Fresh semen was free of pus, but there were still no spermatozoa. The urine was clear.

Summary.

1. Catheterisation of the ejaculatory ducts and lavage of the vesicle by this means is not practicable at present.

2. During the treatment of acute gonorrhœa the possibility of infection of the vesicles should be borne in mind, especially in those cases which show severe illness or early complications. These should be carefully scrutinised after convalescence.

3. The investigation should follow the lines suggested under diagnosis.

4. Indications for vasotomy :—

(*a*) In protracted cases lasting over five months in whom other treatment has been tried, especially if rheumatism is present.

(*b*) In resistant cases in whom, owing to a deep perineum, it is impossible to massage the vesicles efficiently.

(*c*) In cases where the coöperation of the patient is doubtful during a long course of treatment and where the disease hinders him from continuing his occupation.

(*d*) Where sterility is already established by previous double epididymitis.

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BIRMINGHAM HOSPITALS.—The report for 1930 of the Birmingham General Hospital states that the financial position is now very serious. There is an overdraft of £20,000 in excess of the remaining unsold free investments, and the governors recently decided to promote a Bill in Parliament for the amalgamation of the General and the Queen's Hospitals. A committee of three experts has been appointed to investigate the position, and representatives of the hospitals council are to discuss how best the financial difficulty can be removed without detriment to the work. In 1930 the income was £79,902 and the expenditure £100,779; in the preceding year the income was £82,656 and the expenditure £90,611. The report states that the Queen's Hospital is in a similar position. It had been expected that the contributory scheme would be able to pay £3 a week in respect of members admitted, and the governors' financial policy had been based on that assumption, but at present the scheme can pay only about half that amount. In-patients last year numbered 7682, an increase of 625; out-patients were 59,282, an increase of more than 1400.

THE IMPORTANCE OF KERATOMALACIA AS A CAUSE OF BLINDNESS IN INDIA.

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WITHIN the past year keratomalacia has figured somewhat prominently in current medical literature. Various features of the condition (so-called), which is very familiar to ophthalmologists in many parts of the Orient, have been presented afresh to the profession in a more interesting light, and previously unrecorded clinical evidences of this deficiency-complex have been noted. Prominent amongst the papers which have appeared are those by Pillat of Vienna,[1] based on material studied in China. He has presented a study of keratomalacia as met with in the adult which, despite errors and omissions, is perhaps the most complete and up-to-date assemblage of the diverse pathological changes which go to make up this complicated clinical picture of deficiency disease; for all practical purposes his exposition serves equally well for children. To my mind, however, the one great outstanding feature of keratomalacia is its enormous importance as a cause of preventable blindness. This aspect of the disease has not yet been fully appreciated, even by observers of the condition who live in countries like India, where, according to McCarrison,[2] faulty nutrition is the great basic cause of the bulk of the ill-health. Pillat does refer to it, but with scarcely sufficient emphasis; he says: "Keratomalacia of adults as well as in children ends so frequently in blindness in China that it represents also a social problem to which the attention of the government and officials should be turned."[3]

I have for several years felt much more strongly than this on the economic question, and my experiences and observations extending over a decade lead me to state that keratomalacia is almost certainly the chief cause of preventable blindness in children in the greater portion of the Indian Empire, and where similar conditions of malnutrition exist in other parts of the world it is likely to be of similar importance. I say "almost certainly," because it is impossible to prove such statements by recourse to records in a manner which would satisfy a statistician. Figures for the general public are unobtainable, so we must form opinions from our hospital population. In so far as the Madras Hospital is concerned—and it deals with about 20,000 out-patients per annum, fairly representative of the South Indian population—keratomalacia is responsible for more blindness amongst children than any of the other great blinding conditions of youth—i.e., irritant remedies, small-pox, ophthalmia neonatorum, syphilis, and trachoma. Last year, for example, 187 cases of keratomalacia were registered at the out-patient department. Dr. P. A. Narayana Iyer, in charge of this department, kept a special record of 95 of the more advanced of these in which the eye lesion threatened vision. The record shows that 67 were under 5 years of age, that total blindness occurred in 30 cases, and practical blindness in 70 per cent. As compared with this, there were 59 cases of ophthalmia neonatorum and lesser numbers of the other conditions mentioned above. In only five of the 59 was vision totally lost, and in only three others was it seriously interfered with. Our experience has been that blindness is a

very much more common sequel to keratomalacia than to ophthalmia neonatorum. This may possibly be associated with the fact that gonorrhœa, especially ophthalmia neonatorum, appears to run a milder course in this part of India than it does in England.

Coming first in the blinding diseases of youth, the importance of keratomalacia as a blinding disease at all ages may be gathered from a comparison with the position in England and Wales, where ophthalmia neonatorum is held to be the chief cause of blindness.[4] Although the actual number of blind under 5 years of age in England and Wales for recently recorded years is small (under 500 in 1911 and under 300 in 1927), and not half of this number is accounted for by ophthalmia neonatorum, still its effect calculated up through the different age-groups, in spite of the lessening effect of the death-rate, makes ophthalmia neonatorum the greatest single cause of blindness. Causes such as ophthalmia neonatorum which operate heavily during the first five years apparently have a major influence on the total number of blind persons.

Assuming that no other massive causes of preventable blindness come into play during the later age-groups in the Madras Presidency, it is perhaps permissible to argue that, if keratomalacia is our greatest cause of blindness in the first five years of life, it is also the greatest probable cause of preventable blindness at all ages. Looking at the actual census figures for the Madras Presidency, 1921, we find that the total number of blind (37,162) is less than that for England and Wales for 1911; but the number of blind at five and under in Madras (768) is enormously greater, which appears to strengthen the argument. The Indian census report gives as its final age-group, "70 and over," and at this period we find an enormous rise in the actual number of blind as compared with the numbers in the preceding five-yearly periods. Such a rise, however, in a combined group of the last few age-periods hardly affects the question, even though it may be accounted for by a single cause; cataract, for example, with which we are not concerned as the definition "preventable" excludes it.

Keratomalacia, then, in so far as we are able to estimate, is the greatest cause of preventable blindness in the Madras Presidency in the first five years of life, a much greater cause in these years here than is ophthalmia neonatorum in England and Wales. This position with regard to keratomalacia is not, however, peculiar to the Madras Presidency. The professors of ophthalmology at Calcutta, Bombay, and Lucknow, Lieut.-Colonels Kirwan and Duggan, and Dr. Acharya, assure me that the same is true in Bengal, Bombay, and the United Provinces respectively. On the other hand, Colonel Dick, professor of ophthalmology, Lahore, informs me that keratomalacia is practically unknown in the Punjab. One of the great differences between the Punjab and the other areas mentioned above which influences the occurrence of keratomalacia is that the food in the Punjab gives a more complete diet, as pointed out by McCarrison.[5] The inhabitants are largely wheat-eaters, not rice-eaters; moreover, the Punjabis also consume larger quantities of milk and milk products and other vitamin A-bearing foods. Hence there is very little deficiency disease in the Punjab.

The disease in adults, if not so frequently met with in India, has been well recognised, although one might gather from Pillat's work that it was practically unknown. Undoubtedly in India the disease as observed in children had been much more stressed because of its greater frequency, but the disease in adults was well known and recognised in the teaching ophthalmic centres throughout this country. For example, in Maynard's "Manual of Ophthalmic Practice," largely used by students in this country for a number of years, we find, "the condition is not infrequently seen in adults." Nor is Pillat correct in thinking that I omitted to give relative figures for adult keratomalacia, or that my recognition of keratomalacia in the adult was based on Kirkpatrick's opinion. The disease in adults and also its relative frequency and importance as compared with the juvenile disease were well known to me, and actual figures are given in my annual hospital reports for 1921 and 1922.[6] Now, although adult keratomalacia is not so common in India as it appears to be in China, yet the fact of its occurrence in appreciable amount adds still further to its influence on the total blindness in the country, because, unlike ophthalmia neonatorum, it operates through all the age-periods.

Importance of Various Vitamins.

It is, I think, unfortunate that the name keratomalacia should be used for a generalised disorder of malnutrition in which ophthalmic features, however noteworthy, are but localised signs of a multiple deficiency-complex. The chief primary ætiological factor—but not the only factor, in so far as our present knowledge goes—would appear to be a lack of fat-soluble vitamin A in the diet. It had long been recognised that the various eye signs and symptoms and the many other associated pathological states of the body in this disorder were primarily due to malnutrition. Later, the whole gamut of changes was ascribed, perhaps prematurely, to a deficiency in vitamin A. To-day, however, there are some who consider that it is not a pure vitamin-A deficiency but a multiple deficiency. Some years ago, in looking for other elements in this complex, I held and promulgated many mistaken ideas on the subject of keratomalacia, and probably continue to do so. Some of my former ideas were published, in connexion with the clinical investigations which have been undertaken in our out-patient department for the past ten years, in the annual reports of the hospital. To-day, however, I would hardly be bold enough to say that the clinical condition so well known here in all its phases, both in children and adults, as keratomalacia, was even initially due to a deficiency in vitamin A alone. In discussing this question with Colonel McCarrison recently, I gathered that there is much to suggest that vitamin-B deficiency may play a part in causing its protean manifestations. I refer, of course, to the earliest evidences of the deficiency complex; later on, the organs and tissues damaged by the primary deficiency cease to play their normal rôle, and there are secondary disturbances due to altered function—e.g., endocrine function. It is very difficult, even under conditions of experimental research in animals, rigidly to exclude all but one known vitamin from the diet. In clinical investigations it is impossible to observe the effect of a steady insufficiency of any one essential food factor, and so experimental work with human material is exceedingly hard to plan and interpret. The experimentally produced animal disease probably presents much truer and simpler pictures than those seen in the clinic. Some years ago I did not take this sufficiently into account, and failed to give proper credit to the fact that the human condition known as keratomalacia was a deficiency-complex involving a greater number of factors than the experimental one known as xerophthalmia, and that this was sufficient to account for the apparent differences met with under natural and experimental conditions.

In so far as human cases are concerned, after

various essays in experimental feeding we are at least able to say that crude cod-liver oil in suitable doses is the most effective agent in eliminating the major signs and symptoms of this deficiency-complex. This oil is probably largely effective by virtue of its vitamin-A content, but it also contains vitamins B, C, and D. There is no proof that it is the fat-soluble vitamin A alone in cod-liver oil which produces the beneficial effects in keratomalacia. Recently Dr. R. Muthayya of my staff has administered pure fat-soluble A (B.D.H.), kindly supplied by Colonel McCarrison to children suffering from this disease, but they did not improve so rapidly as they ought to have done on crude cod-liver oil. In all probability it requires an initial multiple vitamin deficiency, with a secondary multiple dysfunction of glandular structures to account for the whole picture of degeneration, loss of function, wasting, necrosis, secondary infection, and death, which we see in keratomalacia. It seems more than likely that the principal initial factor is an A-deficiency and that certain of the prominent clinical features are due to the effects of this deficiency on important tissues and organs of the body, such as the epithelial surfaces of the integument and mucous membranes and their glandular diverticulæ.

Secondary Infection.

Animal experimentalists appear to lay a great deal of stress on bacterial invasion as a primary resultant of vitamin-A deficiency. This vitamin may be more important to animals in an anti-infective rôle than it is to man, because clinically it is difficult to find much support for this hypothesis. In man masses of organisms can be found in the epithelial debris of which some of the discharges are largely made up, but a localised necrosis may occur—e.g., in the cornea—without any of the evidences of acute organismal infection. An extensive necrosis of the substantia propria may be present with a practically intact epithelium. As Pillat shows,[7] a patient may have a most indolent undermined skin ulcer, with a minimum of inflammatory response, in which the ordinary pathogenic organisms carry on a localised and apparently saphrophytic existence. Organismal infection, as the clinician understands it, is only seen as a terminal event. Children may drag on for weeks in a state of extreme marasmus, with recognisable pathogenic organisms present in large numbers in their usual areas of invasion—e.g., respiratory tract, skin, and conjunctiva—without any specific change taking place. Such children may be transformed in a fortnight by cod-liver oil—sometimes administered on a flannel binder when the alimentary tract is too damaged to retain or use it—in a way that they could never be if bacterial invasion were the key to the position.

The primary pathological picture in the keratomalacia deficiency-complex is one of degeneration and wasting of epithelial surfaces, almost as distinctive a process as any of the classical degenerations. There is a tendency to proliferation, and metamorphosis to a lower type; columnar cubical epithelium tends to become squamous—e.g., in the respiratory tract. In certain situations—e.g., the skin—the pathological change is akin to the degenerative changes of senility. The clinical impression conveyed is that the effect of organismal attack in human keratomalacia is a late secondary association. Rises of temperature and blood changes are also probably secondary. I have seen numbers of keratomalacia cases, even moderately advanced, continue for weeks without a rise in temperature, but it is easy to picture how fever might be secondarily produced.

Some years ago thyroid extract was administered here as part of our routine treatment in keratomalacia, without knowing whether it would do good in the absence of cod-liver oil. We have discontinued it, as cod-liver oil by itself serves the purpose equally well. McCarrison[8] has recently demonstrated the histopathological changes in the thyroid and upper respiratory passages of white rats fed on a diet insufficient in fat-soluble vitamin. Presumably there are similar changes in the human subject, and no doubt the damaged thyroid plays a secondary rôle, but we do not know to what extent these changes are resolved by the administration of a sufficiency of vitamin A in the diet once they have started. The epithelial changes which he has described in the tracheal lining are probably very similar to those which occur in the respiratory passages in human keratomalacia.

Associated Clinical Features.

There are certain clinical features of keratomalacia which may perhaps be viewed in the light of chance associations. Prominent amongst these in South India is the association of keratomalacia and liver disease, both in adults and children. It seems to be more common in the adult, but then we see fewer cases of adult keratomalacia, and liver disease is more common in the adult general population. Some years ago I considered that this combination was much more than an association, and laid unnecessary stress on the rôle of the liver in this disease. It would be foolish to deny that the liver may become deranged late in fat-soluble deficiency, and, like the simple secreting glands of the integument and alimentary canal or the thyroid, undergo definite changes in structure and function with the production of secondary changes which in time become summated to the disease complex, but I now know that the liver may be apparently perfectly normal in advanced keratomalacia, in so far as can be made out by clinical methods and modern biochemical tests. The opportunity of seeing a diseased liver in a keratomalacic subject post mortem is rare in this hospital, and was not forthcoming until this year (January, 1930), when an adult with well-marked keratomalacia, who was jaundiced and whose liver appeared to be about normal in size, suddenly died. Even in this case I was only able to obtain a hurried examination through a "surgical" incision, as the friends were expected. The greenish, slightly roughened organ presented all the appearances of biliary cirrhosis so commonly met with here, and the microscopic examination showed the change to be of the typical obstructive type. I have no doubt that, in such Madrasi children as show an association of liver disease and keratomalacia, the usual post-mortem finding would be infantile biliary cirrhosis, a relatively common affection in children here.

I have pointed out elsewhere,[9] that a primary liver defect may be the deciding factor in precipitating generalised vitamin-A deficiency symptoms. The comparatively rapid onset of keratomalacia, in a patient living on a diet which had been efficient in keeping him apparently healthy until the development of primary carcinoma of the liver, is an example. It is well known that the liver stores fat-soluble vitamins, and perhaps it may even elaborate them. It is useless to speculate, as we now feel more confident that liver disease in keratomalacia is ordinarily a chance association—not the result of the deficiency—and the reason we see such a relatively large number of cases with this association is because liver disease in the general population is common in Madras.

Pillat does not lay much stress on jaundice and affections of the liver in keratomalacia in China; perhaps cirrhosis is not so common there. He does, however, produce definite evidence that the liver function, as tested by detailed biochemical methods, may be normal in adult keratomalacia. Some years ago we tried liver feeding as a method of treatment, but found it inferior to cod-liver oil.

The Conjunctivæ.

Icterus of the ocular membranes is not uncommon in keratomalacia in South India. Frequently the peculiar olivaceous effect of the characteristic smoky conjunctival pigmentation is superimposed on the yellow subconjunctival tissues, and similarly in the skin. Apart from jaundice, however, the keratomalacic patient sometimes presents a subicteric tinge both of skin and mucous membranes, but as a rule the smoky discoloration predominates. These three factors need not, however, be confused. The smoky pigmentation of the conjunctiva is one of the most characteristic signs of the keratomalacic complex and may be observed in its purest form as an early feature in apparently well-nurtured children, where the pigment is seen superimposed on normal subconjunctival tissues. Pillat and King,[10] in a discourse on the origin of this pigment, credited Kirkpatrick and myself with believing that the pigmentation was due to liver disturbance. Kirkpatrick,[11] reviewing their paper, repudiates this misrepresentation of his views, and I also must plead not guilty. Pictures illustrative of the eye signs in keratomalacia, made under Kirkpatrick's direction a number of years ago in Madras (copies of which may be seen in the London School of Hygiene and Tropical Medicine) make clearer than mere description the impression given to an observer of this smokiness. Pillat's suggestion that this pigmentation is indicative of suprarenal disease, although attractive, is opposed by the fact that the smokiness is one of the earliest signs of the malnutrition complex; in my experience it is often the second clear indication, night-blindness being the first. It is quite possible that the adrenal gland is affected in the keratomalacic deficiency-complex, since a pure uncomplicated deficiency of vitamin A in the food is never seen; there are necessarily other deficiencies associated with the A-deficiency. Of these the most common, in Madras at least, is deficiency of the B-vitamins (B and B_2). According to McCarrison,[12] of all the organs of the body the adrenals are the most susceptible to insufficiency of vitamin B. It is accordingly reasonable to expect signs of adrenal derangement. Probable reasoning, however, from the experimental evidence at our disposal, suggests that the gland becomes involved late, when other well-known results of the deprivation are already in evidence. Colonel McCarrison suggested that the smoky pigmentation of the eye and the otherwise inexplicable puffiness and œdema sometimes seen may be an expression of an adrenal dysfunction due to the effects of an associated vitamin-B deficiency; we have therefore undertaken an experiment with yeast feeding, but so far its results have been negative.

The second factor in abnormal pigmentation is the icteric or subicteric tinge. This is sometimes so marked as to give an impression of jaundice, but suitable biochemical tests readily prove that it is not true icterus. It is essentially a yellowness of the epithelial and subepithelial tissues. It is somewhat similar, perhaps, to the yellowness said to be due to hypercarotinæmia, but makes its appearance under opposite conditions. The third pigmentation, true icterus, has already been referred to and its frequency in Madras explained.

In spite of any opinions previously expressed to the contrary, I have no knowledge of any ophthalmoscopic intra-ocular changes which might be given a place in this complex, excepting such changes as may directly or indirectly result from the corneal lesion. Only on one occasion have I been able to examine the lenses of a baby born to a keratomalacic mother, and these were clear. This is of interest in view of von Szily's findings of lenticular changes in the sucklings of xerophthalmic white rat mothers.

In the present state of our knowledge the many interesting problems connected with this deficiency-complex are really more of academic interest than of practical importance to the ophthalmologist and public health worker. The discovery of the particular deficiency which is responsible for certain signs and symptoms is a problem which may well be left to the research worker who specialises in malnutritional disorders. That this particular malnutritional disorder should be the chief cause of preventable blindness in the Indian Empire is a matter of the greatest economic importance, but until the population becomes more nearly adjusted to its food-supply, it is difficult to see how things can be otherwise. Meanwhile, the prevention of the disease is more the concern of those departments of Government which have to do with the improvement of conditions of living and with the food-supply of the community than of the Medical Department. The general practitioner or ophthalmologist cannot do more than control those cases which come within his sphere of activities by the simple method of administering cod-liver oil. The issue of cod-liver oil on a large scale as a prophylactic measure in India would hardly be taken seriously by those who are responsible for the framing of our budgets.

The scanty references given will afford those interested in the subject a guide to the important clinical and experimental work done in this field before 1930.

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ST. MARK'S HOSPITAL.—At the annual general meeting of the governors of this hospital in City-road, London, on March 19th, it was stated that the patients waiting admission numbered 130, while in the out-patients' department attendances were last year 1440 more than in 1929. Mr. J. P. Lockhart-Mummery said that during the past three or four years it had been possible to provide a certain number of private wards which had been greatly valued by the public, 93 patients having been admitted during the past year. It was hoped in the future to increase the number of those wards. Mr. Swinford Edwards, honorary consulting surgeon, who has been connected with the hospital for well over half a century, said that the new building was almost double the size of the old. Mr. J. Sandrey, the resident surgical officer, reported that the number of admissions for 1930 was 815. While there had been an increase of major operations there had been a relative decrease in the number of minor operations, owing to the recent introduction of successful palliative measures in the out-patients' department.