experiments of Lacassagne on young male mice are of intense interest. He injected oestrin into their bodies; the animals developed breasts in which carcinoma appeared in the majority of instances. There is no suggestion of inflammation to be observed in the microscopical sections he made of the succession of changes that ended in carcinoma.

Lister's View

This question now arises: If the process of inflammation be deprived of all changes except loss of function, as I think it should be, what is there left to consider as being, in truth, inflammation? The answer brings me to Lord Lister's work on the early stages of inflammation. His observations and his experiments led him to believe that it was a process of diminished activity and loss of function as a result of injury—quite the opposite of Hunterian conceptions.

He demonstrated that the injured parts contained blood vessels dilated in a state of paralysis, and that the red and white corpuscles tended to adhere to each other, and to the blood vessel wall. The red blood corpuscles formed rouleaux, and stasis occurred as the result of the exudation of plasma. But when the corpuscles escaped from an injured into a normal blood vessel they immediately behaved naturally. Lister also showed that injury stops the movements of the cilia of ciliated epithelium, and the movements of pigment granules within pigment cells are arrested.

As a result of his researches Lister taught that the signs of inflammation were pain, heat, redness, swelling, and loss of function. Repair of tissue, the change of a lymphocyte into a macrophage and into a fibrous tissue cell, and the inclusion of a micro-organism within a polynuclear leucocyte are examples of co-ordinated and successful efforts of function. The adoption of Lister's teaching sinks inflammation into comparative insignificance. On the other hand it removes from the subject all the matter that now confuses the prevailing attempts to describe what is meant by the terms "acute" and "chronic" inflammation.

Deductions

The point is not merely academic and needing clearness only for the sake of the medical student. To all whom it concerns the term "inflammation" should have a definite meaning and limitation. To take only one example of this statement: in all breasts of male and female infants at birth the developing ducts are surrounded by many layers of new connective tissue, among which lymphocytes are commonly seen. These normal breasts cannot be conceived to be in a pathological state of "chronic mastitis." Yet when exactly the same morphological appearances surround the epithelial elements of adult breasts they are usually described as being in a state of chronic inflammation. Indeed, many observers regard the condition of what is called "chronic mastitis" as being a precursor of cysts, and in other instances of carcinoma.

The study of whole serial sections of normal and abnormal breasts does not warrant these conclusions. For some reason these particular breasts seem to be in a state of activity when they should be at rest. I have never seen the epithelial elements of these cases develop into cyst formation, nor have I discovered any form of neoplastic growth, except the fibro-adenomata of puberty type: Cyst formation and carcinoma belong to a different category.

I do not believe the so-called "chronic mastitis" to be inflammatory in origin or dangerous in prognosis. If the subject of inflammation had not reached us by

gradual descent from early days I doubt if the term would be called into existence in the present conception of disease and of the active efforts of nature to keep the body alive.

Finally, I hope I shall not be accused of treating Hunter with disrespect. Nobody realizes more than I the stagnant state of surgery into which Hunter was plunged. He appears to me to be an outstanding man of his time whose disposition was shaken by thoughts beyond the reaches of his soul. His reputation is as high to-day as it was in the eighteenth century, and justifies the annual homage that is paid to his memory.

URINARY TRACT COMPLICATIONS IN THE PROLONGED IMMOBILIZATION OF CHILDREN

BY

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During the treatment of certain orthopaedic conditions by prolonged immobilization there is a tendency for urinary tract complications to occur, especially renal calculus formation. Many textbooks on orthopaedic surgery make little or no mention of the subject, although most surgeons who have experience in the treatment of surgical tuberculosis, for example, can give instances of urinary tract complications.

Urological surgeons recognize their incidence. Swift Joly,¹ also Ball and Evans,² record the liability to nephrolithiasis of patients who have to lie in the recumbent position over a long time. In a recent paper Lee Brown and Earlam³ consider theories of the mechanism of renal calculus formation in general. They also consider the relationship of prolonged immobilization thereto, reviewing the literature, and reporting six of their own cases. The influence of urinary tract infection, coincident with prolonged immobilization, on nephrolithiasis is also discussed.

The subject seems to merit rather wider appreciation than it receives at present, especially from the standpoint of adopting suitable prophylactic measures. At the least, early diagnosis and treatment are desirable. Many cases of nephrolithiasis or renal tuberculosis, for example, occurring in recumbent patients are asymptomatic over long periods, and are only brought to light by routine radiography of the urinary tract or by periodical microscopy of the urine. When symptoms do arise it is still not infrequent to find the patient's troubles labelled with diagnoses such as "haematuria" or "albuminuria," no reasonable attempt having been made to elicit the pathology of the underlying condition.

Incidence of Complications

With the object of determining the incidence of urinary tract complications in children undergoing prolonged recumbent treatment, I investigated 200 unselected cases at Princess Mary's Hospital for Children, Margate. This hospital is intended principally for the treatment of surgical tuberculosis, but cases of other orthopaedic conditions are also admitted, and tables of the clinical material examined are subjoined. A number of the patients (principally those with tuberculous cervical lymphadenitis) were not confined to bed for any appreciable length of time, but these serve to some extent as controls.

The number of cases treated by immobilization for a period of three months or longer was 162. In them urinary tract complications, to which a definite diagnosis

could be assigned, occurred in thirty-one, an incidence of 19.1 per cent. Of the thirty-eight cases whose recumbent treatment was under three months' duration only one developed a urinary tract abnormality—in this case a renal calculus—after seven weeks of recumbency.

Tuberculous Cases

Site of Disease	No. of Cases	Average Age in Years	Sex		Average period of Recumbency	No. of cases of Urinary Abnormality
			M.	F.		
Spine ...	38	9 8/12	24	14	2 8/12 yrs.	12
Hip ...	50	9	40	10	2 5/12 yrs.	13
Knee ...	22	8	19	3	1 8/12 yrs.	2
Pelvis ...	6	9 6/12	6	0	2 6/12 yrs.	1
Tarsus ...	4	8	2	2	1 4/12 yrs.	0
Upper extremity ...	5	12 7/12	3	2	7 weeks	1
Multiple osseous lesions ...	5	11	4	1	3 6/12 yrs.	0
Abdomen ...	13	10 9/12	12	1	4 1/2 months	1
Cervical glands ...	24	8	23	1	1 month	0
Diagnosis of tuberculosis not confirmed ...	3	9	2	1	5 weeks	0

Cases of Non-tuberculous Osteomyelitis or Suppurative Arthritis

Spine ...	1	12	1	0	6 months	0
Pelvis, hip-joint, femur ...	8	10 1/2	6	2	1 5/12 yrs.	1
Knee-joint, tibia ...	8	10 8/12	6	2	1 year	0
Multiple bones ...	3	6 8/12	1	2	1 7/12 yrs.	1
Upper extremities	2	13 1/2	1	1	5 months	0
Unclassified ...	2	12	1	1	4 months	0

Various Orthopaedic Cases

Various ...	6	6 8/12	5	1	10 weeks	0
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Diseases of the urinary tract occurring in this series of cases were:

Renal, ureteric, or vesical stone ...	...	...	...	20
Renal tuberculosis ...	...	...	...	3
Pyelitis ...	...	...	...	9
				32

(The term "pyelitis" is here employed in the usually accepted clinical sense, recognizing that such a diagnosis may be pathologically inaccurate.)

It is unnecessary to recount in detail the methods adopted in investigating this series of cases, but any child suspected of having an abnormality of the urinary tract was subjected to all the diagnostic measures usually employed in urological investigations. In this connexion it is worth mentioning that intravenous pyelography was found to be of considerable help, and only in children under 5 years of age was there any appreciable difficulty in obtaining satisfactory pyelograms.

Symptomatology

Mention has already been made of the comparative, or even complete, absence of subjective symptoms in recumbent patients who develop urinary tract disease. Initial symptoms in my thirty-two cases were as follows.

Stone.—Haematuria following turning of the patient from the dorsal to the ventral position was the commonest first indication of urinary tract disorder. Discovery of erythrocytes on routine microscopical examination of the urine was almost as frequent. Frequency of micturition was the initial symptom in three cases, and renal colic in two cases.

Renal Tuberculosis.—All three cases were first detected by microscopy of the urine.

Pyelitis.—Only one patient had typical symptoms; another had atypical manifestations. The remaining seven cases were all discovered by microscopical examination of the urine.

The comparative dearth of symptoms drawing attention to disease of the urinary tract (with the exception of haematuria) is worthy of note, and emphasizes the need for complete periodical investigation.

Aetiology

In the event of calculous disease, or pyogenic infections of the urinary tract, occurring in patients undergoing prolonged recumbent treatment it seems that a number of factors may take part in the aetiology. These factors are probably, to some extent at least, interdependent, but may conveniently be considered under separate headings.

1.—Prolonged Immobilization

If the tables previously given are studied it will be seen that there is a relationship between the site of the body diseased and the occurrence of urinary tract disorder. Twenty-seven of the thirty-two cases discovered occurred in children who were suffering with disease of the hip, spine, or pelvic girdle, and the treatment of disease at these sites involved prolonged immobilization in dorsal decubitus. Of the remaining five cases all except one were also immobilized in complete dorsal decubitus for various reasons.

Of the whole thirty-two cases, therefore, nearly 97 per cent. were associated with dorsal decubitus, in which position the kidneys are placed at a disadvantage for drainage. The apices of the minor calices occupy the most dependent position, while the renal pelvis is drained at its highest point. In these circumstances there must be a tendency towards stasis, even making allowance for normal functioning of the ring-muscle system of the renal pelvis and calices, as described by Kelly and Burnam.⁴ It does not seem unreasonable to assume that such stasis may play a part in calculus formation by initiating conditions favourable for the deposition and retention of crystalline substances. Stasis may also render infection likely, which, in its turn, increases the chances of calculus formation.

Changes of apparatus, especially in the treatment of surgical tuberculosis, are fairly frequently required for changing conditions of the disease. It is therefore almost impossible to incriminate any particular apparatus as being a form of immobilization conducive to disorders of the urinary tract, but it seems probable that any apparatus which effectively immobilizes a patient in the dorsal position is culpable.

Gordon Pugh, who has had vast experience of treatment by prolonged immobilization at Queen Mary's Hospital, Carshalton, has long recognized the desirability of facilitating normal drainage of the renal pelvis and calices. For some years he has employed a special frame, which is capable of being rotated about a transverse axis. Every few hours in the day the frame is rotated to the left and to the right, and kept in each position for a quarter of an hour or so, facilitating renal drainage without interfering with the essential orthopaedic treatment. It is claimed that, since using this apparatus,⁵ combined with the elimination of foodstuffs containing calcium oxalate, free imbibition of fluids, attention to the bowels, and strict local cleanliness, the incidence of urinary tract complications has greatly diminished. The principle of the apparatus used (periodic rotation of the patient towards alternate sides) would seem to be fairly easily and widely applicable.

In my twenty cases of urinary calculus the average period of dorsal recumbency before the appearance of any evidence of urinary tract disease was ninety-seven weeks.

It is noteworthy that three cases were detected after seven, eight, and thirteen weeks respectively, while four other cases occurred in under nine and a half months of recumbency. In all the cases the commonest sites in which renal stones formed were in the middle and lower calices.

It may not be out of place here to remark that renal lithiasis is no longer a disease of childhood, under ordinary circumstances. Swift Joly records but eight cases occurring between birth and 19 years in 165 cases admitted to St. Peter's Hospital during the decade 1915-24. The youngest patient was 11 years old, which is well above the average age incidence (9.8 years) of the cases quoted in this paper.

2.—Foci of Chronic Infection

It is now commonly believed that infection of the upper urinary tract is blood-borne, whether the primary focus is in the intestine, tonsils, or any other distant site.⁶ The principal exception to this general rule is obstruction or paralysis of the lower urinary tract, when an ascending infection may occur. In patients suffering with chronic sepsis and undergoing prolonged dorsal posturization a tendency towards infection of the kidneys might be expected on account of the focal sepsis and deficient renal drainage.

So far as the association of renal calculus and foci of chronic pyogenic infection is concerned, Paul⁷ reported a series of twenty cases of nephrolithiasis occurring in an unspecified number of patients suffering with chronic bone infection. He went so far as to say that if every case of nephrolithiasis could be investigated with sufficient thoroughness, history of a preceding systemic infection would be elicited. This opinion is not universally endorsed.

Of the 162 recumbent cases dealt with in this paper seventy-two had chronic septic foci—those in the tuberculous patients being secondarily infected sinuses or wounds. Ten out of the twenty cases of nephrolithiasis reported were associated with chronic focal sepsis, but only three of the nine cases of pyelitis were similarly associated.

3.—Diet, Calcium Metabolism, and Insolation

A considerable amount of work on the influence of diet in the occurrence of renal calculus formation has been undertaken, and I merely wish to draw attention to certain factors which appear to have special application to the subject of this article. The food given to the children is unusually varied and has an adequate vitamin content. The chief sources of calcium are milk, cheese, butter, and green vegetables.⁸ Three out of four of these foodstuffs are given to the patients in more than ordinary quantities, and it is probable that the calcium absorbed is slightly in excess of that derived from the poorer dietary which the children ordinarily receive in their homes.

Comparatively little work has been done on the estimation of blood calcium in the destructive stage of osseous tuberculosis or osteomyelitis. It might be expected that a marked destructive process, with resultant localized liberation of calcium, and also the more widespread partial decalcification to be found in all such cases, would be followed by an appreciable rise in the blood calcium. Barkus⁹ found only a slight rise under these conditions, while Despontins¹⁰ states that the calcium level is actually reduced. Popoviciu,¹¹ in an investigation of the calcium and phosphorus content of the blood in surgical tuberculosis and other bone diseases, states that in osseous tuberculosis the serum calcium is more often of subnormal value than raised, but that, as the result of treatment by generalized actinotherapy, the calcium level is raised in the majority of cases, often well above the normal. This is due to the insolation causing synthesis of con-

siderable amounts of vitamin D, with a resultant increased absorption of calcium and phosphorus from the intestine.

It seems feasible that a raised serum calcium content, caused principally by increased ingestion and absorption, may predispose a patient undergoing prolonged recumbent treatment to the formation of stone in the urinary tract. In connexion with insolation the production of concentrated urine due to sweating should not be forgotten. It would seem, therefore, that therapeutic sun-bathing, from the urological point of view, should be carried out with caution. Not only should the usually employed procedure of gradual exposure be rigidly adhered to, but sweating should be avoided and fluids be imbibed freely.

4.—Paraplegia

Mörl¹² reported his observations on the occurrence of renal calculus formation in cases of spinal injury in which paraplegia occurred. From his own experience, and surveying that of others, this author expressed the opinion that renal calculus formation in paraplegia was relatively uncommon, and that when it did take place the most important aetiological factor was an ascending infection, usually due to repeated catheterization. In my series of cases three children had paraplegia, with vesical dysfunction. One child formed renal calculi, another developed pyelitis which eventually cleared up entirely, while the third child escaped without infection or stone formation.

Diagnosis and Prognosis

Discussion of the diagnosis and treatment of the various urological conditions encountered would be out of place in this article. Latency or absence of symptoms has already been stressed, but I feel that the significance of haematuria occurring in recumbent patients is not always appreciated. W. E. Wilson¹³ reported twenty-three instances of renal colic and haematuria in a series of 150 cases of fractured femur, and stated that only in one case was there evidence of calculus formation. He considered that the haematuria in these cases was ascribable to intrinsic renal vascular changes following sudden change of posture. This hypothesis hardly seems tenable, in view of the fact that only ten urines were examined and "a very small proportion" investigated radiologically for calculus. Haematuria may occur without radiological evidence of stone, but it should not be forgotten that in childhood 15 per cent. of urinary calculi consist of uric acid or ammonium urate, or a combination of these,¹⁴ and that their detection by radiography may be a matter of the utmost difficulty.

So far as the treatment of renal calculi, occurring as a complication of orthopaedic practice, is concerned, it is a fortunate fact that only the minority of cases require operative treatment. Some of the stones are more aptly described as mud; others are very small. In either case natural expulsion often occurs when the patient resumes an ambulant life. In other cases, however, surgical intervention is called for, and these cases may present complex problems.¹⁵

With regard to renal tuberculosis, Addison,¹⁶ in a recent article, comments on its relative commonness in association with bone and joint tuberculosis, and maintains that many early cases of tuberculous kidney become cured. Stress is, however, laid on the close necessity of watching such cases lest in time the question of nephrectomy should arise. Whatever measures of treatment are deemed suitable it is obvious that these cases should be detected early. Too often the true state of affairs is cloaked beneath misnomers such as "pyuria" until such time as any effective treatment becomes an impossibility.

In conclusion, the early diagnosis of urinary tract complications in recumbent patients is strongly urged. The minimal measures in this direction are routine *micro-*

scopical examination of the urine, and radiological examination of the entire urinary tract, at least every three months.

Summary

1. The incidence of 19.1 per cent. of urinary tract complications is reported in a series of 162 children who were undergoing prolonged recumbent treatment.
2. Attention is drawn to the latency or absence of symptoms and signs in these cases.
3. Factors conducive to calculous disease, or pyogenic infection, of the urinary tract in recumbent patients are considered. The most important factors appear to be defective renal drainage, due to rigidly enforced dorsal posturization, and chronic focal sepsis.
4. Brief allusion is made to certain aspects of diagnosis and prognosis, and a plea is made for the early detection of urological abnormalities.

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many helpful suggestions. I also have to thank Dr. Gordon Pugh, medical superintendent of Queen Mary's Hospital, Carshalton, for kindly giving me information on certain cases transferred to his hospital for urological investigation.

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A POSSIBLE RESERVOIR HOST OF *TRYPANOSOMA RHODESIENSE*

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The question of the identity of the two polymorphic trypanosomes found in man and ruminants in Eastern Africa has ever been a vexed one. The German school, led by Kleine, maintains that the human strain *T. rhodesiense* is distinct as a species from *T. brucei*, whereas it seems to be generally accepted by British workers that the former is merely a variant of the latter, which, for reasons imperfectly understood, has developed qualities making it pathogenic to man. Thus Duke (1923) believes that the epidemic of trypanosomiasis which broke out in the neighbourhood of Mwanza, Tanganyika Territory, was due in the first place to an infection with *T. brucei*, which became pathogenic to a population the stamina of which had been sapped by famine and the physique undermined by hookworm.

If the supposition of Kleine and his co-workers is correct and the human trypanosome is indeed specific to man, the existence of a true reservoir host must be postulated. If the identity of the two trypanosomes is accepted then, according to the views of Wenyon (1926), the animal strain, having once gained a footing, is more easily passed on to other men. (For, although in the first instance its virulence is light, it is later increased, presumably after many passages, in the same way as the virulence of *T. gambiense* can be increased by passage through a series of rats.) On the other hand, Duke has advanced the hypothesis that not only the polymorphic trypanosomes *T. gambiense*, *T. brucei*, and *T. rhodesiense*, but also the monomorphic trypanosomes *T. evansi*, *T. equinum*, and *T. equiperdum*, may be simply physiological variants of the one species, *T. brucei*.

If a human reservoir exists it is to be expected that he would be in every way comparable to the carrier of such conditions as enteric fever or diphtheria, being himself unaffected by the parasites in his body. Efforts have been made to find such an individual. For instance, in Nyasaland, consequent on the epidemic of sleeping sickness which broke out there in 1908, a search for human reservoir hosts was made in 1916 by Dr. J. B. Davey. He examined the blood of many adult natives living in the area that had been proclaimed, and injected

the blood of a hundred others into monkeys, utilizing as many as fifty-six of the animals, with a view to demonstrating the existence of occult infections, but without result. It is believed by the writers that a human reservoir host has been discovered, and the following are the preliminary details of the case.

Clinical Details

An adult male native, aged about 30, was admitted to the native hospital at Fort Johnston, Nyasaland, on June 16th, 1935, suffering from urinary schistosomiasis. During the investigation of his case examination of the faeces revealed a heavy infection with ankylostomiasis, and, in addition, polymorphic trypanosomes were found in his blood. These latter parasites were later identified as *T. rhodesiense* by their pathogenicity to rats and by the development of posterior nuclear forms in these animals.

The native has now been under observation for over six months, and, apart from an improvement in his general health as a result of the successful treatment of

hookworm and bilharzia, his condition remains the same as on admission. Further than a positive formol-gel reaction tested against a control the patient shows no sign or symptom of trypanosomiasis. His course has, in general, been afebrile, for only twice has a rise of temperature been noted, and on these occasions he experienced no discomfort whatever. He has been content to remain in hospital, where he is housed and fed, and where he helps in the routine work of the wards. In his spare moments he weaves mats for the hospital, the intricate nature of this work indicating that his muscular co-ordination remains unimpaired.

During his stay in the hospital the patient's blood has been examined at weekly intervals with the object of defining the parasite rate, and of demonstrating what relation, if any, this bears to the temperature. Once every month the condition of the cerebro-spinal fluid and of lymph obtained by gland puncture has been investigated, but without result. As will be seen from the chart depicting it, the trypanosome rate has varied