -ic	P8	Mild
99.	20	20	<1	Thorax L - B	Urethritis	0		0	normal	2	Non-specific Urethritis	1	R. S.I.	0	R.T.U.	V early prob.
100.	19	19	8/12	Periph -eral L - B	0	0		0	L-limited	3"	Endocarditis Mitral incompetence	30	L. S.I. early	D.X.T.	P8	Early.

Key to Table II.

Onset & Movement.

C	=	Cervical
T	=	Thoracic
L	=	Lumbar-pelvic
S	=	Shoulders
H	=	Hip joint
B	=	Buttock
K	=	Knee joint
Sc	=	Sciatic pain

Previous History.

G.S.W.	=	Gunshot wound
D.U.	=	Duodenal ulcer
Rh fever	=	Rheumatic fever
Rh Arth	=	Rheumatoid arthritis
#	=	Fracture
P.I.D.	=	Prolapsed invertebral disc
D.X.T.	=	Deep X-Ray therapy
G.C.	=	Gonococcal urethritis

Family History.

F.	=	Father
M	=	Mother
GrM	=	Grandmother
S	=	Sister
GrF	=	Grandfather
Rh	=	)
Rheum	=	) Rheumatism
P.T.B.	=	Pulmonary Tuberculosis
O.A.	=	Osteo Arthritis
A.S.	=	Ankylosing Spondylitis

Predisposing Factors.

G.U.	=	Gastric Ulcer
Inj.	=	Injury
POW.	=	Prisoner of War

Complications.

D.U.	=	Duodenal Ulcer
G.U.	=	Gastric Ulcer
#	=	Fracture
Resp	=	Respiratory
T.B.	=	)
P.T.B.	=	) Pulmonary Tuberculosis
D.X.T.	=	Deep X-Ray therapy
RhA	=	Rheumatoid Arthritis
$\propto$		Onset of illness
G.C.		Gonococcal urethritis

X-Rays.

S.I.	=	Sacro iliac joints
Calc. sp.	=	calcified spinal ligaments
T	=	Thoracic
Scl.	=	Sclerosed
L	=	Left
R	=	Right
obl.	=	Obliterated
Ank	=	Ankylosed

Treatment.

D.X.T.	=	Deep X-Ray therapy
Physio	=	Physiotherapy
B.T.Z.	=	Phenylbutazone
Strep	=	Streptomycin
P.A.S.	=	Para amino salicylate
D.U.	=	Duodenal ulcer

Disposal.

P3	=	Lines of communication service
P4(c)	=	Home service (Canada)
P6	=	Non-tropical service
P7	=	Home Service (United Kingdom)
P8	=	Invalided from the service
R.T.U.	=	Returned to unit and duty.

APPENDIX. TABLE III.

	Case No.	Age.	Age at on-set	Time to diagnose years	Stiffness	Pain	Spinal Movement	Chest exp. (inches)	E.S.R.	X-RAYS
	19	31	31	5/12	Rapid progression	0	Almost Nil	3/8	49	Bamboo spine.
	20	24	22	1/½	Slow "	slight at on-set	Limited T-L areas	1	43	Sacro-iliac joints abnormal.
	26	38	24	2	Slow "	0	"	3/4	3	Bamboo spine. Sclerosed S-I joints.
⋇	27	50	49	7/12	Rapid "	slight at on-set	Whole spine fixed.	1/4	58	S-I obliteration calcified spinal ligaments.
o	28	33	30	3	Slight and slowly progressive	0	"	2	30	Bamboo spine. Marked S.I. sclerosis.
	25	31	26	5	Slowly progressive.	Some cervical pain 9 months before diagnosis.	Cervical limited. Lumbar fixed.	3/4	57	Bamboo spine.
o	51	56	45	7	Slight and slowly progressive.	Some at onset.	Poker back.	1/2	2	S.I. sclerosis. Bamboo spine.

⋇ But this patient had attacks of IRITIS . aged 33 and 37.
o Found at routine medical examination.

A P P E N D I X IV.

Case of Ankylosing spondylitis with endocarditis.

Case 40. An officer, aged 45, was seen in January, 1954. He had suffered from symptoms of ankylosing spondylitis since 1946, the diagnosis being made in 1948, when deep X-Ray treatment was given. In 1949 he had an attack of iritis in the right eye. Clinical and X-Ray examination revealed advanced ankylosed spondylitis and systolic and faint diastolic aortic murmurs with some left ventricular enlargement. There was no previous history of acute rheumatism or syphilis and serological tests were negative. The electrocardiogram showed a prolonged P-R interval (0.28 sec.) and left axis deviation.

In November 1955, he had suffered from dyspnoea on exertion and some swelling of the ankles at night of a few weeks' duration. On examination peripheral arterial pulsation was obvious and the pulse was collapsing. Loud blowing to and fro aortic murmurs were audible over the whole precordium and a low-pitched mitral diastolic murmur with triple rhythm at the apex was now audible. The heart had enlarged further on clinical and X-Ray assessment, the left

ventricle only being involved.

The condition was considered to be a pure aortic incompetence associated with ankylosing spondylitis by Dr.D.Evan Bedford.

By April 1956 symptoms and signs of congestive heart failure had increased in spite of treatment with digitalis, and paroxysmal auricular flutter was noted. Some improvement was obtained from treatment with quinidine and mercurial diuretics. Repeated investigation had shown no evidence of subacute bacterial endocarditis, which was thought to be an explanation of the progressive deterioration and increasing murmurs and enlargement of the heart.