Thesis on

Calculus of the Bladder among the natives of India

with

Statistical Tables

compiled from the half yearly reports of the
Government Charitable Dispensaries
in Bengal:

and an Analysis of 115 Urinary Calculi extracted
from natives

by

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Part III. Statistical Tables &c—

Part 1st.

Before proceeding to discuss the more immediate matter of My Thesis, a few words of explanation will be advisable, to account for my having chosen a subject on which I can naturally be supposed to have little personal information, and one apparently on which much could not at any time be written.
A relative of my own, lately returned from India on furlough, had brought home with him the greater number of the Calculi which he had extracted from Natives, who had come under his charge in one of the Government Hospitals in the Upper Provinces of Bengal. I was at this time in search of a subject for my Thesis, and he most kindly put his collection at my disposal, suggesting, at the same time, that I should pay some attention to the prevalence of the disease in Tropical Climates, a point on which the most erroneous ideas prevailed among the members of the Profession.— I accordingly obtained most of the standard authorities on Calculous disorders, and found that the opinion of their rarity in warm climates was expressed without exception in every work which I consulted.

A Treatise on the Formation, Constituents & Extraction of Urinary Calculi. by John Green Crosse – P. 2.

"Observations on the frequency of Urinary Calculi in the County of Norfolk &c" by William England M.D. P. 79.

What makes the error thus commonly fallen into of more importance is that many writers, entering into speculations on the causes of Calculous disorders, assume this supposed rarity of the disease in warm climates as a ground work on which to found arguments and theories explanatory of its prevalence in more temperate localities. Let me select an example from one of our most justly esteemed works on this subject. I mean the Jacksonian prize essay on "The formation of Urinary Calculi" by Mr Crosse of Norwich. Arguing for the influence of atmospheric causes in the production of Calculi of the bladder he says that this is shown "from the great rarity of Calculous disorders in Tropical Climates".

Again Dr England in his essay on the same subject argues that it is much the diet of an irritating and indigestible quality that is the true cause of Calculus, because "within the Tropics the human body seems but rarely subject to Calculi", and because a large proportion of the natives in these regions subsist on "a mild and uninitating food." Being convinced that the refutation of such erroneous doctrines was of the greatest importance, I determined to fix upon the present subject for my Thesis — one

Transactions of the Medical & Physical Society of Calcutta. Vol V. P. 249.

totally uninvestigated and likely to lead to interesting results. But here my difficulties had to commence. To prove my assertions I required evidence, and evidence not obtained from individual assertion that such complaints were frequently met with in India, nor even such as the numerous calculi in my possession afforded, as they might have been produced by the concurrence of some extraordinary local peculiarities, but such incontrovertible proof as would be afforded by accurate Statistical information gathered from trustworthy authorities. I naturally turned my attention to the published transactions of the Medical Societies of India, hoping that amongst the many contributions, relating to the diseases peculiar to Tropical Climates, contained in them, I might find some relating to the prevalence of the disease I treat of. However, with the exception of a few scattered cases of calculus seperately reported, and a short paper by Dr Barnard of the Bengal Army, they contained nothing relating to the subject. The paper I speak of merely pointed out the subject as one worthy of being fully considered, but neither offered any suggestions as to the causes probably instrumental

in determining the prevalence of the disease, nor of any statistical information from which positive proof of this prevalence might be drawn. Failing in my endeavours to obtain information from this source, I thought of procuring access to any returns of operations that might be made by Medical Officers attached to the Company's service. The only published documents of this sort are contained in the half yearly reports of the various dispensaries instituted by Government at the Principal Stations. These were only printed for the private use of the Officers of the service, and no copies of them were to be found in any libraries to which I had access. But through the kind assistance of some friends in London, who applied to Col. Sykes, a Member of the Court of Directors, I was enabled to obtain a complete set of these reports, from the year 1840 down to 1864 inclusive. These referred however to the Bengal Presidency alone. These volumes contain a mass of information on every point connected with the Dispensaries, but from the scattered manner in which the different Operations are recorded, sometimes in the form of tables, sometimes scattered through the body of the report it was very difficult

to obtain satisfactory results. However I have been able to construct a few tables, embracing the most interesting points connected with the disease, which are to be found in the third part of the Thesis. From these I will, I think, be able to prove satisfactorily, that the general ideas entertained by authors on this subject are completely erroneous. It is difficult to understand how such an extraordinary error has been so generally fallen into by writers of established repute. For not only have our English authorities, who may [illegible] be supposed to have given their statements from hearsay, recording this blunder, but even men who lived long in India are found to make the same assertion. For example Dr Scott says, "The formation of stone in the urinary bladder, is nearly unknown within the Tropics - I have not met with a single instance of it." A solution to this problem may I think be found in the unsettled and wandering life led by the great majority of army practitioners in India; a life which does not allow them to stay sufficiently long in any place to form an acquaintance with the diseases prevalent among the General population, with

Cyclopaedia of Practical Medicine. Vol. 1. P. 352.

whom indeed they are at no time brought into professional relations, their medical practice being confined entirely to the soldiers of the regiment to which they are attached. It is probably on information given by these officers that most of the statements contained in works are founded. And once printed they are perhaps copied by other authors who have no opportunity of investigating the correctness of the statements they thus record. The rarity of Calculous disorders in Armies and Navies is an admitted fact, although we are ignorant of its cause. And therefore the testimony of Regimental Surgeons cannot be held as of any importance. We might as correctly argue that Calculus is never met with in this country, because our army surgeons have seldom or never opportunities of seeing the disease in soldiers under their charge. The tables on which I formd my assertion that the disease is a common on in India, are drawn up from reports, not of Regimental, but of Civil Hospitals; Of Hospitals expressly formed to give Medical aid to the poor Native population, and therefore the data furnished by them must be held to give as near an approximation to the truth as can be obtained.

The first table contains an account of the actual number of patients operated on in some of the principal Dispensaries during a period of 14 years. During the last four years we have the cases occurring in five and twenty hospitals. While in the first period of five years we have only results from twelve. This is explained by the circumstance that it is only very lately that these dispensaries have been opened by Government, and more have been instituted every year, so that in the latter years I have been able to obtain results from more than double the number of institutions. It will be observed that the actual number of cases operated on is also much increased as we come down to more recent dates. Take for example the Budaon Dispensary. This does not seem to have been instituted till 1847. During that year we have only seven cases of Lithotomy reported. The next year the benefits derived from the Hospital seem to have been more widely known, and we have twenty-eight cases occurring. In the year following we have forty-two, and every year more and more patients seem to apply for treatment till

in 1851 we have Seventy-three cases reported as having been operated on with in the twelve months. So also at Bareilly, one of the dispensaries which is reported on in the first volume of returns which I have. Here during the first three years. viz - 1841, 42, and 43, we have only three operations performed, while during the years 50, 51. & 52, we have forty-eight. So that even the cases recorded in the Table, numerous as they seem to be, can not be held as giving an accurate account of the actual number of Stone cases occurring in any district, at least in the dispensaries lately instituted. But there are other reasons, besides the recent formation of these Hospitals, which render it likely that the cases recorded in the table do not give any adequate idea of the actual prevalence of the disease in India. Of some of these I shall attempt to give a short account. From the small number of Hospitals it is evident that these returns, even if they be allowed to include all the cases occurring, can only refer to a very limited portion of the Country. The number of Dispensaries even now existing is by no means sufficient to afford Medical

aid to every part of such an extensive range of territory as that we posess in India. I think I am safe in averring that there are very large tracts of land, densely populated, that are much too far away from any of these institutions, to allow of the natives applying for relief. So the cases which must occur in these districts, of which we have no account, are not included in the table. These must be very numerous although it would be impossible to make even a rough calculation of their number. When the system of affording Medical advice by the formation of these Dispensaries is more elaborated, and when the advantages to be derived from them are more widely known and appreciated, a more accurate set of statistics may be possible.

From certain peculiarities of the native population it is probable that a great number of those afflicted with calculus, do not apply for relief, even in districts where dispensaries are instituted, and where advice can be easily procured. From the history of numerous cases which are detailed in these reports it seems that a great reluctance is shown by natives all over

India to enter an Hospital, and they are often known rather to endure the sufferings of disease them do so. There are circumstances connected with their religious doctrines which will probably account in a great measure for this prejudice. The Hindoo population is divided into a number of castes or sects controlled by the strictest regulations. One of these requires that every native shall cook his own food. So as not to run the risk of what they consider contamination, by having it prepared by persons not in their own station. Of course while recovering from an operation, and confined to the wards of an Hospital, these religious scruples cannot be attended to. I believe that in some Hospitals a cook is provided selected from the Brahmins, which is the highest caste of Natives; so that every patient can be certain that his food is prepared by one who does not belong to a lower sect than himself. But this precaution is very often neglected; and such is the influence which these peculiar notions have on the minds of the Hindoos, that they will rather suffer as long as possible, than contaminate themselves

by entering the Dispensaries. Even the means of obviating this difficulty that I have alluded to are not sufficient to overcome the scruples of many of the Shuéter class of Hindoos. It may be supposed that such a trivial cause would not prevent those suffering from such a painful disorder from applying for relief. But every one acquainted with the fanatical regard which the Natives pay to these long established regulations, will be aware, that it is certainly sufficient to produce this effect. Another circumstance causing them to refrain as long as possible from submitting to an operation, is their excessive poverty. With families entirely dependant for subsistance on their labours, they must find it a serious loss to be prevented from following their ordinary avocations, even for a single day. Knowing then that the means adopted for their cure will necessitate their giving up work for a considerable time, they naturally endure the agonies of the disease, rather than see their little families left without means of support during the period of their treatment, and probably do not apply for aid unless absolutely forced to do so by the unbearable tortures which they suffer.

From such causes I think the conclusion I have ventured to make, that these tables do not give an adequate idea of the actual prevalence of the disease, is fairly deducible.

Now on comparing the results I have obtained with the statistical accounts of the number of cases in our English Hospitals, it will be seen, that far more cases occur, period for period, in India than in England. I am aware that such a comparison is by no means accurate, for there is no way of comparing districts of similar size, or the numbers of cases occurring amongst equal numbers of people. But let us take what is supposed to be the total number of cases occurring in the whole of Great Britain and Ireland in one year, and compare them with the ~~cases~~ operated on during the same period in the twenty-five Indian Dispensaries from which we have returns. It is evident that the comparison is a very unequal one, for we have the maximum of cases that can possibly occur within a year in this country, compared with the actual numbers operated on in five-and twenty Hospitals only. But let us see the results.

Medico-Chirurgical Transactions. Vol. II. p. 52.

I take my data of the frequency of stone in England from Mr Smiths excellent statistical enquiry, and in that work we find the following passage;
"Finally then it will follow, if the premises be correct, that 1/91 will be the sum total of cases both at home and abroad, and I verily believe that if we take them, for the sake of round numbers, at 200. we shall have the very extreme point of calculous cases for our whole population" What Mr Smith means by "abroad" in the above sentence is not very clear, for in another part of his paper he has said, "in our foreign possessions generally the operation has never been performed." Thus in one we have 200 stated as the very largest amount of stone cases that can occur in this country. Now on taking the average of the operations in the five and twenty dispensaries for the last four years, it appears that the annual number in them alone is 217.25. Thus what must be a small fraction of the actual number of cases occurring in Bengal is seen to exceed considerably what is allowed to be an exaggerated account of the annual number occuring at home. But fortunately I am able to institute a more exact

comparison, in one particular instance, from data that I have in my possession. I have been able to obtain a trust-worthy account of the amount of population in the Saharunpore district, and will thus be able to compare it with a given district in England. I will choose for this purpose Norwich, as that in which the disease is avowedly the most prevalent. Though here again comparison is in favour of this country, because Saharunpore, as will be seen on referring to the tables, is not that part of India in which the disease is of most frequent occurrence. The population of Norwich city and district, which includes the counties of Norfolk and Suffolk, is stated as 563,466. (I quote again from Mr Smith), while that of the Saharunpore city and district is 907,599. Now for the last 48 years in Norwich there has been an average of 11.5 cases per year, and in the Indian district there has been an annual average of 36 cases, which is evidently a much larger proportion; and this, it must not be forgotten, not in a locality peculiar for the excessive prevalence of the disease. We can put the calculation in another way, so as to make the difference more apparent. If the data above given are correct it follows that in

Norwich there is one operation for stone in every 48,991 of population, while in that part of Bengal which we have been comparing with it there is one for every 25,211.08. Very nearly double the number of cases. Now this is very striking if we consider the peculiar circumstances in which the Norwich district is placed with regard to the prevalence of the disease. By Mr Smiths own account there are as many stone cases annually in that portion of England, as in the whole of Scotland and Ireland. A fact which leads to the conclusion that in one small district of India, where all the cases occurring are probably not operated on, and where there is no peculiar frequency of the affection, we have almost twice the annual number of cases that we have in the whole of Scotland and Ireland.

Having thus, I trust, sufficiently proved the fallacy of the general notions on this point, I shall attempt, in the second division of My Thesis, to enquire what circumstances may conduce to establish this great prevalence of the disorder. In order to do so more effectually I purpose to give a brief sketch of the natives of

habits of the country, of their diet, and mode of life; in so far as these can have any bearing on the subject in hand. A short account of the climate and seasons, of the geological structure of the country, and any points which can bear on the question will also be advisable.

From these I shall attempt to draw some conclusions that may possibly account in a slight degree for the frequency of the disease, or at least show how the circumstances which are stated as likely to prevent the formation of Calculus in Tropical Climates, have not the effect which has been attributed to them.

Part II.

The natives of India are divided into two great classes, seperated from each other by their religious belief. These are the Hindoos and Mahomedans. The former are the original inhabitants of the country, and are by far the most numerous. The latter first settled in India a.d. 1215 as a conquering race, from which time they rapidly increased in number; but still are only in the proportion of one to every eight Hindus. Considering the vast extent of territory over which these classes are spread, we are naturally led to expect, what actually occurs, that they should present great differences in configuration, in constitution, and in habits, according to the peculiarities of the situation which they inhabit. Descended, however, from one common stock many of their leading characteristics are the same, and one description will serve to give some idea of the leading features of the whole native population. In general the natives of India are distinguished from Europeans by their weaker and less robust frames. The body is slim and slender, the muscular power not great, and the whole configuration gives

the idea of a people who are weak and feeble. Mr Ford an old English writer, has described them as, "Of a gesture and gait, I may say maidenly and well nigh effeminate." Their features are meagre and thin, and they are incapable of supporting any great amount of exercise or fatigue. They are also of a naturally indolent and idle disposition. Many of these peculiarities may doubtless be ascribed to the enervating effect of the climate, and other circumstances in the midst of which they are placed. Living in a country abounding in natural resources, removed in some measure from the necessity of exercising that activity of mind and body which is imperative on the inhabitants of colder regions, and surrounded by the influences of a demoralizing Religion it is not to be astonishing that they should give themselves up to a life of comparative indolence. Their weak frames, poor constitutions, and low vital energies may thus be easily accounted for. But this description, it must be remembered, is only of a very general nature. There are many classes of natives of whom a very different

account might be given. The diet of the natives is a point of great interest in relation to the investigation in which we are engaged. The great majority, being Hindus, are strictly forbidden by their religion to taste any description of animal food whatever; and this rule is most scrupulously adhered to. The Mahomedans are permitted to eat animal food, but the greater number of them are, from their poverty, unable to obtain it. So that, in fact, we cannot practically distinguish the two sects in this particular, considering as we are the disease as occurring in the poorer classes of the population alone, and the statistical results being entirely derived from that portion of the community.

The diet differs considerably in the Upper Provinces of India and in Bengal proper. In the latter the staple article of food is rice, while in the former it is coarse kind of flour called atta. This atta is made into a heavy dough with water, and cooked on iron girdles, in the form of cakes. To these substances the poorer natives are obliged almost exclusively to confine themselves. Along with this excess of

farinaceous food a large quantity of condiments are invariably taken, as stimulants to digestion. These are principally Chillies, coriander seed, salt in abundance, and turmeric. They are consumed in large quantity, and it has been found that when the natives are prevented from obtaining them severe gastric derangement results. So much so that in prisons it has been found necessary to add these materials to the diet table in order to prevent evil consequences. It will be seen on reference to Table No that Calculus is considerably more common in the Upper Provinces than it is in Bengal. Dr England and several other authors seem inclined to attribute the prevalence of the disease in Norwich, to the peculiarly indigestible qualities of the dumplings that are consumed in such quantities by the inhabitants of that district, and it is an interesting circumstance, that the diet of that part of India in which the disease is most common should be almost identically the same as in that part of England similarly circumstanced. What the real effect of this sort of food in producing the malady is, I shall shortly attempt to show; I merely point it out here as a

curious and interesting coincidence. The food then of the natives in general is eminently distinguished by the large amount of non-nitrogenous elements that enter into its composition; and although it contains the constituents which are absolutely necessary for the nourishment of the body, they are present in a state requiring greater powers of assimilation, than where there is a proper admixture of animal food. I may also mention here that the derangements of the digestive organs, inevitably resulting from the prolonged use of such very indigestible aliments, are much increased and encouraged by the use of water containing a large quantity of Mineral ingredients, especially the salts of Lime. That the water in general use must do so I argue from the information I have been able to procure regarding the Geological nature of the soil, and not from any Chemical Examination of the waters themselves. For the whole of the North West Provinces of India, stretching from the Himalaya Mountains as far as Bengal, the soil is highly impregnated with Calcareous matter. So much is this the case that in sailing down the Ganges or Jumnah, or examining the sides of any ravine in the plains there will

observed, scattered irregularly through the alluvial loam, masses of a material called "Kankar", which is nothing else than a very impure carbonate of Lime. This is dispersed in successive layers, very similar in appearance to the layers of flints that are found in chalk formations. This Kankar occurs in irregular masses, often of most fantastic shapes and of large size. It is also scattered through the soil, in every direction, in the form of fine gravel. So abundant is this material that is largely used by the natives for making Lime, and forming roads, and in fact is the only material employed for these purposes. This large quantity of calcareous matter has been probably originally derived from the outer ranges of the Himalayas, which consist principally of Limestone rock. Now it is impossible that the streams arising in and running through a soil of this description could avoid being impregnated with a considerable amount of the salts of Lime. And in further illustration of this I may observe, that Springs are very frequently met with in the Upper Provinces, when such a large amount of Lime is held in solution by an excess of Carbonic Acid, that any substances placed in them such as

leaves, hogs &c. are very speedily covered with a copious deposit of that substance; and I have in my possession very beautiful specimens of this description. Of course any influence these hard waters may possess can only be of an indirect nature.
I am not aware that there is anything in the habits of the natives, or in their mode of life that would be likely to predispose them to calculous disorders. They follow very various trades, and in some of them are considerably exposed to the effects of the sun, and other atmospheric influences. In general, however, they try to have their out of door labours finished before the extreme heat of the day, and shelter themselves at that period a good deal within doors. Still they are often very considerably exposed. What is the nature of this climate, and its effects I shall now proceed to consider.

Climate.

Much stress has been laid on the influence of the atmosphere as a predisposing cause of urinary calculus. The unsettled nature of the climate of England, the frequent alternations of wind and rain, of extreme cold with a tolerably high temperature, have been deemed by many circumstances very likely to

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originate the disease; while the heat of tropical climates has been frequently stated as a reason for its supposed rarity in those regions, on account of the free perspiration which it induces. It will be interesting then to see of what nature the climate of India is, and what effect it really has on the prevalence of calculous disorders.

The seasons in India may be divided into the hot, cold, and rainy. The hot season extends from the beginning of March to the end of June. During this period the thermometer in the sun often rises to as much as 100° to 120° Fahrenheit, although in the shade it is generally considerably less. During this period of excessive heat there are occasionally storms and hurricanes, accompanied often with rain, which lessen the oppressive influence of the high temperature. The continuance of this great heat has some interesting results on the body. Some of them have been summed up by Dr Martin in his work on the "Influence of Tropical Climates," from which source most of my information on this head is derived. He talks of the effect of the hot season as "a determination of the fluids

generally to the surface of the body, the blood being
venalized in proportion to the elevation of the
temperature, and respiration being less perfectly
carried on, owing to the rarefaction of the air
and the consequent diminution of oxygen in
a given bulk. A vicarious decarbonization
of the blood is established in the great increase
of the biliary secretion, at the same time the
urine is surcharged with saline impregnations
and diminished in quantity." This diminution
of the quantity of oxygen respired is a point
to which I would wish to call particular
attention in reference to the enquiry on hand,
and one the importance of which I will attempt afterwards to show. It is a necessary
consequence of the great heat, for although
equal quantities of air are inhaled with every
act of inspiration, yet, being expanded by
the heat, the quantity of oxygen respired will
be much less volume for volume than in air
of a lower temperature. The languor, listlessness,
and low vital energy which I formerly adverted to as prominent features of the nature
character may be easily accounted for by

the depressing effect of this great heat, which must act as a direct sedative on most of the functions of the body. The Rainy Season generally lasts till October. During its continuance the air is saturated with moisture, and during the greater part of the time the heat is still considerable. The effect on the human body is very unpleasant. The cutaneous transpiration is very much checked by reason of the atmosphere being already loaded with moisture, and to compensate for this the body is usually covered with an excess of exhausting perspiration. It is described as "an atmosphere having all the properties of a tainted vapour bath." It is a season of the year proverbially unhealthy. A feeling of the greatest inaptitude and disinclination whether of mind or body is constant during its continuance. At this time the diseases formerly prevalent change their type considerably. They become more asthenic in their character. The fevers of the hot season with high pulse, hot skin, burning pain in the head lose these distinctions and assume a much lower form. This unhealthy period gradually changes into the third great division of the climate of India.

the Cold Season. The transition period from the rainy to the cold season, lasting for perhaps a month or more, is that in which most sickness and disease prevails. After the 1st of November, when the cold weather has fairly set in, the climate is much more agreable. The thermometer varies from 45° to 75°. The prevalent wind is North east. Fogs are very common, especially during the night, at which time there is often much moisture present in the air; but during the day the dryness of the atmosphere is great. This is the season of the year usually chosen by a European for his first arrival in India, and when the temperature is very agreable; but to one long accustomed to the excessive heat of the hot and rainy seasons the great diminution of temperature is neither healthy nor pleasant. To sum up these facts it is very evident that if a dissipated and unsettled climate is a principal cause of calculus, as many would have us believe, then the prevalence of it in the Bengal Presidency is very easily accounted for. The fact if we compare the climate of England with that which I have just described it will be seen,

that although the diversities observed in India are perhaps not so frequent, yet they are much greater in degree than we ever have in this Country. Dr Martin applies it very happily. and apparently with much reason. the lines of Chaucer.

"Some hote as fire, some colde as ashes ded.
Some hote for colde, some colde for hete again.
Some cold as ye. and some as coles red.
For hete I brenne"

The effect which a climate so variable has on the native constitution is extremely debil-
-itating. but I do not think that in it alone can we find an explanation of the prevalence of Calculous disorders. Every attempt to limit the cause of this disease to any one circumstance, whether of a purely local or more general nature, has invar-
-iably failed. And now that Chemical investigations have so much increased our knowledge of physiology and pathology we must be aware that any limitation of the sort is impossible. It is rather to a combin-
-ation of adverse circumstances that we must look for a true explanation of the causes.
Recent researches in organic Chemistry have thrown much light on the normal constituents

of the urine, on the manner in which they are formed, and on the conditions which regulate their amount. It has been shown that the metamorphosed textures destined for excretion, especially those derived from the albuminous tissues, are first changed into Uric Acid. If this Uric Acid so formed is exposed to the action of Oxygen, as in the human body it ought normally to be, we have a series of changes taking place which result in these matters being excreted in the form of Carbonic Acid and Urea. The following diagram from Leibig will explain this alteration;

$$\left.\begin{array}{l}\text{1 atom of Uric Acid } C^{10}N^{4}H^{4}O^{6}\\ \text{4 atoms of Water}\\ \text{6 " of Oxygen}\end{array}\right\} = H^{4}O^{10} = \left\{\begin{array}{l}\text{2 atoms of Urea } C^{4}N^{4}H^{8}O^{4}\\ \text{6 " Carbonic Ac. } C^{6} \cdot O^{12}\end{array}\right.$$

$$C^{10}N^{4}H^{8}O^{16} \qquad C^{10}N^{4}H^{8}O^{16}$$

Now this is a change that in health will always take place, and the urine will then retain its normal constitution. Should any circumstances occur however which would prevent sufficient Oxygen or water being taken into the system, the complete changes mentioned above would be prevented from occurring, and certain morbid states result

Liebigs Physiology. Page. 187.

differing according to the greater or less deficiency of Oxygen. " If Uric Acid is subjected to the Action of Oxygen it is first resolved, as is well known, into Alloxan and urea. A new supply of Oxygen acting on the Alloxan causes it to resolve itself either into Oxalic Acid and Urea, into Oxaluric and Parabanic Acids, or into Carbonic Acid & Urea."
Now according as the Oxygenation of the Uric Acid is less or more carried we will have the normal secretion of Urea and Carbonic Acid, of Urea and Oxalic Acid, or of Urea and Uric Acid. Knowing these facts we naturally enquire. whether there ever can be such a deficient Oxygenation of the primary products of effete tissues, as would account for their unaltered presence in the Urine, - and what circumstances are productive of this result.
The facts I have already stated contain. I think, data which will perhaps partially account for the very frequent presence of some of these Morbid States among the Natives of India.
The vital force is the power which resists the destructive and disintegrating action of Oxygen on the tissues of the body, and prevents their being too rapidly wasted, and thrown out of the system.

Whatever circumstances them lower and diminish
this resisting agency will favour the change of textures.
I have attempted to show that the natives of India,
partly on account of their natural constitution,
and partly from their habits and mode of life,
are peculiarly wanting in this vital force.
In them we may suppose that a rapid
combination of tissues with the respired Oxygen will
go on, and a proportionally large amount of them
will be thrown out of the system. Now if sufficient
Oxygen still remained to combine with the Uric
Acid thus formed, and effect the Change I
have already described, we would not find
any abnormal constituents in the urine.
But there are causes present to prevent this;
1st There is taken into the system at every
inspiration a quantity of Oxygen considerably
less than we inspire in our own more temper-
-ate climate, on account of the expansion
of the air by the high temperature. (Page 25)
2nd ly. The quality of the food will also tend to
prevent this healthy change. It is, as has
been seen, essentially of a non-nitrogenous
nature, or in other words what is called

respiratory food. Now to fit this food for combustion a large quantity of Oxygen is required, and whatever may not be used in breaking down and disintegrating the tissues, will be consumed in preparing this peculiar diet for playing its allotted part in the animal economy.
Thus there are sufficient reasons why the Uric Acid once formed should not be further altered, but should be excreted unchanged in the urine. Of course this morbid Chain of events cannot be expected to take place always, it must be an exceptional occurrence; yet an exception likely to occur sufficiently often to explain the frequency with which Calculus is met with. The Chemical examination that I have made of Calculi extracted from Natives. (Page 54.) bears out these views. It will be seen on referring to the table that by far the greater number are Uric Acid, and Oxalate of Lime, the very deposits which the above theory would lead us to expect. To the low vital powers then, of the Natives, however induced, to the heat of the climate and to the abundance of Non-Nitrogenous food which they consume, I would be inclined to ascribe their liability to Calculous disorders.

Part III

The third division of my Thesis contains various tables drawn up from the half yearly reports before alluded to. These do not refer only to the prevalence of the disease, as perhaps they ought strictly to have done, but also illustrate various points connected with the operation for its relief. Some of these are more particularly framed to show the differences between the results of the Operation in India and in this country, and others are of a general interest as regards the statistics of the disease. I have thought it better to depart so far from the immediate subject I proposed to myself, as the Reports furnished data for constructing some tables which, as far as I am aware, have not been previously formed. In considering these statistical results I shall prefer making a few explanatory remarks along with each table, to summing up the results in a general resumé of the whole.

The first series of tables are formed with the view of showing how many cases annually occur in the dispensaries instituted in the Bengal Presidency. On these it is unnecessary to dwell here, as in the first part of the paper I have already commented on them at considerable length; and have stated

reasons for believing that they only give a very imperfect idea of the actual prevalence of the disease I have there also instituted a comparison between the relative frequency of Calculus disorders in this Country and in India; the general result of which was to show, even supposing that these tables included every case of Calculus occurring in India, that the disease would still be considerably more common there than it is in this Country. A result altogether at variance with the prevalent notions on this subject As I was only able to obtain the dispensary reports of the Bengal presidency, I tried to get some information regarding the prevalence of the disease in Madras and Bombay. from other sources. Regarding Bombay I was told by a Medical Officer who had served there, that the disease was very frequently met with; and was believed by him to be considerably more common than in Bengal. On this vague and uncertain information, however, I owned not wish to lay any stress. With the view of obtaining some information from Madras I wrote to a relative in that presidency, who very kindly applied to the Secretary of the Medical board for Lorimer Under whose superintendence the annexed table

was drawn up, and consequently may be relied upon as authentic. It will be seen that the results are very different from those I have already given regarding Bengal. It will be seen that in this Presidency the disease is certainly not common. It must be remember-ed, however, that not knowing any particulars regard-ing the Dispensaries, and the mode in which they are conducted, we cannot be certain that these returns give a complete report of the actual number of cases occurring annually. I have already shown that the number of patients depends very much on the length of time the Dispensaries have been instituted, and the knowledge possessed by the natives of the means of relief within their power. We have no data showing when these institutions were founded in Madras; and consequently cannot be at all sure that all, or nearly all, the cases of Calculus are operated on. Putting these modifying circumstances out of view however, there can be no doubt that the disease is far more uncommon than it is in Bengal: Yet not nearly so much so as to justify the statements made by authors on the subject. Looking to the similar results published by Dr Smith regarding various Hospitals

in this country, it will be seen that in many of them the proportion of cases is little more than in Madras, and in some actually less. It must not be forgot also in estimating the number of Operations, and this remark applies equally to Table I, that we must put out of view all the cases occurring in women. It is a result of the peculiar opinions held by the natives regarding the female portion of the community, that the disease, as occurring in that sex, never comes under the observation of a European Doctor; while such cases are certainly included in the English returns. Unacquainted as I am with the conditions influencing the native population in Madras, the climate, diet, and mode of life, I cannot venture to offer any explanation of this remarkable difference from the Bombay Presidency.

Table I. Total number of Operations in twelve Dispensaries from the years 1840 to 1844 inclusive.

Dispensaries	Years.					Total.	
	1840	1841	1842	1843	1844.	Cured.	Died.
Bowanipore. (Calcutta).	"	"	2	1 died.	"	2	1
Chittagong.	"	"	"	"	1 urethral	"	"
Benares	"	"	"	"	"	"	"
Allahabad.	1	"	2	"	"	3	
Cawnpore.	3	6	11	5	2	27	
Furruckabad.	"	"	"	"	"	"	"
Sajehanpore.	"	"	"	"	"	"	"
Bareilly.	"	1	1	2	1 3 stones.	5	"
Moradabad.	1	"	"	"	"	1	"
Delhie.	3 1 died. 1 with 3 stones.	1 (died).	"	11	14	27	2
Muttra.	"	"	7	36. (1 died)	"	42	1
Jubbulpore.	"	2	7	4 1 with 2 stones.	"	13	"
					Total for five years.	120	4.

Average. 1 death in 31.

Table 1st. (continued.)

Total Number of Operations in eighteen Dispensaries from the years 1845 to 1849 inclusive.

Dispensaries.	Years.					Total.	
	1845.	1846.	1847.	1848.	1849.	Cured.	Died.
Bowanipur	"	"	"	"	"	"	"
Chittagong.	"	"	"	1	"	1	"
Benares.	"	"	1 died	7	9 (32)	13	4
Allahabad	1	1	"	2 1 died	2	5	1
Cawnpore.	5 10.	10	1	10	8	32	3.
Furruckabad.	"	"	"	3 10.	7	9	1
Shahjehanpore.	3	8	5 10.	2 10.	3	19	2.
Bareilly.	2	5.	2	7	7 10.	22	1
Moradabad.	5 2 died.	1	"	1	4 10.	8	3.
Delhie.	7	25 10.	"	20	28 40.	75.	5.
Mullra.	28 1 died.	22	5 10.	12 30.	14	62	5.
Jubbulpore.	4	3	2 1 died	5 10.	1	13	2
Agra	5 10.	3	4 10.	10 10. 1 with 2 sons.	41 40.	56	7
Budaon	"	"	7 1–25 1–35	28 10.	42 35.	73	4
Mirzapore.	"	"	"	1	"	1	"
Gazeepore.	"	"	"	1	1	2	"
Almorah	"	"	"	3 10	"	2	1
Saharunpore.	"	"	10 10.	13 20	80 60.	94	9
					Total for five years	487	48

Average. 1 Death in 11.14.

Total Number of Operation in 24 Dispensaries for the years 1850. 51, 52. the first half of 53.

Table 1

39

Dispensaries.	Years.					Total.	
	1850.	1851.	1852.	1853.	1854.	Cured.	Died.
Patna.	"	"	8 10.	2	"	9	1
Bowaneepore.	"	"	2 10.	"	"	2	"
Gazeepore	"	"	2	3	"	5	"
Muzuffurpore.	"	"	1	1	"	2	"
Benares.	3	1 10.	2 10.	"	"	4	2
Caunpore.	7 20.	5	4	"	"	14	2
Jubbulpore.	8 10.	5 20.	2	3	"	12	3
Agra.	26 10.	13 30.	21	11	"	56.	4.
Muttra	26 10.	27 30.	26 10.	16	"	90	5
Shahjehanpore.	7	9 20.	21 10.	10 10.	"	43	4.
Bareilly.	10 10.	8	30 20.	14 10	"	58	4.
Delhie.	26 10.	38 30.	31 20.	9 10	"	91	7.
Moradabad.	4 10.	7 30.	9 10.	4	"	19	5
Budaon.	57 70.	73 90.	59 40	23 30.	"	189	23
Almorah	3 20	6 10.	3	"	"	10	3
Sasarumpore	39 90.	30 40.	37 100.	19 60	"	101	29
Allahabad.	2	11	6 10.	7 10	"	24	2
Furruckabad.	"	2	7 10.	2	"	10	1.
Ajmeere	"	3	2	"	"	5	"
Allesporah. (Est. for 51-2).	"	"	1	"	"	1	"
Mirzapore.	"	"	3	2	"	5	"
Alleyghur.	"	"	15	7 30.	"	19	3
Gorruckpore	"	"	2	"	"	2	"
Dacca.	"	"	2	"	"	2	"
				Total for 3 years dahalf.		775	94

Average 1 death in 9.24

Admissions from all diseases in the undermentioned Civil Dispensaries, Madras Presidency, for a period of four years 1851, 2, 3, 4; and admissions from Calculus Vesicae during the same period

Districts.	Dispensaries.	Operations for Calculus Vesicae. In patients.	Total of all Diseases. In patients.
Northern Circars.	Kumptee.	1	1613.
	Secunderabad.	"	1875.
	Chicacole	1	945.
	Vizagapatam.	"	777.
	Rajamundry.	1	691.
	Masulipatam.	"	667.
Ceded Districts.	Kurnool.	"	968.
	Cuddapah.	1	577.
	Bellary	1	605.
Malabar & Canara.	Calicut.	"	673.
	Mangalore	"	569.
	Tellicherry	"	28.
Carnatic and Southern India.	Coimbatore	"	847.
	Salem	"	403
	Combaconum.	1	1311.
	Madura	2	2207.
	Trichinopoly	"	1342.
	Cuddalore	"	573.
	Chittoor	"	772.
	Chingleput	"	810.
	Guntoor	"	838
Presidency Town.	Triplicane.	"	2447.
	Black Town.	"	4249
	Vepery.	"	1778
	Total.	8	27559

Table III.

is constructed to show the comparative frequency of the disease in the Upper Provinces of the Bengal Presidency and what is called Bengal proper. The result is very curious, and one that is not easily explained. It will be seen at a glance that in the North West Provinces the complaint is very much more common than it is in Bengal proper. That is the eastern part of the Presidency nearer the Bay of Bengal. In fact in seventeen Dispensaries in the former we have 828 cases, while in eleven in the latter we have only 15. This discrepancy cannot be wholly explained by the dates at which the Dispensaries were founded; although, on the whole, those on the North Western districts seem to have been formed soonest. (See Table IV).

Nor are there differences in the climate or in the constituents that can explain it. The only marked point in which they are opposed to each other is as regards the diet. I have already mentioned that in Bengal the staple article of food is rice, while in the N. W. Provinces it is a coarse flour made into Chapatties or Cakes. It is impossible to suppose that this could of itself have such a startling effect, for in the ultimate composition of the two substances there is no such marked dissimilarity. It is probably in a combination of circumstances that we will find a true explanation of this remarkable fact.

Table III.

Shewing the Comparative frequency of Operations for vesical Calculus in Bengal proper. and in the North West Provinces of the Bengal Presidency.

Extending over a period of five years.

11 Bengal Dispensaries.	Operations.	17 N.W.P. Dispensaries.	Operations.
Lukeeachaur.	"	Benares.	6.
Bowanipore.	2	Gazeepore.	5.
Hoogly.	"	Mirzapore.	5.
Midnapore.	"	Gorukpore.	2.
Moorshedabad.	"	Allahabad.	26.
Dacca.	"	Caunpore.	16
Chittagong.	"	Jubbulpore	15.
Purneah.	"	Furrukabad.	11
Gyah.	"	Agra.	60.
Patna.	10	Muttra.	95.
Muzuffurpore.	2	Bareilly.	62.
		Moradabad.	24.
		Almorah.	13.
		Delhie.	98.
		Saharunpore.	130.
		Jajehanpore.	47.
		Budaon.	212.
Total in Bengal.	15.	Total in N.W.P.	828.

Table IV.

Dates on which the various Dispensaries were established.

1839.	Patna.
	Campore.
	Delhie.
1840	Dacca.
	Benares.
	Allahabad.
	Agra.
	Bareilly.
	Mooradabad.
	Chittagong.
1841	Bowanipore.
	Poorea.
	Jubbulpore.
1842	Furruckabad.
1843	Mulltra.
1844	Hoogly
	Gyah
	Shajehanpore.
1845	Budaon
	Loodianah
	Mulnotte.
1846.	Gazeepore
1847.	Sangor
	Mirzapore
	Purneah.
1848	Gorruckpore.
	Almorah
1849	Sajanupore.
	Muzzufurpore.
	Indneepore.
1850.	Ajmeere.

Table V.

This table has been constructed to show the relative prevalence and mortality of the disease at different periods of life. Along side of it I have placed the similar results in operations performed in this country, (taken from Smiths tables,); so that the mortality in the two countries can be contrasted at a glance. The age at which the disease is most common seems to be much the same. In India, as in England we have by far the most cases under ten years of age, and the number of cases progressively decreases in proportion to the age, except between thirty and forty when there is a slight increase. As however this is very small we may fairly consider it accidental. The mortality however will be seen to be very considerably less in India than it is in this country. It is well known that the natives often make the most extraordinary recoveries from injuries, such as would inevitably prove fatal to a European. This is a circumstance well known to army surgeons who often witness wonderful recoveries from wounds apparently mortal. Of this the Half Yearly Reports mention many striking instances; for example cases where the abdomen has been ripped open by the horns of a buffalo, where the intestines have

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protruded, and yet where a perfect cure has been Obtained. The small mortality after Lithotomy need not therefore astonish us. In fact there is little doubt that were it not for the presence of very unfavourable circumstances a still fewer number of deaths would take place. What these are can be very easily inferred from several cases detailed in the Reports. In the first place a patient is never known to overcome his prejudices, or his dread of operative interference, till he is absolutely compelled to do so by the intolerable agony which he endures. The consequence is that the Operation is generally performed on individuals who have been long ill, whose constitutions have been weakened and worn down to the last degree, often with the bladder extensively diseased, and altogether in a very unfit state for recovery. In these respects they contrast very unfavourably with those operated on in England, who are generally persons of good health and unimpaired constitutions, and who are treated as soon as the existence of the disease is discovered. Another point of difference must not be ommitted. In England it is always in the power of the Surgeon to prepare his patient for the safe performance of the operation by a suitable hygeinic course. The case is very different with the

practitioner in India. Such a preparatory course a nature will in no case submit to; partly from want of patience, and partly from other reasons that I have before adverted to. (Page 10 et seq.) Unless they are operated immediately after entering the Hospital, they will insist upon leaving; and, in such circumstances, they have been known to commit suicide to free themselves from the agonies they suffer.

Under such unfavourable conditions a small mortality could hardly be expected; and yet it is little less than that in this country. That it would be much decreased under more propitious circumstances is I think a legitimate conclusion. A conclusion favoured by the fact that in the Reports it is mentioned that in one Hospital there were only one in forty three consecutive operations, and in another one in forty two; (the latter in the practice of the Officer whom I am indebted for the calculi.); a success I believe quite unequalled in this country, but which would be perhaps a near approach to the ordinary result in India, were it not for the reasons I have mentioned above.

(For Table see next page)

Table V.

Ages of 1002 cases. Operated on for Calculus Vesicae.		Ages of 104 fatal cases among those in first column.	Proportion of deaths in India at various ages.	Proportion of deaths in England at various ages.
1 to 10 years.	407.	18	1 death in 22.6	1 — 4 ½
10 — 20.	194.	25.	1 — 7.7	1 — 5
20 — 30.	107	7.	1 — 15.2	1 — 7
30 — 40	136.	19.	1 — 7.1	1 — 5
40 — 50.	91.	19.	1 — 4.7	1 — 3 ⅓
50 — 60.	52	10.	1 — 5.2	1 — 4 ⅔
60 — 70.	10	4.	1 — 2.5	1 — 2 ½
70 — 80.	2	1.	1 — 2.	1 — 2
80 — 90 & upwards.	3.	1.	1 — 3.	"
Total	1002.	104.	1 in 9.63	1 in 4.5

Tables VI & VII

The next two tables have been constructed with the view of showing the average number of days in which the natives recovered from the operation. One shows the actual number of days under treatment, and the the other the number of days ~~before~~ the urine passed wholly by the natural passages. As I have not seen any similar table formed as regards the results of the operation in this country, I have not been able to compare accurately the difference of time in the two climates. From incidental observations in various surgical works, however, it would appear that in England the urine generally ceases to pass at all through the wound between the thirteenth and fifteenth day. It will be observed that among the natives of India a similar result holds, as between the tenth and fifteenth days there are by far the largest number of cases set down. So it would not appear that the natives recover sooner from the operation, although the average Mortality among them is less.
It will be observed that an equal number recover between the fifth and tenth day, as between the fifteenth and twentieth, and that there are a considerable number of cases in which the recovery was extraordinarily rapid. The most curious of these have been noted seperately.

Table VI.

Number of days under treatment in 876 Cases.

Days.	Cases.	Days	Cases.
1 to 10.	51.	50 to 60.	23.
10 to 20.	292.	60 to 70.	11.
20 to 30.	291.	70 to 80	4.
30 to 40.	137.	80 to 90 & upwards.	8
40 to 50.	59.	"	—

Table VII. Shewing in how many days the urine passed wholly through the urethra in 198 cases.

No. of Days.	Cases.	Days	Cases.
1 to 5.	13.	20 to 25.	28.
5 — 10.	36	25 — 30.	13.
10 — 15.	50.	30 — 40.	12.
15 — 20.	37.	40 & upwards.	9.

Of these there were in 1 day — 2 Cases.
" 2 " — 2 "
" 3 " — 4. "
and the longest period was 53 days.

Tables VIII & IX.

Refer to an interesting point connected with the operation, viz. whether the size of the stone, or the age of the patient has any marked influence on the cure. We would naturally expect that the extraction of a large stone would be attended with greater risk, and cause the patient the longer under treatment than the extraction of a small one. The results however, as shown in the Table, do not seem to justify such a conclusion. The amount of pressure and bruising which the ~~tissues~~ must have undergone in the extraction of some of the larger calculi there mentioned must have been very great, and yet this does not seem to have influenced the cure to any remarkable extent. It will be observed that at first the average time under treatment certainly does progressively increase with the weight, by one day for every ʒij additional weight of the stone up to ʒij. But when we come to the higher weights, where we might expect more definite results, we find ourselves at fault; here we have the results very irregular, and we have the average duration of cure the same for stones above ʒiij, as for stones of only ʒiv. We cannot then, I think, state certainly that a large stone

will inevitably cause a deficiency, although perhaps he might be justified in inferring that on the whole this is the case.

The deductions from the other table are even less satisfactory. We cannot I think, infer that the age of the patient has anything to do with the length of time required for his cure. There is not here the progressive ratio that partly occurs in the other table, and the varying number of days at different ages are probably accidental. There is however a decided increase between the ages of 30 & 40 — perhaps too much to be accounted for in this way. (See next page).

Table VIII Shewing the average period at which urine passed wholly by the natural passages in 196 cases in reference to the weight of the stone.

Weight of Calculus.	No. of Cases.	Average number of Days.	Weight of Calculus.	No. of Cases.	Average number of days.
Lo. 3ij	38.	15.	Lo. 3ij ss.	29.	18
— 3iv.	55.	16.	" 3ij.	11.	20
— 3vj	27.	17.	" 3iij.	9.	19.
" 3j.	21	19.	above 3iij.	6.	16.

Table IX. Shewing the average period in which the urine passed wholly by the natural passages in 198 cases in reference to age.

Age.	No of Cases.	Average No. of Days.	Age.	No. of Cases.	Average No. of Days.
1 to 10.	68.	16.	40 ~~to 50~~.	17.	15.
10 — 20.	36.	17.	50 — 60.	11.	15.
20 — 30.	36.	17	60 — 70.	2.	18.
30 — 40.	28.	20.	"	"	"

Table VI

Analyses of Calculi.

The following table contains the results of a chemical examination of 115 Calculi, all of which were extracted from natives of India. I have not attempted to perform these Analyses with great minuteness, but have contented myself with ascertaining, as correctly as I was able, the materials of which each is principally composed. The results I have placed in such a form that they can be seen at a glance. The principal point of interest to be observed is that Calculi formed essentially of Uric Acid are in a larger proportion to the whole number than in most English Collections. In this country the general proportion of this description of Calculus is 1 to 3½ while in India they seem 1 to the other Calculi as 1 to 1.85. This circumstance, as I have before observed, affords a strong argument in favour of the explanation of the prevalence of the disease in India that I have ventured to advance. The proportion of Oxalate of Lime Calculi is somewhat less there in England. There we have 1 in every 14½ Calculi, and in India 1 in 18.11; but the number of Calculi composed of Uric Acid and Oxalate of Lime together

will be observed to be great. My analysis of the very beautiful specimen of Cystic Oxide Calculus. (Marked No 66 in the cabinet) was kindly confirmed by Dr. Geo. Wilson.

Table.

Chemical examination of 115 Calculi extracted from Natives of India.

Principally Uric Acid:	" Urate of Ammonia.	" Oxalate of Lime.	" Uric Acid and Oxalate of Lime.	" Phosphate.	" Uric Acid and Phosphates.	Alternating Calculi.	Cystic Oxide.
62.	3.	10.	18.	10.	12.	3.	1.

Total 115.

Table

Contains the weights of most of the Calculi contained in the cabinet accompanying the thesis. Their weights were carefully taken before the Calculi were cut, but I regret that while at the lapidaries they got accidentally mixed, and the weights being much diminished in the process of cutting I have been unable to identify many of them.

Weights of Calculi in the Cabinet.

	Grains.
Between 1300 & 1400 grains.	4.
" 900 & 1000 " .	3.
" 800 – 900 " .	2.
" 700 — 800 " .	6.
" 600 — 700 " .	6.
" 500 — 600 " .	4.
" 400 — 500 " .	12.
" 300 — 400 " .	16.
" 200 — 300 " .	15.
" 100 —— 200 " .	26.
" 50 — 100 " .	8
" 1 —— 50 " .	300

Total Number 106.

No 3 in the cabinet when all stones were extracted at once weighs 2310 grains.—