The 'Oriental sore,' as observed in India : a report / by T.R. Lewis and D.D. Cunningham.

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THE

'ORIENTAL SORE,'

AS OBSERVED IN INDIA.

A REPORT

BY

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CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING.
1877.

CALCUTTA:

PRINTED BY THE SUPERINTENDENT OF GOVERNMENT PRINTING,

8, HASTINGS STREET.

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CHAPTER I.

GENERAL REMARKS REGARDING 'ORIENTAL SORE': ITS DELHI FORM.

Introductory.

THE subject of which the present report treats has occupied our attention for several years past, but it was only during the earlier part of the present year that we were able to devote time specially to its study in the locality where it has generally been considered to prevail to a greater extent than any other in India, namely, at Delhi. The complaint has been known in that city for many years, but it was not until after 1857 that special attention was drawn to it by the large amount of invaliding which it produced amongst the European troops who were stationed there after the mutiny. Since this period the disease has occupied a prominent place in the literature of cutaneous affections under the designations of 'Delhi sore,' 'Delhi boil,' or 'Delhi ulcer.' The Government appointed a Commission, presided over by Dr. John Murray, to report upon the subject in 1864, and subsequent to this numerous medical officers have made special investigations regarding the origin and nature of the sore, foremost among whom may be mentioned Dr. Alexander Smith and Dr. Joseph Fleming.

The literature of 'Delhi sore.'

As, however, the literature of the complaint has been very recently lucidly summarised in a joint work by Drs. Tilbury Fox and Farquhar on the "Skin Diseases of India" published

* Appeared as an Appendix to the *Twelfth Annual Report of the Sanitary Commissioner with the Government of India.*

under the sanction of the India Office, we do not consider it necessary to particularise the various views which have been propounded from time to time regarding the malady, and shall restrict ourselves to giving a *précis* of the observations which were conducted by ourselves in accordance with the instructions which we received from the Government of India. We may, however, mention that a short but very accurate description of the sore has recently been published by Sir Joseph Fayrer,* but which seems to have appeared too late to be referred to by the authors of the above work. Though occupying a few pages only, it expresses pretty nearly all of value that has been written regarding the matter.

The different names given to the sore.

One of the chief results of the many contributions to the literature of the subject has been the identification of this sore with sores occurring in other districts and cities of India—cities and districts which have likewise given it a local signification by lending it special names. The consequence has been that Scinde, Mooltan, Roorkee, Meerut, Lahore, Lucknow, and other places have all been credited with the prevalence of a peculiar sore or boil. These, again, have all been pretty conclusively identified with similar affections very prevalent in parts of Syria, Egypt, Arabia, and other Oriental countries, where they have received such designations as the '*Boutons*' of Aleppo, Biskra, Bagdad, Bussorah, and so forth.

The term 'Aurangzeb.'

Additional importance has been attached to the prevalence of the disease at Delhi from the circumstance of its being associated with the name of the celebrated Emperor Aurangzeb, who, it is popularly believed, suffered from the affection. Some even go so far as to say that it was the immediate cause of his death. In Delhi itself the affection is commonly described as "Aurangzeb" without any further qualification.

Having failed to trace any definite reason for this general belief in the works of Tavernier, who wrote minutely regarding Aurangzeb's times, or in the works of Bernier (the latter writer was for many years physician at the Court of Aurangzeb at Delhi, and nevertheless makes no mention of the Emperor having suffered from any such complaint), we consulted Professor Blochmann, the well-known Oriental scholar, and he very kindly favoured us

* "The Practitioner,"—October 1875, pages 264-267.

with the accompanying note,* from which it will be seen that, even according to all the original independent historians of this Emperor's reign, there exists no foundation for the general belief that the Emperor suffered from any special cutaneous affection.

In another communication to us Mr. Blochmann makes a suggestion as to whether the term may not have originated on account of some supposed resemblance of the sore to a kind of cloth termed 'Aurangzeb.' Be this as it may, there can be no doubt that the association of the disease with the Emperor is based on no authentic ground. Moreover, the Emperor lived far from Delhi for several years before his death. It may further be noted in connection with this matter that the Moghuls, no matter where they lived, used nothing but Ganges water for drinking and cooking purposes.

The term 'Oriental Sore' adopted.

With the view of bringing all these designations under one heading, we have in the present report adopted the term 'Oriental Sore,' which has been suggested by Dr. Tilbury Fox, but restrict our observations, as far as the pathology of the disease is concerned, to the examples of it met with in this country, especially to those found in Delhi, which are acknowledged to represent the type of the malady as it occurs in India.

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* "Muhammadan historians do not state that the Emperor Aurangzeb (or Álamgír, as Natives call him) died of Delhi sores. For his reign we have only three *independent* historical works, *viz.*, the Maásir-i-Álamgírí, Kháfi Khán, and the Tabsirat-un Názirín; and of these Kháfi Khán only gives a more detailed account of the Emperor's illness and death. He says (Edit. Bibl. Indica, II, page 539):—

Note by Professor Blochmann regarding the Emperor Aurangzeb.

"'At this time (a short time before Ramazán 1117, or January 1705) His Majesty fell seriously ill. He felt an extraordinary and most acute pain in all joints, which extended to every limb. Although he tried to keep down the sickness and continued to decide Government matters, in order not to dishearten the people, his illness continued, and when one or two fainting fits supervened, a great commotion took place among the soldiers and the camp-followers. At last, however (the Maásir-i-Alamgírí says, after ten or twelve days), His Majesty's health again improved.**** On the recommendation of Hakím Sádik Khán, His Majesty took doses of *chobchíní* (China root), and continued doing so for three or four weeks. Every day during the treatment, sums of money were given to the poor; and, when the cure was effected, the Hakím was weighed against goldmohurs, which were given to him. He also got the title of *Hakím-ul-Mulk* ('physician of the empire'). By the end of Rajab (November 1705) His Majesty moved to Bergáon.'

"But during 1118 (1706 A. D.) Aurangzeb continued ill, and his life was embittered by the hostilities that had broken out between his son A'zam Shah and Kám Bakhsh. When the two princes, after the month of Ramazán 1118 (January 1707), left the Emperor's camp for their provinces, 'the pain His Majesty suffered increased, the fever was very strong, and yet His Majesty, in spite of his illness, performed the five daily prayers.' The *Maásir* (Edit. Bibl. Indica, page 520) says: 'In the end of Shawwál 1118 (January 1707) the Emperor was again ill, and improved a little. Then followed four or five days of strong fever, and three days later he died on Friday morning, 28th Zí Ka'dah 1118' (21st February 1707).[1]

There are several other historical works, as the Tazkirah-i-Salátín-i-Chaghtái, the Siyar-ul-Mutaakhkharín, the Táríkh-i-Muzaffarí, &c., but they contain nothing new."

1 Nearly ninety years old.

CHAPTER II.

STATISTICS ILLUSTRATIVE OF THE GEOGRAPHICAL DISTRIBUTION AND PREVALENCE OF DELHI SORES AND ALLIED AFFECTIONS.

In considering the question of the etiology of the Delhi sore, it is necessary not only to obtain information in regard to the prevalence of the disease in this special locality, but to ascertain, as far as possible, to what extent similar or related forms of disease prevail, and have prevailed formerly, in other parts of the country. Unfortunately all the information attainable is, at best, very imperfect. In the statistical tables relative to the health of the European and Native Armies, sores, such as those occurring in Delhi, are entered along with a variety of other affections under the general heading of "abscess and ulcer," and in many tables under the more comprehensive one of "all other causes," along with a heterogeneous mass of minor forms of ailments causing admissions into hospital.

Necessity of acquiring information regarding prevalence of "Delhi sore" and similar forms of disease in different parts of the country.

In turning to other sources, such as the medical histories of regiments, we are again encountered by various sources of fallacy, the most important being due to the local name commonly applied to the disease. Observers are not prepared to recognise Delhi, Mooltan, Scinde, &c., sores out of the places giving the local names, so that, unless in cases where the reporter has been in such stations, no indication is afforded of the existence of such forms of disease beyond that to be gleaned from the general prevalence of ulcers, and their more or less chronic nature when this is noted.

Taking the material as it stands, the following pages show the amount of information which it appears capable of affording.

1.—Prevalence of "Abscess and Ulcer" as a cause of 'Admission into Hospital' in different places and at different times.

The following table shows the general admission rates of the European and Native Armies of Bengal, from 1861 to 1874, contrasted with those from "abscess and ulcer." The year 1861 is the date selected as a commencement, because it is the first year from

Admission rate from 'abscess and ulcer' among the troops compared with total admission rates.

which we have information regarding the native troops; but it may be mentioned here that the average total admission rate from all causes, and that from abscess and ulcer, among the Europeans for the five previous years, regarding which we have any information (1854, 1855, 1856, 1859-60), were respectively 2307·0 and 128·9 per thousand.

TABLE I.—*Total Admission rates, and Admission rates from 'Abscess and Ulcer,' of the European and Native Armies of Bengal.*

Year.	Europeans.		Natives.	
	Total admissions per 1,000.	Abscess and Ulcer per 1,000.	Total admissions per 1,000.	Abscess and Ulcer per 1,000.
1861	2045·6	114·6	1169·0	109·5
1862	1970·8	106·7	1384·5	134·6
1863	1838·4	99·7	1476·5	124·7
1864	1641·6	130·4	1388·7	149·4
1865	1605·3	119·0	1475·6	131·1
1866	1501·7	101·3	1385·8	147·8
1867	1412·5	86·4	1447·7	121·5
1868	1438·3	105·9	1175·8	105·4
1869	1729·5	94·6	1501·1	95·7
1870	1731·9	85·0	1492·3	101·7
1871	1507·7	86·3	1287·2	106·2
1872	1514·1	80·2	1496·0	93·4
1873	1349·8	80·9	1289·5	88·5
1874	1443·8	84·7	1266·5	93·7

From this table we see that there has been a very considerable diminution in the admissions from abscess and ulcer among the Europeans coincident with a great general diminution of admissions from all causes. Among the native troops the diminution under the special heading is very marked, but the general admission rate shows little, if any, sign of steady diminution. The only other diseases which have shown a considerable diminution among native troops for the same period are diarrhœa and dysentery, and they do not do so nearly so decidedly as abscess and ulcer. Having thus seen that there has been a general diminution in abscess and ulcer coincident with improved general health of the troops dependent, beyond doubt, on attention to sanitary improvement, we may next proceed to matters of more detail.

Diminution in both rates of late years.

The next table shows the relative prevalence of abscess and ulcer among the troops in different parts of the country from 1865 to 1874.

TABLE II.—*Admission rate per* 1,000 *from Abscess and Ulcer in different parts of the country.*

Year.	European Troops.							Native Troops.						Irregular Forces.	
	Bengal Proper.	Gangetic Provinces.	Rohilkund and Meerut.	Agra and Central India.	Punjab.	Hill Stations.	Bengal Presidency.	Bengal Proper and Assam.	Gangetic Provinces.	Rohilkund and Meerut.	Agra and Central India.	Punjab.	Bengal Presidency.	Punjab Irregular Force.	Central India Irregular Force.
1865	123·8	105·0	142·3	129·0	115·4	...	119·0	103·8	124·5	157·1	169·6	128·0	131·1	153·3	124·3
1866	89·1	99·5	112·6	101·1	99·9	...	101·3	157·1	127·6	174·4	173·7	133·0	147·8	139·0	116·3
1867	118·8	93·9	90·0	98·0	71·0	...	86·4	114·5	124·7	107·8	160·7	110·1	121·5	134·3	82·4
1868	135·5	114·3	98·0	107·6	97·2	...	105·9	91·8	127·8	86·1	122·6	98·6	105·4	124·4	90·7
1869	89·3	100·2	99·1	86·9	94·0	...	94·6	71·7	114·3	78·1	182·0	81·4	95·7	115·2	110·5
1870	80·7	81·5	87·6	90·8	84·4	46·5	85·0	85·1	110·2	77·3	147·6	103·6	101·7	144·1	77·2
1871	87·1	95·0	113·8	94·7	75·5	68·7	86·3	93·4	106·3	68·1	138·2	118·8	106·2	172·5	76·5
1872	78·0	99·3	93·2	63·6	77·3	50·0	80·2	82·0	93·2	75·6	154·8	91·7	93·4	146·5	94·5
1873	75·3	110·1	81·6	70·9	77·3	50·6	80·9	88·1	89·0	79·5	117·2	85·5	88·5	142·5	94·8
1874	92·2	107·3	84·9	82·0	79·8	62·5	84·7	87·5	92·3	83·5	117·7	93·0	93·7	128·4	82·7
Average for ten years	96·9	100·6	100·3	92·4	87·1	55·6	92·4	97·5	110·9	108·7	148·4	104·3	108·5	140·0	94·9
Average for first five years	111·3	102·5	108·4	104·5	95·5	...	101·4	107·7	123·7	140·7	161·7	110·2	120·3	133·2	104·8
Average for second five years	82·6	98·6	92·2	80·4	78·8	55·6	83·4	87·2	98·2	76·8	135·1	98·5	96·5	146·8	85·1

The general diminution demonstrated by the previous table is here (Table II) shown to have been due to improvement in each individual area for both European and native troops. The native troops of the Punjab frontier, in place of any diminution, show a considerable increase; but as the former table only shows the figures for the regular army, this peculiarity may be set aside for the present. Taking the figures regarding Europeans alone first, we find that the Gangetic Provinces give the highest average rate, followed successively by Rohilkund and Meerut, Bengal, Agra and Central India, the Punjab, and the hill stations. Taking the average for the ten years, Rohilkund and Meerut is almost equal to the Gangetic Provinces; but this is almost entirely due to the two first years, as the averages for the two periods of five years included in it very distinctly show.

Comparison of the admission rates from abscess and ulcer in different areas occupied by troops.

The next table shows the individual stations in which Infantry regiments have given over 70 per cent. admissions from abscess and ulcer, together with the years in which they have done so from 1865 to 1874, and the general admission rate of the station for each year. In this table the years with high ulcer rates are distinguished by the difference in the type with which the general admission rate is printed. Only Infantry regiments have been taken into account, Cavalry regiments and Batteries having been set aside on account of the small numbers of men contained in them, and as regards the Artillery, moreover, because there are no native troops of a corresponding nature.

*from Abscess and Ulcer' have occurred in European Infantry Regiments.**

Station.	Admission rate from all causes per 1,000 average strength.										Average.	Number of times in which stations have given high Ulcer-rates during ten years.
	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.		
Berhampore	...	...	...	**2283·8**	...	...	...	...	...	...	...	
Darjiling	941·0	**1173·1**	644·8	943·9	1000·0	1890·6	1121·2	929·4	561·0	1084·3	1028·9	Once.
Ranikhet	...	...	...	..	...	...	**1816·0**	1194·2	982·4	838·1	1207·6	
Solon	...	...	...	...	...	...	...	..	...	**1082·2**	1082·2	
Dugshaie	1023·6	610·4	756·5	568·1	612·0	641·7	**1256·3**	694·7	**1299·2**	711·0	817·3	Twice.
Rai Bareilly	**1098·4**	**980·0**	684·5	...	870·1	...	...	...	...	...	908·2	
Jubbulpore	2184·6	**2698·9**	**2015·8**	1308·0	2136·2	**2547·0**	1380·4	579·2	687·1	922·7	1645·9	
Jullundur	**935·6**	1636·1	652·3	**1574·6**	2632·4	**2269·1**	1142·5	1002·5	926·8	1089·4	1386·1	
Mooltan	1259·5	943·2	836·2	**1271·3**	**2059·1**	**1846·8**	1019·0	1517·4	1531·8	1147·3	1343·1	Three times.
Moradabad	**862·1**	**1239·4**	**1204·0**	715·7	935·9	812·3	1066·3	848·8	738·4	980·0	890·2	
Subathoo	**1409·3**	**1249·2**	1163·8	731·3	1200·0	690·7	920·9	**727·8**	839·4	628·8	956·1	
Bareilly	**1037·5**	**853·0**	**1012·4**	**836·5**	1208·2	790·6	794·5	1166·2	871·1	1035·5	965·2	
Delhi	**1580·0**	1230·0	1950·0	1986·0	**2262·8**	1543·7	**2162·8**	**2578·6**	1279·4	1934·6	1850·7	
Nowshera	1910·0	**2282·3**	**1452·1**	1522·6	2167·6	2762·9	3395·5	**2434·3**	2028·4	**1870·5**	2182·6	Four times.
Rawul Pindi	**1325·5**	1420·5	**1212·3**	1256·4	2472·2	2138·2	1801·8	**1157·6**	**1185·4**	1100·3	1507·0	
Seetapore	**1413·3**	961·1	747·4	978·3	1285·7	1178·6	809·1	**901·3**	**1031·7**	**1496·0**	1080·2	
Agra	1833·4	**1599·8**	**1308·2**	**993·4**	973·4	1751·6	**1380·1**	1222·3	824·4	**1434·3**	1332·0	
Ferozepore	**1507·6**	**1521·1**	**1421·8**	**1419·8**	1727·8	**1573·8**	1082·6	1165·6	1030·6	1173·1	1362·1	Five times.
Cawnpore	1443·2	1136·5	1356·1	1292·2	**1341·3**	**1764·6**	**2178·0**	**2414·2**	**1537·4**	**1443·0**	1590·6	
Dum-Dum†	**2351·4**	**2466·2**	**1118·6**	1724·3	1310·0	**1019·7**	1050·6	1403·1	**628·7**	**780·3**	1385·2	
Fyzabad	**1537·3**	**1186·8**	809·5	**819·1**	887·5	**1304·9**	880·7	989·7	**1829·1**	**1242·4**	1148·7	
Mean Meer	1273·7	1691·8	2290·3	**2109·4**	**3392·2**	**2687·3**	**1455·3**	**2498·5**	2934·3	**2273·1**	2260·5	Six times.
Morar	**1713·9**	**1853·3**	**2086·4**	**1697·7**	2485·5	**1860·6**	2360·0	**1489·8**	968·1	1219·9	1773·5	
Peshawur	**2837·4**	**1666·3**	2021·8	2028·1	2998·2	**4061·3**	**2242·6**	**2877·7**	2205·0	**2989·7**	2592·8	
Allahabad	**1220·1**	1620·6	**1628·4**	**1848·4**	**2580·2**	1578·4	1673·8	**1660·0**	**1805·4**	**1594·1**	1725·4	
Dinapore	**1574·4**	**1927·1**	**1350·6**	**1580·8**	1429·1	1197·9	**1442·2**	1875·7	**1196·4**	**1982·8**	1525·9	
Hazaribagh	**1420·7**	**1813·9**	**979·4**	1807·7	1086·9	877·7	**1384·4**	**1118·3**	**896·2**	**1088·9**	1247·4	
Roorkee	860·0	**770·0**	2350·0	**941·7**	**1849·6**	1571·4	**1651·6**	**1679·9**	**936·4**	**1075·9**	1368·6	Seven times.
Sagar	**2608·5**	**2715·8**	**2118·7**	**1682·8**	**2265·7**	**2031·7**	**1718·1**	1559·2	1427·1	1929·5	2005·7	
Shajehanpore	**1820·4**	**1410·6**	**1440·7**	**723·1**	**639·6**	**883·5**	**2178·6**	900·0	777·3	..	1197·0	
Sialkote	**1135·0**	**1253·6**	**1303·5**	**1238·2**	6541·6	**1668·0**	1154·2	1471·9	**1319·6**	**1109·8**	1319·5	
Umballa	**1678·4**	**1208·3**	**1231·0**	**1497·9**	1355·9	**1482·9**	1234·5	1319·6	**1468·3**	**1628·4**	1410·5	
Fort William	**1712·3**	1660·5	**1760·5**	**1355·5**	**983·4**	**1289·1**	**1230·0**	**1980·7**	**1353·9**	840·7	1416·6	
Jhansi	**1965·5**	1832·7	2225·3	**1989·2**	**3257·0**	**2946·3**	**3042·3**	**2688·3**	**2183·5**	**2154·2**	2428·4	Eight times.
Meerut	**1886·7**	**1377·9**	**1511·1**	**1270·4**	**1411·0**	**1593·7**	**1995·1**	**1972·9**	1575·4	2739·6	1733·3	
Benares	**2360·7**	**1660·5**	**1788·2**	**1402·7**	**1484·2**	**1377·9**	1262·6	**1466·5**	**1088·6**	**1577·4**	1546·9	Nine times.
Lucknow	**1184·7**	**1230·3**	**1143·2**	**1223·4**	**1204·0**	**1410·8**	**1094·4**	**1496·3**	**1296·7**	1298·4	1258·2	
Total Stations giving 70 per 1,000 of admissions from Abscess and Ulcer.	25	23	20	20	13	19	15	17	16	17	...	
Average admission rate from All Causes.	1555·8	1496·4	1399·2	1343·5	1795·5	1668·0	1531·7	1499·6	1271·8	1398·3	...	

* The years which gave a high rate of Admissions from 'Abscess and Ulcer' at the several stations are distinguished by the figures of the Admission-rate from 'All Causes' being printed in larger type.

† The Regiments at Dum-Dum, as a rule, supplied detachments to Berhampore until June 1870; consequently the returns of the two stations are usually includedin this statement up to that date.

Relative liability of different stations to show a high prevalence of abscess and ulcer among the troops occupying them.

The table also shows the average admission rate, from all causes, of each station for the ten years, and the average admission rate of all stations for each year. The stations are arranged in groups according to the number of years in which the admission rates of regiments in them from abscess and ulcer attained or exceeded 70 per 1,000. This number varies from one year in the case of certain hill stations to nine in Benares and Lucknow. It will be seen that during the period under review there has been a considerable diminution in the number of stations, giving 70 and upwards per 1,000 admissions in any individual year. It also appears that there is no necessary correspondence between the average total admission rate of any station and the prevalence of abscess and ulcer in it. Lucknow, for example, with a very low average total admission rate, is one of two stations giving excessive admissions from abscess and ulcer in nine of the ten years. It is, moreover, not necessarily the case that in any individual station the years of highest general admission rate should coincide with those giving the highest admission rates from abscess and ulcer and *vice versâ.*

The next table shows the same stations arranged as before in order of frequency of high prevalence of abscess and ulcer, but in addition contains the actual rates and the individual regiments giving these in each year.

TABLE IV.—*Stations at which the Admission rates from Abscess and Ulcer in European Infantry Regiments have been* 70 *per* 1,000 *and upwards, with the Years, Regiments, and actual Rates.*

Station.	Regiment.	Admission rate from Abscess and Ulcer per 1,000.									
		1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873	1874.
Berhampore*	2-25th Wing	...	...	...	110	...	...	...	...	...	...
Darjiling	58th Head-Quarters	...	106	...	...	...	...	...	...		...
Ranikhet	2-1st Wing	...		...	...	...	...	140		...	...
Solon	36th Wing	...	...	...	...	...	...	...	...	..	77
Dugshaie	85th	...	...	...	...	...	...	78	...	...	...
	37th	...	...	...	...	...	...	...	...	102	...
Rai Bareilly	2-12th Wing	116	107	...	...	...	...	...	...	...	...
Jubbulpore	1-23rd	...	75	113	...	...	...	...	...	...	...
	2-12th	...	...	...	...	...	70	...	...	..	...
Jullundur	1-19th	73	...	...	...	...	...	...	...	...	...
	92nd	...	...	...	113	...	95	...	...	...	...
Mooltan	109th	...	...	...	141	208	106	...	...	...	...
Moradabad	36th	86	105	98	...	...	...	...	...	...	...
Subathoo	38th	308	142	...	...	...	...	...	..	...	...
	2-12th	...	..	...	...	...	...	...	73	...	...
Bareilly	77th	83	88	...	...	...	...	...	...	...	...
	37th	...	...	106	88	...	...	...	...	...	...
Delhi	98th Wing	93	...	..	...	...	...	...	...	...	...
	79th „	...	...	...	...	89	...	...	...	...	...
	109th „	...	...	...	...	...	...	208	102	...	...
Nowshera	90th	...	81	...	...	...	...	...	..	...	...
	1-19th	...	...	80	...	...	...	...	...	...	...
	2-60th	...	...	...	...	...	...	...	76	...	...
	39th	...	...	...	...	...	...	...	...	...	79
Rawul Pindi	42nd	77	...	...	...	...	...	...	...	...	...
	3rd Battalion Rifle Brigade	...	...	74	...	...	...	...	...	...	...
	70th	...	...	...	...	...	...	...	95	71	...
Seetapore	2-12th Head-Quarters	95	...	...	...	...	...	...	...	...	...
	1-3rd „	...	...	...	...	...	...	...	79	97	...
	1-14th „	...	..	...	...	...	...	...	...	...	90
Agra	41st	...	104	82	80	..	...	...	...	...	...
	65th	...	...	...	...	...	...	111	...	...	...
	59th	...	...	...	...	...	...	...	...	...	77
Ferozepore	1-7th	109	...	...	...	...	...	...	...	...	...
	97th	...	226	...	...	...	...	...	...	...	...
	1-5th	...	...	118	86	...	...	...	...	.	...
	39th	...	...	...	...	...	77	...	...	...	..
Cawnpore	1-14th	...	...	...	...	130	95	98	...	...	...
	1-8th	...	...	...	...	...	...	...	83	104	...
	73rd	...	...	...	...	...	...	...	...	...	115
Dum-Dum†	55th	99	...	...	...	...	...	...	...	...	...
	91st	...	82	...	...	...	...	...	...	...	...
	27th	...	...	72	...	...	...	...	...	...	...
	96th	...	...	...	...	...	73	...	...	...	...
	62nd	...	...	...	...	...	...	.	...	74	72
Fyzabad	1-11th	126	89	...	70	...	...	...	...	...	...
	26th	...	...	...	...	...	72	...	...	...	...
	51st	...	...	...	...	...	...	...	...	88	104
Mean Meer	85th	...	...	...	122	108	118	...	...	...	...
	37th	...	...	...	...	...	...	77	118	...	...
	36th Head-Quarters	...	...	...	...	...	...	...	...	...	109
Morar	34th	701	113	...	...	...	...	...	...	...	...
	103rd	...	...	89	89	...	...	...	...	...	...
	1-11th	...	..	...	...	...	76	...	76	...	...

* Separate admission rate only given for 18618.

† Supplied detachments to Berhampore unti Jun1870.

Stations at which the Admission rates from Abscess and Ulcer in European Infantry Regiments have been 70 *per* 1,000 *and upwards, with the Years, Regiments, and actual Rates*—continued.

Station.	Regiment.	Admission rate from Abscess and Ulcer per 1,00.									
		1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	18740
Peshawur ...	51st	78	...	...	...	...	...	...	...	...	...
	90th	117	...	...	...	...	...	...	...	...	...
	1-19th	...	118	...	...	...	...	...	...	..	...
	38th	...	...	..	...	...	70	...	...	...	...
	1-6th	...	...	...	..	...	...	103	71	...	...
	2-60th	...	...	...	...	...	...	85	...	...	...
	1-17th	...	...	...	...	...	...	...	...	...	85
	72nd	...	..	...	...	...	...	...	...	...	90
Allahabad ...	107th	84	...	100	119	...	...	...	...	...	...
	58th	...	...	...	...	74	...	...	...	...	...
	2-19th	...	...	...	...	...	...	...	112	149	122
Dinapore ...	1-20th	80	...	...	...	...	...	...	..	...	..
	105th	..	183	207	105	...	...	...	...	...	...
	96th	...	...	...	...	...	...	87	...	73	...
	109th	...	...	...	...	...	...	...	...	...	94
Hazaribagh...	27th	96	77	...	...	...	...	...	...	...	...
	91st	...	...	79	...	...	...	...	...	...	...
	63rd	..	...	...	...	..	...	71	115	123	...
	2-22nd	...	...	...	...	...	...	...	...	...	118
Roorkee ...	98th eHad-Quarters ...	...	92	...	...	...	...	...	...	...	...
	79th „ ...	..	...	...	87	77	...	...	...	...	...
	109th „ ...	...	...	...	...	...	...	129	104	83	...
	55th „ ...	..	...	...	...	...	...	...	...	...	85
Sagar ..	97th	162	...	...	...	..	...	..	...	...	...
	1-7th	...	98	106	109	76	...	...	...	...	...
	1-19th	...	...	...	...	...	105	75	...	...	...
Shajehan-pore ...	36th Head-Quarters ...	188	99	95	...	...	...	...	...	...	...
	2-25th „ ...	...	..	...	80	...	...	...	...	...	...
	37th „ ...	...	...	..	...	71	131	...	...	...	...
	2-1st „ ...	...	...	...	...	...	...	121	...	...	...
Sialkote ...	93rd	168	115	...	...	...	...	...	...	...	...
	38th	...	...	85	105	...	...	...	...	...	...
	58th	...	...	...	...	...	103	...	...	...	...
	1-6th	...	...	...	...	...	...	...	...	75	80
Umballa ...	94th	126	82	79	...	...	...	...	...	...	...
	106th	...	...	..	101	...	110	...	...	...	...
	72nd	...	...	...	...	...	...	...	...	80	...
Fort William	4th Battalion Rifle Brigade ...	...	...	...	..	...	...	...	...	...	100
	54th	85	...	...	...	...	...	...	...	...	...
	2nd Battalion Rifle Brigade ...	...	85	...	...	...	...	...	...	...	...
	2-60th	...	...	...	102	..	...	...	...	...	...
	26th	...	...	...	...	90	...	...	...	...	...
	2-19th	...	...	...	...	...	86	97	...	...	...
	1-14th	...	...	...	...	...	...	...	70	70	...
Jhansi ...	104th	97	...	...	...	...	...	...	..	...	...
	93rd	...	...	...	88	84	...	...	...	...	...
	2-1st	...	...	...	...	...	71	...	...	...	...
	106th	...	...	...	...	...	...	73	80	105	...
	63rd	...	...	...	...	...	...	...	...	...	111
Meerut ...	2nd Battalion Rifle Brigade 131	96	...	...	...	...	...	...	...	...	...
	1-3rd	...	...	85	99	...	...	...	...	...	...
	105th	...	...	...	...	79	77	70	87	...	...
Benares ...	58th*	147	88	266	115	...	...	...	...	...	...
	2-60th Wing	...	...	...	...	130	120	...	...	...	...
	1-3rd	...	...	...	...	...	...	...	108	125	...
	1-14th	...	...	...	...	...	...	...	...	...	110
Lucknow ...	46th	91	125	95	...	...	...	...	...	...	...
	55th	...	78	80	77	...	...	...	...	...	...
	102nd	...	...	...	112	86	...	...	...	...	...
	62nd	...	...	...	...	131	103	108	83	...	...
	1-17th	...	...	...	...	...	133	98	116	86	...
	40th	...	...	...	...	...	...	...	...	134	...

* Only one wing from 1866.

While the previous table showed a diminution in the annual numbers of affected stations, this shows a corresponding diminution in number of affected regiments; but it also shows a marked diminution in the average annual admission rate for these. The average admission rate for the 26 regiments appearing in the column for 1865 is 118 per 1,000; that for the 18 regiments in 1874 is only 95 per 1,000.

Diminution has occurred both in number of regiments giving high rates and in the rates themselves.

In order, as far as possible, to complete our information, three more points remain to be considered, and these are—the general health of the regiments in the years they show high ulcer rates as evinced by their total admission rates, their history as regards admission rates from abscess and ulcer, and the nature of the locality from which they had come to any station in which abscess and ulcer prevailed among them.

Necessity of information regardng general history of regiments as to health and previous stations.

The statistics show that although, as a general rule, high admission rates from the special cause concur with high general admission rates, still, as in regard to stations and years so in regard to regiments, there is no necessary coincidence; it is not invariably those years in which the regiments show highest general admission rates that they show high ulcer rates, nor those with lowest admission rates in which they show relative exemption.* All the facts go to prove the existence of some special causation beyond mere general condition as regards health.

High total admission and high ulcer rates generally coincide, but not necessarily so.

In Table V the stations are arranged according to the frequency with which they occur as antecedent localities—as localities in which regiments had been immediately previous to coming to the stations in which they suffered specially from prevalence of abscess and ulcer, and which may, therefore, be supposed to have exerted some predisposing or causative influence on such prevalence. Of all these localities England stands out conspicuously, occurring more than three times as frequently as

Stations considered as predisposing localities. Frequency of high ulcer rates in regiments new to the country.

* A Table illustrative of this point will be found printed in the Edition of this Report which appeared in the Twelfth Annual Report of te Sanitary Commissioner with the Government of India, page 145.

any of even the highest of the others do. Owing to the vagueness of the nomenclature more cannot be said regarding this than that it certainly demonstrates the influence of previous localities on the production of the diseases included under the general term, and that it probably, partially at all events, explains the extreme prevalence of such forms of disease in stations such as Lucknow in which regiments new to the country are frequently located. The prevalence of such forms of disease among new arrivals may also probably explain many of the cases in which low total and high special admission rates coincide.

TABLE V.—*Table showing the immediately previous Stations of the Regiments which furnished 70 per 1,000 and upwards of Admissions from Abscess and Ulcer.*

Previous Station occurring once during the ten years.	Previous Station occurring twice.	Previous Station occurring three times.	Previous Station occurring four times.	Previous Station occuring five times.	Previous Station occurring seven times.	Previous Station occurring twenty-three times.
Abyssinia.	Allahabad.	Benares.	Bombay Presidency.	Mean Meer.	Peshawur.	England.
Agra.	Bareilly.	Delhi.	Fort William			
Berhampore.	Dinapore.	Dum-Dum.	Luckow.			
Ceylon.	Dugshaie.	Hazaribagh.				
Darjiling.	Jubbulpore.	Nusserabad.				
Ferozepore.	Madras.	Rawul Pindi.				
Fyzabad.	Nowshera.	Seetapore.				
Jhansi.	Roorkee.	Umballa.				
Jullundur.	Sialkote.					
Kamptee.						
Kussowlie.						
Meerut.						
Mooltan.						
Rai Bareilly.						
Sagar.						
Shajehenpore.						
Subathoo.						
17	9	8	3	1	1	1

Illustrations of stations playing the part of predisposing localities.

Comparing the last two tables with one another, the influence of previous localities is also illustrated by cases such as those of the 38th in Subathoo in 1865-66, and of the 85th and 37th in Dugshaie in 1871 and 1873. In regard to the 38th in 1865, it is specially noted that many of the admissions were due to Delhi sore, the regiment having been in Delhi during the previous year, and having suffered there severely from the disease. With regard to the 85th and 37th the influence of Mean Meer is hardly less distinct. The necessity for taking the history of individual regiments into account is also very clearly brought out by the case of the 109th. It is only during the years in which this regiment was in Mooltan

that that station appears as giving a high admission rate from abscess and ulcer, and it is only in connection with it that it appears as an antecedent station.

Influence of newness to the country necessarily not so important an agent in the case of native regiments.

In considering the characters of stations as illustrated by the figures regarding natives, we are free from the fallacies dependent on any such great change in climate and conditions of life as that to which Europeans are subject in coming newly to the country. The change, however, to which natives of localities far up country are exposed in coming to stations in the lower provinces is very considerable, and one might naturally look for a result similar in kind, though perhaps not in degree, to that occurring in newly-arrived Europeans. In fact, however, no evidence of any such effect can be traced. On the contrary, the stations in Lower Bengal and Assam give an admission rate very considerably lower than that for any other area (Table II).

Relative exemption from abscess and ulcer of native troops in Bengal Proper.

During the first three years of the period the admission rate was considerably higher than it has been since, due to the very high admission rates of the regiments connected with the Bhutan war. When the Eastern Frontier stations are excluded from consideration, the admission rate is very much diminished, the average for the ten years being only 78·8, and that for the nine last years only 73·3 per 1,000.[1]

[1] The following are the detailed Annual Rates for comparison with those including the Frontier stations in Table II:—

Showing low admission rate from Abcess and Ulcer in Bengal

Year.	Admission rate for all Regiments, except those on the Frontier.
1865	128
1866	72
1867	93
1868	94
1869	56
1870	80
1871	55
1872	66
1873	72
1874	72
Average	78·8 (or 73·3 for the last nine years.)

So far as general health is concerned, Bengal comes second highest in admission rate, the order being Agra and Central India, Bengal, Punjab, Gangetic Provinces, Rohilkund and Meerut. The order by fever rate is different, being Agra and Central India, Punjab, Bengal, Gangetic Provinces, and Rohilkund and Meerut.

The average, then, for the entire period is very much lower than that of the other areas, the next, that of the Punjab, being 104·3. The averages of the respective areas for the ten years are consistently higher for native than for European troops. The difference for Bengal is, however, very trifling; and if the comparison be confined to the area occupied by both sets of troops by excluding the Frontier stations, the average comes out very greatly in favour of the native troops;—the European average being 96·9, whilst that of the natives is only 78·8 per 1,000.

Averages for ten years period higher for natives than for Europeans in all areas save Bengal Proper.

The following table shows the order in which the various areas range as regards both sets of troops during the first and second five years' periods included between 1865 and 1874, the Eastern Frontier being excluded:

TABLE VI.—*Showing Areas and Troops, according to order of average prevalence of Abscess and Ulcer, during two periods of 5 years.*

First Period.		Second Period.	
Areas and Troops.	Rates.	Areas and Troops.	Rates.
Bengal, Natives ...	88·6	Hill Stations, Europeans	55·6
Punjab, Europeans ...	95·5	Bengal, Natives ...	69·0
Gangetic Provinces, Europeans	102·5	Rohilkund and Meerut, Natives	76·8
Agra and Central India, Europeans	104·5	Punjab, Europeans ...	78·8
Rohilkund and Meerut, Europeans	108·4	Agra and Central India, Europeans ...	80·4
Punjab, Natives ...	110·2	Bengal, Europeans ...	82·6
Bengal, Europeans ...	111·3	Rohilkund and Meerut, Europeans ...	92·2
Gangetic Provinces, Natives	123·7	Gangetic Provinces, Natives... ...	982
Rohilkund and Meerut, Natives	140·7	Punjab, Natives ...	98·5
Agra and Central India, Natives	161·7	Gangetic Provinces, Europeans	98·6
		Agra and Central India, Natives	135·1

These periods are too short to allow of instituting comparisons on the differences presented by them, but there are some curious differences exhibited by the European and native troops in regard to some areas in both periods which are worthy of being noted. In both periods Bengal furnishes a very low admission rate for natives, whilst in the case of the Europeans it furnished the highest admission rate for the first period, and occupied a middle position in the second one. Agra and Central India, on the other hand, occupies a very different position in the scale for natives—for whom in both periods it appears as the area giving highest admissions—from what it does in the case of the Europeans, with whom it occupies a middle position for the first period, and the second exclusive of hill stations in degree of exemption in the latter one.

Differences exhibited by certain areas in reference to European ascompared with native troops.

In comparing the admission rates of natives and Europeans, and observing the general greater prevalence of such forms of diseases as are included under the head of abscess and ulcer among the latter, much influence may be, and often has been, ascribed to the injurious effects of badly fitting boots of European pattern on the unprotected feet of the natives as accounting for a great part of the prevalence of such disease among them, and for its excessive prevalence in certain stations among them as compared with the European troops. Badly fitting boots may, or rather must, form efficient exciting causes for the local development of ulcers; but the figures contained in these tables do not warrant a belief in their being endowed with any more important influence on the causation of the disease. The native troops in Bengal Proper wear boots as well as those in other parts of the country, and yet the prevalence of abscess and ulcer throughout a prolonged period remains consistently lower than that of the Europeans in these localities.

Bad fitting boots, &c., can only act as exciting causes for the development of ulcers.

Before leaving the questions specially affecting the native troops, there are a few points in connection with the Punjab Frontier which appear to call for notice. The average admission rate for the regiments there for the ten years period is very high, and, unlike the rest of the areas, it shows a higher rate for the second five years than for the first—in other words, it shows no evidence of any tendency

Excessive prevalence of abscess and ulcer on the Punjab Frontier.

to diminution in the prevalence of such forms of disease as the other areas do. This being the case, is there anything to explain the matter? Are the conditions of the area such that no improvement is possible or to be looked for? At the outset it must be allowed that the stations on the frontier are generally very unhealthy, the troops almost invariably showing a very high total admission rate. We have, however, already seen that prevalence of abscess and ulcer cannot be regarded as the direct result of general unhealthiness of a station or regiment, so that allowing it all due weight as indirectly influential, some more special condition must yet be sought for. That the excessive prevalence is really not inevitable appears probable from what we find to be the case in Mooltan, which in locality and general conditions so closely resembles the Frontier stations in many respects.

The following table shows the admission rates from abscess and ulcer for European and native troops in Delhi and Mooltan:

TABLE VII.—*Admission Rates from Abscess and Ulcer in Delhi and Mooltan compared with those in their respective Provinces.*

Year.	Europeans.				Natives.			
	Delhi.	Rohilkund and Meerut.	Mooltan.	Punjab.	Delhi.	Rohilkund and Meerut.	Mooltan.	Punjab.
1865 ...	90	142·3	55	115·4	148·7	157·1	92	128·0
1866 ...	107	112·6	80	99·9	244·8	174·4	151	133·0
1867 ...	68	90·0	48	71·0	135·9	107·8	150	110·1
1868 ...	66	98·0	125 *	97·2	47·6	86·1	111	98·6
1869 ...	92	99·1	182 *	94·0	128·8	78·1	78	81·4
1870 ...	55	87·6	97 *	84·4	144·4	77·3	178	103·6
1871 ...	195	113·8	66	75·5	104·7	68·1	102	118·8
1872 ...	86	93·2	63	77·3	88·6	75·6	80	91·7
1873 ..	50	81·6	62	77·3	63·2	79·5	109	85·5
1874 ...	69	84·9	79	79·8	106·5	83·5	109	93·0
Average	87·8	100·3	85·7	87·1	121·3	108·7	116	104·3

* These high figures are entirely due to the 109th Regiment. The Artillery for the same years gave 69, 82, and 65 per 1,000, which would reduce the average to 66·9.

The facts with regard to the 109th appear parallel with those of the 38th in Subathoo.

The figures for Europeans in Delhi and Mooltan are below those of their respective districts. For natives the reverse is the case. It cannot then be any general condition that is the cause; it must be one to which the natives are more exposed.

Comparison of the rates furnished by European and native troops in Mooltan.

Confining our attention at present to the figures relative to the latter station, we find that whilst the average admission rate from abscess and ulcer for native troops there is very high, approaching that of the Frontier stations, and considerably in excess of the average for the Punjab, the average admission rate for European troops is low, less, as it stands, than that for the Punjab, and very greatly less than that when the rates are corrected by excluding the excess due to one regiment, the 109th. There must be something connected with the conditions of the two sets of troops quite apart from the general conditions of the station as to climate, &c., to account for this striking difference.

Comparison of the facts regarding high rates exhibited by the North-West and North-East Frontier.

It is a matter of interest in connection with this subject to compare the admission rates of the regiments on the North-East and North-West Frontiers with those of the troops immediately adjoining them in locality. In both cases the Frontier rates are excessive as compared with the others. Taking the averages for the last five years, we find them to stand thus :

North-East Frontier.	Bengal.	North-West Frontier.	Punjab.
97·4	69·0	146·8	98·5

These figures are very curious. Of course it cannot be maintained that the exact forms of disease are identical for the four areas, as the nomenclature is too vague to allow of any determination of the extent to which this is the case ; but the figures at all events show that, as a feature common to them, Frontier stations present an excessive prevalence in the forms of disease included by the terms abscess and ulcer. It would be hard to find any two regions more opposed to one another in many respects than the North-East and North-West Frontiers. The stations present hardly any common features, save that they are generally unhealthy ; that special forms of disease, such as abscess and ulcer, are very much more prevalent in the troops there than in neighbouring areas ; and that no European troops are present in them. How far this last fact may explain the excessive prevalence it is impossible to determine definitely at present ; but it appears probable that less attention to sanitary improvement at places where no European troops are quartered may, perhaps, account for it.

The previous tables have shown that the prevalence of abscess and ulcer is dependent on some cause distinct from the mere general condition of health of troops; that general unhealthiness does not necessarily cause great prevalence of such disease, nor healthiness necessarily secure exemption: it now remains to be seen to what extent the statistics are capable of affording more definite information. In proceeding to examine the possible special causes for the prevalence more closely, it appears that one condition or set of conditions on which importance has frequently been laid, namely, those giving rise to the so-called malarial fevers, may be set aside. The figures clearly show that malaria, as indicated by prevalence of such fevers, is not the determinant cause of the prevalence of abscess and ulcer. This cannot be better illustrated than by comparing the stations of Lucknow and Nowshera.

Malaria does not determine prevalence of abscess and ulcer.

TABLE VIII.—*Comparison of Admission rates from Fever and Abscess and Ulcer of Europeans in Lucknow and Nowshera.*

Year.	Lucknow.			Nowshera.		
	Total Admission rate.	Fever.	Abscess and Ulcer.*	Total Admission rate.	Fever.	Abscess and Ulcer.
1865 ...	1184·7	382·3	91	1910·0	1067·1	56
1866 ...	1230·3	198·1	100	2282·3	1202·4	81
1867 ...	1143·2	186·2	88	1452·1	959·0	80
1868 ...	1223·4	153·9	95	1522·6	929·5	69
1869 ...	1204·0	211·1	111	2167·6	1506·6	32
1870 ...	1410·8	376·5	112	2762·9	2136·1	55
1871 ...	1094·4	219·0	103	3395·5	2591·4	43
1872 ...	1496·3	185·5	103	2434·3	1588·7	76
1873 ...	1296·7	336·6	110	2028·4	1194·3	58
1874 ...	1298·0	310·8	48	1870·5	1189·7	79
Average ...	1258·1	246·0	96·1	2182·6	1256·4	62·9

* Calculated from Infantry Regiments only.

As far as European troops are concerned, the illustration is liable to a fallacy, owing, as has been previously noted, to the excessive liability of new arrivals in the country to abscess and ulcer. Taking the native troops, however, this is avoided, and on doing so we arrive at similar results. During the six years from 1869, from which year Nowshera was occupied by native troops, we find the results as below :

	Lucknow.	Nowshera.
Average fever rate for six years ...	453·3	1031·7
Average abscess and ulcer for six years ...	128·3	94·1

The same thing is demonstrated on a large scale by the statistics of the European Armies of Madras and Bengal, as shown in the following statement relative to the four years from 1871 to 1874 :

TABLE IX.—*Admission rates of European troops in the Armies of Bengal and Madras compared.*

Year.	Army of Bengal.			Army of Madras.		
	Total.	Fevers.	Abscess and Ulcer.	Total.	Fevers.	Abscess and Ulcer.
1871 ...	1507·7	590·5	86·3	1193·2	167·1	122·4
1872 ...	1514·1	495·9	80·2	1357·4	267·7	123·6
1873 ...	1349·8	516·1	80·9	1270·6	236·8	108·7
1874 ...	1443·8	552·8	84·7	1143·9	187·1	103·0

No evidence furnished by the statistics in favour of influence of organic impurities in water on the production of such disease.

The question of the influence of water in producing such diseases will be more fully entered upon in connection with the special facts regarding Delhi, and our own observations there; but the general statistical results regarding the prevalence of them over the country at large go so far, at all events, as to give no support to theories which regard the organic impurities of water as of paramount importance. There is nothing in the general distribution of the disease as illustrated by these figures to justify any such views, and there are some facts, such as the persistent and marked comparative exemption of the native troops in Lower Bengal, which seem entirely opposed to them.

2.—Facts regarding the occurrence of Sores among the troops at Delhi.

The special facts relative to the occurrence of abscess and ulcer among troops in Delhi remain to be considered. The

following table (Table X) shows the total admission rates of the Native and European troops, with the ratios contributed by the main causes of admissions. The portion referring to the Europeans begins from the year 1859, that for Natives only from 1864, as that is the earliest date for which detailed information regarding them is attainable.

An additional column is added in both cases from the year 1865, in which the rates of admission from abscess and ulcer are stated separately in place of being included along with others under "All other causes."

Ulcer rate in Delhi much higher for native than European troops.

Most of the features presented by this table are just repetitions on a small scale of those shown in the previous tables in regard to the distribution and prevalence of diseases of this class over the country at large, such as the general tendency to diminution of the special admission rate with diminished total rate, the absence of any necessary coincidence between high general admission rate, or high fever rate, with high ulcer rate in any special year, &c. The most important thing in the table is the demonstration it contains of the existence in Delhi of a much higher ulcer rate for Native than for European troops, the average rates for the ten years' period from 1865 to 1874 being—

European Troops.	Native Troops.
87·8	121·3

The previous tables have shown that such a relation between the rates is not necessary or invariable; in Bengal, for example, we found the reverse to be the case, and we are therefore justified in coming to the conclusion that there is something special in the conditions of the native as compared with the European troops in Delhi, which renders them specially liable to such disease.

Parallel between facts in Delhi and Mooltan.

It is interesting to note the parallel exhibited by Mooltan to Delhi in regard to the occurrence of abscess and ulcer among European as compared with Native troops: *vide* Table VII. Both stations show an admission rate from abscess and ulcer considerably below the provincial average for Europeans, and considerably in excess of the same for natives.

The next and last table (No. XI) shows the total admission rates, and those from fever and abscess and ulcer, of each body of troops for each year of the ten years' period.

TABLE X.—*Admission rate in Delhi per* 1,000.

Year	European Troops.													Native Troops.											
	Cholera.	Heat Apoplexy.	Fevers.	Dysentery.	Diarrhœa.	Hepatitis.	Ophthalmia.	Rheumatism.	Venereal diseases.	Diseases of respiratory organs.	All other causes.	Total.	Abscess and ulcer.	Cholera.	Fevers.	Dysentery.	Diarrhœa.	Hepatitis.	Spleen.	Ophthalmia.	Rheumatism.	Venereal diseases.	Diseases of the respiratory organs.	All other causes.	Total.	Abscess and ulcer.
1859	2·1	6·4	665·7	67·9	104·3	41·4	100·0	90·7	539·3	80·0	551·4	2249·2														
1860	1·9	...	647·1	56·0	113·9	48·5	82·2	165·2	413·6	77·5	633·1	2239·0													
1861	74·5	...	766·6	136·6	247·6	57·7	119·8	63·0	656·0	45·2	394·0	2561·0													
1862	...	1·7	958·1	49·6	87·1	50·4	94·0	59·0	377·0	51·3	483·7	2211·9													
1863	...	7·5	1175·4	49·7	158·4	55·3	79·7	85·4	294·5	105·1	561·9	2569·3													
1864	...	2·1	904·6	46·7	76·8	77·8	76·8	61·2	379·6	70·5	681·5	2377·6	...	...	954·3	87·7	21·9	...	16·5	11·0	51·2	43·9	67·6	1252·3	2506·4	...
1865	...	9·2	594·5	39·2	66·8	25·3	13·8	78·4	345·6	80·7	336·4	1589·9	90	...	432·9	35·7	25·5	5·1	...	13·6	57·7	39·0	50·9	419·4	1079·8	148·7*
1866	2·7	2·7	397·4	42·1	50·0	42·1	36·8	71·0	355·2	92·1	315·8	1407·9	107	...	335·5	4·8	34·8	...	...	23·7	63·3	26·9	33·2	392·4	914·6	244·8
1867	2·9	...	720·8	65·5	136·8	54·1	14·2	111·1	165·2	74·1	324·8	1669·5	68	1·6	635·9	34·0	68·0	...	11·3	9·7	29·1	16·2	24·3	228·1	1058·2	135·9
1868	...	10·0	1179·4	29·9	83·1	122·9	23·2	122·9	166·1	156·1	501·7	2395·3	66	2·9	1028·8	33·1	36·0	...	40·4	2·9	31·7	23·1	15·8	344·4	1559·1	47·6
1869	...	24·9	1309·4	71·8	99·4	74·6	13·8	77·4	127·1	121·5	428·2	2348·1	92	...	1189·7	59·6	51·7	...	28·2	7·8	23·5	15·6	29·8	473·4	1879·3	128·8
1870	...	5·9	731·6	59·0	53·1	67·8	50·9	61·9	277·3	85·6	271·4	1619·5	55	1·5	1620·5	69·3	54·2	3·0	9·0	1·5	37·7	9·0	31·6	238·0	2075·3	144·4
1871	...	...	839·7	62·2	110·0	19·1	12·0	71·8	308·6	55·0	540·7	2019·1	195	2·9	1114·5	47·8	30·4	1·5	1·5	5·8	36·2	10·1	23·2	279·7	1553·6	104·7
1872	...	1·8	1057·1	47·9	117·9	75·5	14·7	103·1	195·2	70·0	430·9	2401·4	86	...	791·2	68·6	35·1	...	7·6	10·7	36·6	41·1	18·3	192·1	1404·0	88·6
1873	...	6·3	664·6	48·5	78·1	90·7	21·1	57·0	128·7	97·0	377·6	1569·6	50	...	925·0	36·8	27·6	...	4·6	9·2	12·2	16·8	26·0	154·7	1212·9	63·2
1874	...	5·6	1282·8	13·1	78·7	18·7	11·2	76·8	108·6	82·4	353·9	2031·8	69	...	961·7	51·1	17·6	3·2	12·8	9·6	46·3	30·3	102·2	246·0	1480·8	106·5

* These figures are derived from Dr Bryden's Statistical Tables. They refer to Infantry Regiments only; no particulars regarding the detachments of Cavalry being attainable.

TABLE XI.—*Total Admission rates, and those from Fevers, and Abscess and Ulcer, of the individual Regiments, &c., at Delhi since* 1865.

Year.	Regiment, &c.	Total admission rate per 1,000.	Abscess and ulcer per 1,000.	Fevers per 1,000.
1865 ...	98th Regiment, Wing ...	1580·0	93·9	618·1
	25th Native Infantry* ...	970·0	148·7	382·9
1866 ...	98th Regiment, Wing ...	1230·0	60·1	322·7
	XXV Brigade, 2 Bat., Royal Artillery ...	1660·0	328·3	447·1
	25th Native Infantry ...	910·0	244·8	335·4
1867 ...	79th Regiment, Wing ...	1950·0	50·1	829·4
	XXV Brigade, 2 Bat., Royal Artillery ...	1480·0	158·7	428·5
	25th Native Infantry ...	1000·0	135·9	558·2
1868 ...	79th Regiment, Wing ...	1986·0	63·1	889·4
	XXV Brigade, 2 Bat., Royal Artillery ...	2204·1	61·2	632·6
	17th Native Infantry ...	1460·0	47·6	1030·7
1869 ...	79th Regiment, Wing ...	2262·8	89·7	1237·1
	XXV Brigade, 2 Bat., Royal Artillery ...	2636·3	127·2	1400·0
	17th Native Infantry ...	1780·0	128·8	1202·2
1870 ...	103rd Regiment, Wing ...	1543·7	47·6	2710·3
	XXIV Brigade, 1 Bat., Royal Artillery ...	1876·7	82·1	876·1
	17th Native Infantry ...	2111·8	144·4	1625·7
1871 ...	109th Regiment, Wing ...	2162·8	208·5	922·8
	XXIV Brigade, 1 Bat., Royal Artillery ...	1797·5	126·5	455·6
	17th Native Infantry ...	1577·8	104·7	1146·0
1872 ...	109th Regiment, Wing ...	2578·6	102·5	1166·2
	XXIV Brigade, 2 Bat., Royal Artillery ...	1970·6	19·6	676·4
	20th Native Infantry ...	1359·5	88·6	752·5
1873 ...	109th Regiment, Wing ...	1279·7	54·4	480·1
	XXIII Brigade, 2 Bat., Royal Artillery ...	2242·1	31·5	848·2
	20th Native Infantry ...	1123·1	63·2	836·9
1874 ...	55th Regiment, Wing ...	1934·6	59·0	1263·7
	XXIII Brigade, 2 Bat., Royal Artillery ...	1741·6	123·5	943·7
	20th Native Infantry ...	1407·2	106·5	879·7

* No separate details are given regarding the detachments of Native Cavalry at Delhi, the returns regarding the men there being included in those of the regiment to which they belong.

3.—The special local conditions at Delhi possibly bearing a causative relation to the Sore: the Water-supply.

Having, then, ascertained that there must be some local condition in Delhi tending to produce 'abscess and ulcer,' and a condition to which the native troops are more exposed than the Europeans, we have next to endeavour to ascertain to what extent these statistics indicate the occurrence of the special form of disease known as 'Delhi sore' among the troops, and whether it occurs more among the native than the European troops.

Delhi sore only began to prevail among the troops subsequent to their location within the city walls.

Although the existence of a peculiar form of sore in Delhi has been long well known, it was, as already mentioned, only after the mutiny that the occurrence of the disease among the troops stationed there attracted any special attention. Previous to that period the greater part of the troops in the station were located in the old cantonment at some distance from the city, and it is a well ascertained fact that there is but a very slight tendency to the development of the affection in people living there as compared with those within the city walls. The troops occupied the interior of the city from the latter part of 1857, and from that date the prevalence of the disease among them began, and appears to have gone on steadily until it reached a climax in the year 1864. During that year the regiments at the station were the 38th European and the 4th Native Infantry, and the disease prevailed among them to an almost incredible extent. Among the Europeans especially, the prevalence was so great, that 40 and 70 per cent. are said to have been affected. The evil was of such serious magnitude and such a formidable cause of interference with the efficiency of the troops, that a Committee was convened in January 1865 to investigate the matter and to determine on measures for the diminution of the disease. The Committee recommended various sanitary measures, the most important of them bearing on the improvement of the water-supply of the troops, and especially of the European troops. Previous to that date the water-supply of the Europeans had been solely from wells.

Prevalence of Delhi sore very much less in 1865.

During 1865 the measures recommended by the Committee were put into effect, the bathing and drinking water of the Europeans was obtained from the river Jumna as much as possible, and the drinking water

was first boiled and then filtered. The measures regarding the water-supply of the native troops were apparently directed, as has always been the case on occasions demanding improvement in it, to putting the branch of the Jumna Canal which runs through the city, from which they can obtain a supply, into good order; but attention was also paid to cleaning wells, &c. During 1865 there were some cases of the disease in the 98th Regiment and the 25th Native Infantry, but the number was relatively very small; so few, indeed, and occurring so late in the year, that it was reported on the 4th September that not a single undoubtedcase had occurred either among natives or Europeans. Both regiments were, no doubt, new to the station, so that much of this sudden disappearance of the disease is to be ascribed to want of time for its development; still it was during the first and only year of the 38th's location in Delhi, 1864, that it suffered so excessively.

Facts relative to 1866 and 1867.

During 1866 there is no special notice of the occurrence of Delhi sores among the troops; and in so far as the European regiment was concerned, the admission rates for abscess and ulcer in that year were so low, that the disease may be assumed not to have prevailed to any great degree. The battery of Artillery and the 25th Native Infantry, however, show excessive admissions for the same year. During 1867 the European troops were supplied with drinking water from the Jumna and the Putthur Ghuttee well,—the wing of the 79th drawing their water from the former, and the battery of Artillery from the latter source. The supply for the natives was obtained, as before, from the canal and from wells. Many of the men obtained their water from the Khyrattee Gate well: this water was of very bad quality, and caused dyspeptic symptons and diarrhœa in those using it. A certain number of the men, then as always, no doubt went to the river for water, but the distance at which the Jumna lies from the lines—$\frac{3}{4}$ths of a mile—naturally prevented its general use. The Medical Officer of the 25th Punjab Native Infantry, writing in 1867, says "the canal water is of fair quality, but that obtained from the Khyrattee Gate well is bad. I have observed an increase in the number of Delhi sores when the canal supply was stopped, and also a tendency to spread in those sores which were healing. Turning to Table XI, we find that the admission rate of the wing of the 79th, which had only arrived that year in Delhi, from abscess and ulcer is very low, but that the rates

furnished by the Artillery and 25th Native Infantry are again very high.

Occurrence of Delhi sore during 1868 among 79th Regiment.

During 1868 there were a considerable number of cases of Delhi sore in the wing of the 79th,—57 cases and 9 suspicious cases having occurred between December 1867 and February 1869, according to Dr. A. Smith. These would appear to have chiefly occurred towards the latter part of the year, as in February 1868 the Quarter Master General reported that Delhi boils seemed to have left the garrison. The water for ablution supplied to the Europeans was up to this date obtained from the wells in the Fort. During the same year, 1868, the Medical Officer of the 17th Native Infantry reported that "the supply of water was irregularly given to the 17th Regiment, and sometimes altogether stopped. As the wells in the lines supply water only fit for ablution, the men are obliged to go to the river for drinking water;" and that "at all times the water-supply of the regiment is precarious." The admission rates from abscess and ulcer in all three bodies of troops was very small for 1868, that of the 17th Native Infantry, which had arrived in the station that year, being exceptionally so.

Facts regarding 1869.

During the course of 1869 cases of Delhi boil continued to occur among the wing of the 79th. The precise number of cases is not mentioned in any of the reports to which we have had access, but the admission rate from abscess and ulcer is considerably higher than it had been during the two previous years. The admission rate of the Artillery was also high. No special information regarding the water-supply for the year is given, so that it may be presumed to have remained in the same state as before. With regard to the natives, the complaints regarding the water-supply are repeated; the scanty and irregular supply derived from the canal and the brackish nature of the wells in the lines being again commented upon. The supply from the canal is stated to have been regular and abundant for some months, but it is pointed out that this improvement is necessarily only of a temporary nature, as the demand on the canal for agricultural purposes during the hot weather must put an end to it. No special reference is made to Delhi sores, but the admission rate of the regiment from abscess and ulcer is high, being nearly three times as great as during the previous year.

Occurrence of Delhi boils in the 17th Native Infantry in 1870.

In 1870 the admissions from abscess and ulcer in the wing of the 103rd were very few, and those of the Artillery, a new battery, much lower than they had been in 1869. In the medical report regarding the 17th Native Infantry various points in connection with the state of the lines are noticed. The advantage of the shade afforded by the numerous *pipul* and *neem* trees in shading the lines is noted, but there are again complaints regarding the water-supply. The distance of the Jumna is said to form the great drawback to its being generally employed by the men, and it is mentioned that the wells are used "readily enough for some time after canal water has been let into them." Thirty-eight cases of Delhi boil were treated during the year, "about as many as in the preceding year, but there are double that number of men doing their duty in the lines who have these sores, chronic and painless." The admission rate from abscess and ulcer was again high, considerably in excess of that for the previous year.

In regard to the European troops, we have been able to obtain no further definite information with reference to the occurrence of Delhi sores, beyond the fact that at the end of August 1873 it is reported that there were not then, and had not for some time been, any cases of Delhi boils amongst them.

Summary of information regarding the occurrence of the disease among the European troops from 1871 to 1876.

In 1871 the 109th Regiment gave a very high admission rate from abscess and ulcer—the highest, in fact, given by any body of European Infantry in Delhi during the entire ten years' period. The regiment arrived in the station from Mooltan in that year; in the year following it again furnished a high though diminished admssion rate, and only in the third year of residence did it come down to a low figure. This is just the reverse of the phenomena which appear usually to occur with regiments coming newly to Delhi. We have been unable to obtain any more definite information regarding the nature of the cases causing the admissions, but it is questionable how far they ought to be credited to Delhi. The regiment throughout the entire period in which it appears in our tables was very unhealthy, and, as we have seen, is the only body of European troops which furnished high admission rates from abscess and ulcer in Mooltan. The admission rates given by both the 109th and

the Artillery in 1873 are very low. In 1874 a wing of the 55th was quartered at Delhi. The rate from abscess and ulcer furnished by it was low, but that of the Artillery, a battery in its second year, was high. At the time of our visit to Delhi in the early part of 1876, Delhi boil was, and had for some time been, practically unknown among the European troops.

Summary regarding the native troops for the same period.

Returning now to the native troops. During 1871 the 17th Native Infantry continued to occupy the station. The water-supply remained unchanged. Twenty cases of Delhi boil were admitted into hospital, "but that number represents only a portion of the men who suffered" from the disease. The admission rate from abscess and ulcer was again high, although very considerably lower than in the previous year. In 1872 a fresh regiment—the 20th Native Infantry—came. The Medical Officer reports that "the canal water was allowed to flow into two wells in the lines," and "the mixed water used by the men for drinking purposes was well liked." Some of the men, as usual, went to the river for drinking water, "but owing to its distance, this was not common." The admission rate from abscess and ulcer was for native troops in Delhi comparatively low. No cases of Delhi sore occurred, except in one of the officers. During the following year six cases of Delhi sore were admitted from the same regiment, but "a great many men who had them were quite able to attend to their duties, and only presented themselves occasionally at hospital as out-patients." The admission rate from abscess and ulcer is low.

In 1874 the 20th Native Infantry remained in Delhi, and 15 cases of Delhi boil were admitted into hospital. The indifferent quality of the water-supply is again complained of. The admission rate from abscess and ulcer was high, more than 40 per 1,000 higher than in the previous year. In January 1875 the 33rd Native Infantry arrived in the station, and during that year remained free from Delhi sores. The water-supply of the lines was, as usual, dependent on the canal and the wells, until towards the close of the rains, when the canal became silted up in consequence of the excessive floods occurring at that time. It remained closed until the hot weather of 1876, and during the interval the only sources of water-supply open to the men were the wells in the lines, or the river. No cases of

Delhi sore occurred during 1875, but in the spring of 1876 cases began to present themselves, and up to date nine cases have been admitted for the year. This number, of course, does not necessarily indicate the absolute number of cases in the regiment, as it has been already seen that many who suffer are not unfit for the performance of their duties, but only receive treatment as out-patients, or, as is often the case, prefer doctoring themselves with their own nostrums.

Relative exemption of the men belonging to Native Cavalry Regiments in Delhi.

These are the principal facts which we have been able to ascertain regarding the prevalence of Delhi sores among the troops. The only other circumstance worthy of note as bearing on the subject is the fact that, during the period in which the disease was so excessively prevalent, the detachments of Cavalry located at the Lahore and Cabul gates, and obtaining their water-supply from wells outside the city walls, are stated to have showed a marked exemption from the disease.

General summary of information regarding the occurrence of the disease among the troops in Delhi.

So far as our information goes, therefore, it would appear that the troops whilst in the Old Cantonment suffered little; that between 1857 and 1865 Europeans and natives alike were very subject to the prevalence of Delhi sores among them, the Europeans, if anything, suffering more severely than the natives, and some bodies of natives escaping almost entirely; that subsequent to 1865 there has never been the same prevalence, but that the diminution in the prevalence of the disease has been much more marked and persistent in the case of the European than in that of the native troops.

The suddenness of the fall from excessive prevalence is very remarkable in the case of the European Infantry, and must, so far as we can see, even allowing for the influence of change in the bodies of troops in the station, have been due to some sudden improvement in their sanitary conditions. No such sudden or persistent change is perceptible in the case of the natives, although with them also there has been a considerable diminution in the prevalence of the disease.

Parallelism of the series of facts regarding the water-supply of the troops, and their liability to Delhi sores.

Taking these facts into consideration, there appears little doubt that the views which regard the nature of the water-supply as the immediate cause of the occurrence of the disease are well founded. We know that previous to 1865 the water-supply of the troops,

save of some isolated detachments, such as the Cavalry at the Lahore and Cabul gates, was very bad. That of the European was really worse than that of the native troops, the former being dependent on the wells within the fort, the latter having a partial, though very insufficient and irregular, supply from the canal, and being, moreover, to some extent in the way of using the river water. With 1865 the conditions were reversed; river water being supplied as far as possible to the Europeans, whilst the supply for the natives was unchanged, save in so far as more attention was paid to rendering the supply from the canal efficient. Since that date constantly increasing care has been devoted to the water-supply of the Europeans; the use of well water for drinking purposes has been entirely abandoned, and additional care is taken to secure abundant water from a clean portion of the Jumna. No such improvement has been made in the native water-supply; in fact, up to the present time it seems to remain in much the same state as in 1865. The parallelism between the facts regarding the occurrence of the disease and the nature of the water-supply appears to be incontestable. The question of the influence of the water-supply will be further discussed in a separate chapter.

4.—Facts regarding the occurrence of Sores among the city population of Delhi.

Difficulty of obtaining information regarding the degree to which the disease prevails among the city population.

It is not easy, or even possible, to obtain definite data in regard to this point. It has been affirmed that the disease has diminished very much of late years, and it very probably may have done so in connection with the general sanitary improvement of the town—improvements which, it would appear, are in great measure due to the representations made by Lord Mark Kerr. The following statement, giving the number of cases treated at the city dispensary during the years 1873-74-75, shows, however, that the disease has by no means disappeared:

Number of cases of Delhi sore treated at the dispensary.

1873 ...	... 95	1874 ...	... 55	1875 ...	... 84

These numbers are small, but they can be taken as no index of the prevalence of the disease, as the sores are of so chronic and painless a character, and cause so little inconvenience, that often either no treatment at all is

adopted, or recourse is had to native remedies and nostrums of various kinds, which are commonly administered by the city barbers.

Similar difficulty in estimating its prevalence throughout the district.

The same source of fallacy holds good in regard to attempts at estimating the prevalence of the disease in the small towns and villages in the neighbouring district. That it does occur in such places we satisfied ourselves by personal inspection, and had a practical demonstration of the unsatisfactory nature of the information to be derived from dispensary returns, in encountering cases of the disease in the streets of a town the existence of which were totally unknown to the local native doctor.

CHAPTER III.

THE INGREDIENTS IN THE WATER-SUPPLY OF DELHI WHICH APPEAR TO FAVOUR THE DEVELOPMENT OF SORES.

THE result of our enquiries, so far as we have hitherto described them, has been to localise the cause productive of 'Delhi sores' to the water-supply, and we have now to consider to what extent the microscopical and chemical examination of the water itself justifies such a conclusion—to what extent it possesses peculiar characters.

Question of the characteristics of the water in Delhi.

The microscopic features of the waters in question may be dismissed with a few words, as, so far as our own observations went, there was nothing to be detected which could in any way be connected with the production of any cutaneous affection akin to that under consideration.

Microscopical examination.

The chemical examination, however, was suggestive. Bearing in mind what has already been stated regarding the geographical distribution of "sores" in India, it may be reasonably inferred that the organic impurities, as such, may be set aside, for the water of Delhi assuredly is by no means exceptionally bad in this respect. On the contrary, the quantity of unoxidised organic matter is, in most instances, small in the water-supplies most resorted to by the population, and not to be compared with the large quantities commonly presented in the water tanks of places such as Calcutta and other cities in the Lower Provinces, where Oriental sores are practically unknown. Of this we satisfied ourselves by means of special distillations of numerous samples of water in accordance with the principles laid down by Messrs. Wanklyn and Chapman, the details of which, however, need not be recorded here, seeing that our object is not to report upon the local water-supply.

Chemical examination; organic impurities not a prominent feature.

The results of the oxidation of organic substances in the form of nitrates and nitrites have been shown by all our analyses to be present in very large quantities, and are associated with a marked quantity of chlorides. So saline is the water in certain wells, that it cannot be even employed to water plants.

Abundance of nitrates and nitrites.

So far the result of our analyses has been substantially in accordance with those of former observers; but here the agreement ceases, for, according to them, the

Excessive hardness of the Delhi waters.

water of the Delhi wells presented no striking peculiarity in regard to hardness, whereas we found the waters as a general rule excessively hard, and in some cases almost unprecedentedly so.

We append a table giving the estimates of the 'total' hardness, the 'permanent' hardness, and of the amount of chlorine; the last-named calculated in grains per gallon of chloride of sodium in a number of the wells in and around Delhi, as well as of a few samples of water (Nos. 23 to 28) which we collected in three towns in the Delhi district, at a distance of 10 to 25 miles from the city itself.

TABLE XII.—*Results of the analyses of* 28 *samples of water in Delhi and in three adjacent towns with reference to the degree of Hardness and quantity of Chlorine.*

Number.	Source of sample.	Total hardness calculated as carbonate of lime in grains per gallon.	Permanent hardness calculated as carbonate of lime in grains per gallon.	Chlorine calculated as chloride of sodium in grains per gallon.
1	Jumna, west bank	6·65	2·10	0·98
2	„ east „	6·65	2·8	0·57
3	Canal	6·65	2·10	0·57
4	Ditto	5·6	1·75	0·57
5	Well in the lines	32·55	18·55	16·9
6	Well in the town	45·85	28·0	16·9
7	Ditto	42·35	...	25·11
8	Ditto	47·6	...	45·56
9	Ditto	179·5	162·05	176·0
10	Ditto	18·5	9·8	9·57
11	Ditto	39·55	22·05	16·19
12	Ditto	64·05	43·55	51·28
13	Ditto	15·4	...	1·79
14	Ditto	23·1	5·6	62·9
15	Ditto	52·6	...	629·0
16	Ditto	61·60	46·55	48·26
17	Well outside the walls	16·60	...	3·84
18	Ditto	20·30	..	5·48
19	Ditto	10·85	...	38·4
20	Ditto	18·55	1·05	30·4
21	Ditto	15·05	...	4·48
22	Ditto	16·80	...	10·38
23	Well at Alipur	17·85	...	4·46
24	Ditto	40·95	...	27·27
25	Well in Soneput	51·80	13·3	157·6
26	Well at Soneput	11·88	4·9	5·48
27	Well in Faridabad	35·35	12·98	22·24
28	Ditto	22·75	9·1	5·48

Fallacy introduced by magnesian salts into process for determination of hardness.

As is well known, the process generally adopted (Clarke's) for determining the hardness of a water may very readily give rise to fallacy owing to the presence of magnesian salts, unless special attention is

devoted to the point; and it is doubtless due to this, in a great measure, that the hardness of the water has been so largely under-estimated. We believe that our figures may be accepted as correct; they give the result of, in most instances, two or three distinct determinations specially directed for elucidating this very question.

These analyses were conducted towards the end of the dry season, when the waters were doubtless more extensively impregnated with salts than after the rainy season. With the intention of definitely satisfying ourselves as to the extent of the variation, we obtained (by the kind assistance of the Engineer to the Municipality, Mr. A. J. Devon) four more samples of water collected shortly after the cessation of the rains.

Analyses of Delhi waters by Professor Wood.

As analyses made in an extemporised laboratory can seldom be so satisfactorily performed as when conducted with all the proper appliances, and as we were anxious that our estimates should be comparable with those of a professional chemist, we consulted Professor C. H. Wood, the Chemical Examiner to the Government, who very kindly undertook the analyses of these particular samples himself, and has favoured us with the following tabular statement of the result:

TABLE XIII.—*Result of analyses of some Delhi waters subsequent to the rainy season.*

Number.	Source of sample.	Total hardness calculated in grains per gallon of carbonate of lime.	Chlorine calculated in grains per gallon of chloride of sodium.	Sulphuric acid, (SO_3) in grains per gallon.	Total solids in solution in grains per gallon.
1	A well in the Dâk Bungalow compound	65·8	103·8	32·2	341·6
2	A well near the Northbrook Hotel	43·9	51·91	22·12	203·0
3	A well near Khela Ghât ...	31·9	7·27	6·58	48·3
4	A new well in the bed of the Jumna, opposite Selimgarh Fort*	26·0	12·69	5·04	46·9

* With the view to avoid the expense of making special filter-beds in connection with the proposed Water-works at Delhi, the plan of sinking wells in the bed of the river Jumna, and thus effecting the filtration of the water at its source, has been proposed. It would appear, however, from this analysis that the soil in the bed of the river through which the water percolates into the wells, instead of improving the water, tends to assimilate it to that of the wells within the town, as may be observed by comparing the results of this analysis with those of the four analyses of Jumna water from different places in Table XII.

Mr. Wood writes: "All the waters, in addition to lime, contain notable quantities of magnesia. The alkaline metal present is chiefly sodium, the proportion of potassium being very small. The most noticeable feature of these waters is the large proportion of nitrates present."

Delhi waters characterised at all seasons by excessive hardness.

On comparing the above figures with those given regarding the hardness and chlorides in Table XII, it will be found that they both indicate excessive hardness as a prominent feature in Delhi waters, as well after as before the rains.

How far an excess of certain salts in a water may produce the Oriental sore is a question demanding further enquiry What we do know at present is (1). that it is something connected with the water of the wells in Delhi which appears to determine the occurrence of the disease there; (2) that this water is characterised by its excessive hardness, and (3) by the presence in it of very large quantities of salts. It does not necessarily follow that the hardness and saline quality of the water should be the direct cause of the disease; they may be accompanied by some special compound which is the real efficient agent, but there certainly are some points which seem to indicate that the hardness of the water may be taken as an index, at all events, of its containing deleterious ingredients conducive to the development of cutaneous affections of the character of Oriental sores.

Facts regarding coincidence of sores and peculiarities in the water supply.

Taking the well-known fact of the absence of these sores among the population of Bengal Proper, and the figures relative to the occurrence of 'abscess and ulcer' among the native troops in the same region, and comparing these with the prevalence of such forms of the disease in other parts of the country, the general fact comes out very clearly, that where the water is soft, such diseases are at a minimum, and that where it is hard, they increase in prevalence and attain a maximum in a place, such as Delhi, where the hardness of the water is excessive.*

Correspondent geograp hi cal distribution of hard water and sores, &c.

* It is at present impossible to proceed beyond a consideration of the more general phenomena of the distribution of the sources of the disease, as our information on the subject is of so imperfect and fallacious a nature. For example, in the table regarding European troops, Dum-Dum and Fort William occupy a very high place as stations subject to abscess and ulcer, while, as a fact, forms of diseases akin to Oriental sore are practically unknown there.

Want of chemical and statistical data on this point.

It would be a matter of great interest to carry the analysis of this question out in detail, and to determine the question for individual towns and stations. This, however, cannot be done at present; for, on the one hand, there is a want of definite statistical information regarding the occurrence of the disease, and on the other there are no chemical data of assured accuracy regarding the condition of the water.

CHAPTER IV.

CLINICAL FEATURES OF THE ORIENTAL SORE AS SEEN AT DELHI.

ALTHOUGH the appearance presented by the 'Oriental sore' in its advanced condition varies considerably (owing principally, it would seem, to the modes of treatment, accidental as well as intentional, to which such a condition is naturally liable), still there is a certain degree of uniformity in the appearance which it presents at the onset. It generally commences as a pinkish papule, not unlike a mosquito-bite. It may retain this aspect for several days or weeks, or merely attain a more distinctly nodular character. We have heard a patient describe this condition by comparing it to a little seed that had been introduced under the skin. In other cases the tuberculated character is less evident, but in all, so far as we have been able to ascertain, the skin becomes thin and somewhat glistening, and the vascularity of the parts beneath more evident.

Description of the sore at onset.

It may gradually disappear without any further inconvenience, but generally it takes one of the two following courses: (1) Either the central part of the papule desquamates, and layer after layer of shrivelled epithelial scales are thrown off, unaccompanied for a long time with any perceptible secretion or distinctly marked scab; or (2) the desquamation is accompanied with a thickish secretion which forms a hard adherent scab, beneath which a red, raw surface is formed, which may or may not bleed readily on irritation, but is seldom painful.

Forms assumed by sore.

The surface thus affected varies in extent from a few lines to one or even two inches in diameter; but the average area occupied by it is about the size of a shilling or half-a-crown. It is not localised to any particular region of the body, several parts of which may be affected at the same time. The forehead, the cheek, the wrist, the back of the hands and feet, the points of the elbows and the knees, and, not unfrequently, the side of the nose between the bridge and the inner canthus, are the sites where sores are most commonly found.

Size and site of sore.

A sore may start from either one or from several centres, which, gradually approaching each other, eventually coalesce and become covered by a single scab. Sometimes

Sores may be single or multiple.

a shiny, slightly elevated, wheal-like belt of indurated tissue may be observed to encircle the sore, covered with a thin cuticle, and presenting an appearance not unlike that of the indurated tissue forming the margins of a lachrymal sinus, or other fistulous orifice.

The scab.

When a poultice is applied, the softened parts become puffy; the adherent scab, when present, becomes loosened, and the sore bulges forward, often considerably beyond the level of the surrounding parts so as more or less to resemble a boil or, even, a carbuncle. This condition is represented in the accompanying sketch—the chromolithograph of which, however, is somewhat too hard and diagrammatic (Plate I, Fig. 1). The normal colour of the scab is yellowish. Owing, however, to the various nostrums applied, it seldom presents its natural tint, but ranges from a greyish-yellow to various shades of black.

The age of onset.

It is difficult to fix upon any particular age at which the sore manifests itself most frequently. From puberty to 30 may be mentioned as the time of life during which we ourselves have most frequently witnessed the disease, but we have likewise seen it in persons whose ages ranged from 2 to 55 years.

The chronic character of the sore.

As in the case of the 'Oriental sore' described in other localities and countries, so also in the sore as met with in Delhi, one of its leading features consists in the chronic course which it runs. It may last from a month or two to several years, but perhaps six to eight months may be set down as its average duration when not aggravated by improper local and other treatment. When it heals, a permanent pinkish-white or pale-yellow scar marks the site and area of each sore. Dr. C. H. Y. Godwin, in a report on the subject in 1865, thus describes the pseudo-healing process so frequently witnessed during the course of the disease, and which so often only results in disappointment: "When," writes Dr. Godwin, "commencing to heal, it does so by filling up in the centre, and not from the circumference; but the great tendency is to dry or scab over, and this leads the patient often to think that his sore has at last healed: not so, however; this surface breaks down again and again, leaving each time an ulcerated surface larger than before."

Fig. 2

Fig. 1

"THE DELHI SORE"

Fig. 1-A hand with two "Sores" on dorsal surface

„ 2-Vertical Section of "Delhi Sore" Natural size.

CHAPTER V.

THE PATHOLOGY OF THE ORIENTAL SORE.

Our remarks limited to the results of personal observation.

As already intimated, the discussion of the different views which have been propounded in this country and in Europe regarding the significance of the various pathological appearances which the diseased tissues present in this affection forms no part of our programme, nor are we called upon to express any opinion regarding the importance to be attached to the various microscopic objects and organisms which have from time to time been described as associated with the disease, but simply to record what we ourselvse have been able to see, and to limit our inferences to actual observations on the Oriental Sore as in Delhi and its vicinity.[1]

1.—Examination of the Sore in situ.

Description of Plate I, Fig. 1.

The two sores depicted in Plate I (Fig. 1) as occurring on the dorsal surface of a sepoy's hand represent the ordinary features of a developed Delhi sore as covered by a scab, softened by the application of a poultice. These particular sores had existed from 6 to 8 months. They are seen to be slightly elevated, and the scab sub-divided into little areas, and the whole surrounded with a glistening pinkish areola. Although in these particular instances the sores are circular, it may be mentioned that the other sores on this sepoy's body—on the elbow and hip—presented a more irregular outline.

The appearance of the sore beneath the scab.

When the crust which forms over sores of this character is carefully elevated, the raw surface below it will be found, as a general rule, to consist of numerous pinkish nodules of vascular tissue, the tips of which are very commonly indicated by the existence of dark specks visible to

1 We are greatly indebted to the Surgeon in medical charge of the 33rd Native Infantry Regiment (Dr. E. R. Johnson) for the active manner with which he aided us during our stay at Delhi, and for the opportunities which he so readily afforded us for the study of the complaint among the sepoys in his regiment. Assistant Surgeon Radakishen also, by the permission of the Civil Surgeon of Delhi (Dr. Fairweather), materially contributed to the furtherance of our work by collecting numerous cases of the sore for our inspection at the Charitable Dispensary, and in other ways.

the naked eye. In some cases the sores look as if they had been peppered over with such little granules. The microscope reveals that the darkly pigmented particles are due to minute extravasations of blood, the corpuscular elements of which have for the greater part become broken up.

Microscopic character of the exudations: the corpuscular elements.

On drawing the margins of a thin cover-glass very gently across the sore for the purpose of scraping off a little of the moistened surface for subsequent examination, it is seldom that any pain is complained of, nor does hæmorrhage usually ensue. The secretion thus removed and submitted to microscopic examination is found to contain a few red blood corpuscles and a large number of granular, lymphoid cells averaging from $\frac{1}{4000}''$ (= ·006 mm.) to $\frac{1}{3000}''$ (= ·008 mm.) of an inch in diameter (Fig. 1).

Fig. 1. Cells from the free surface of a 'Delhi sore'—×850. (Hartnack's Obj. No. 9 —immersion.)

Fig. 2. As Fig. 1, after the addition of acetic acid—×850.

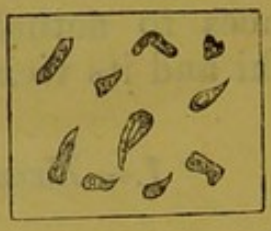

Fig. 3. The nuclei which have become free owing to the destructive action of acetic acid on the corpuscles in Figs. 1 and 2—×850.

Liquor potassæ dissolves these cells completely. *Acetic acid*, however, clears up the cells and brings to view the existence of either one, two, or more nuclei (Fig. 2). After prolonged action of the acid the corpuscles will be found to have become in great part broken up, the nuclei alone remaining to mark the site occupied by the corpuscle (Fig. 3).

Miliary particles.

Occasionally yellowish-white little bodies of about the size and form of millet seed may be detected, and may be readily picked out with a hand lens. They average about $\frac{1}{62}''$ (= ·4 mm.) in length by $\frac{1}{100}''$ (= ·25 mm.) in width. This is the average of three measurements. They are of somewhat shaggy outline, and may be crushed between the cover-glass and the slide by the application of a little firm, continuous pressure.

In the accompanying wood-cut (Fig. 4) one of these miliary particles is depicted as seen under a comparatively low power.

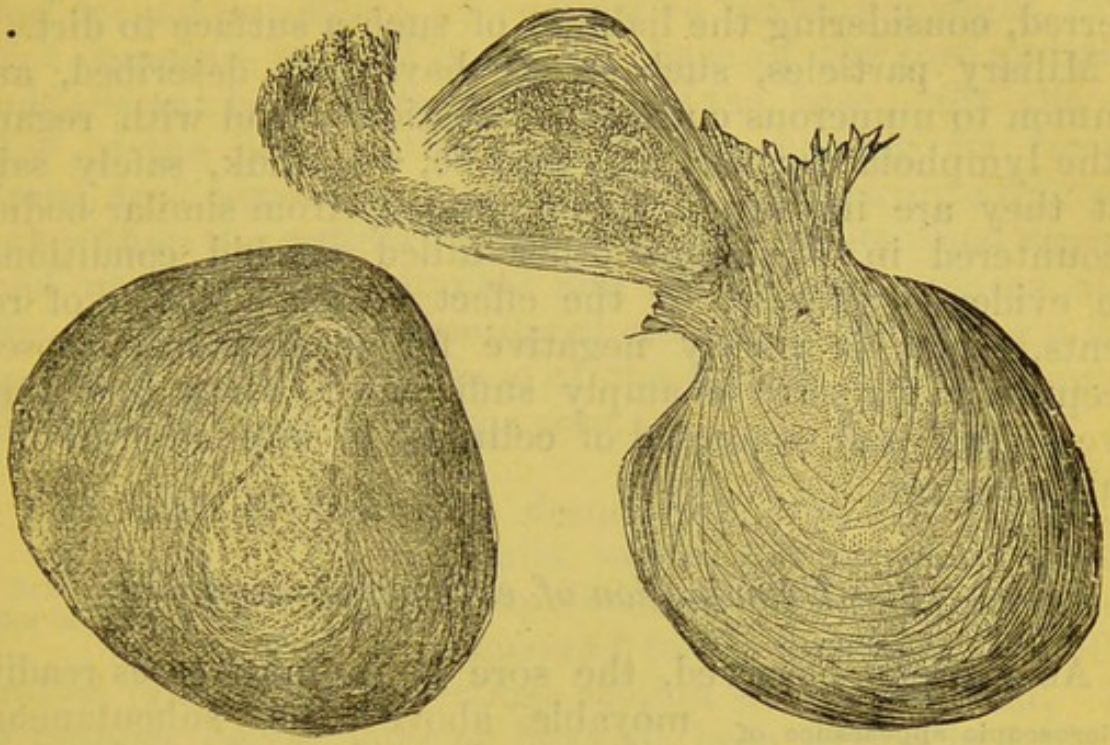

Fig. 4. Miliary particle from the surface of a " Delhi Sore " × 60.
Fig. 5. As Fig. 4 crushed between the cover-glass and slide × 60.

It is manifestly an aborted hair follicle, a portion of the disintegrated. hair being plainly distinguishable in the centre of the mass. The adjoining figure represents the same millet seed-like particle as seen after being crushed beneath the cover-glass. The application of a higher power made it evident that we were dealing with disintegrating epithelial elements.

It is, however, by no means invariably possible to distinguish the remains of a hair in these little particles, and sometimes it seemed as if they consisted of firmly compressed plugs (*comedones*) thrown out of the sebaceous follicles, or even of the disintegrated cast-off follicles themselves. As far as our experience goes, the presence of these little miliary particles of various composition is far from being a prominent feature in the generality of cases.

Summary of microscopic examination of surface of sore.

No other objects presented themselves to us as existing on the surface of the sores, or embedded in the secretion which covered it. We examined most carefully numerous sores in order to satisfy ourselves very thoroughly regarding this point, but nothing which appeared to us to be

worthy of note could be found that could not be referred to contact with extraneous substances. Of the latter, however, endless objects might have been described, as may readily be inferred, considering the liability of such a surface to dirt.

Miliary particles, such as we have just described, are common to numerous cutaneous affections; and with regard to the lymphoid corpuscles, it may be, we think, safely said that they are indistinguishable optically from similar bodies encountered in numerous other allied morbid conditions. The evidence afforded by the effect of the addition of reagents, also, is purely negative for diagnostic purposes, except in so far as to be amply sufficient to show that they have no cell wall composed of cellulose or any material of a similar nature.

2.—Examination of extirpated sores.

Microscopic appearance of section.

As already observed, the sore is in most cases readily movable above the subcutaneous tissue, and when extirpated, especially after the previous application of a poultice for some hours, a considerable quantity of serous effusion may be found to have accumulated around the base. A representation of the appearance of the surface exposed by a vertical section of a sore removed in this manner will be found in Plate I, Fig. 2. The specimen here delineated measured something less than an inch in diameter at the base, and about a third of an inch in depth. It may, however, be remarked that the vertical measurement was perceptibly increased after the application of a poultice.

The principal features manifested by a close examination of the section of a recent but fully developed sore, with the naked eye and by means of a hand lens, are the following (*vide* Plate I, Fig. 2):

Taking the tissues from above downwards, we observe (supposing, as in the present instance, the sore not to have advanced to the condition of an extensive raw surface)—(1) erosion and tenuity of the cuticle along the uppermost surface of the sore, but a thickening of it on either side of this part, which thickening extends but a short distance beyond the area occupied by the diseased tissue; (2) deepening of the Malpighian layer, and enlargement

of the papillæ; (3) pink striæ directed vertically towards the uppermost part of the preparation, manifestly congested vessels proceeding towards the papillæ; (4) a line of glistening decussating fibres of connective tissue of a slight bluish tint running parallel with the base of the sore and about mid-distant between the surface and the base; (5) the even line of the base of the preparation, showing its freedom from any organic connection with the subjacent structures, other than the ordinary cellular tissue with its usual vascular and nervous concomitants; and (6) in some places along the base slightly mammillated elevations projecting a little beyond the level of the base of the growth, directed towards the normal tissue below the sore.

Brief description of a section of healthy skin.

In order to make this description and the anatomical details which follow more readily comprehended, we direct attention for a moment to the accompanying illustration (Fig. 6) of a vertical section of normal skin. The structures therein depicted have all been drawn to scale by means of a camera lucida; and although the illustration is based on three different hardened preparations made from consecutive sections of a fragment of skin removed from midway between the ear and the eye, nevertheless the relations of the parts to each other and the distance of the various structures from the surface have been kept, so that the drawing may be compared with Figure 7, which represents the changes which occur in the different parts of the skin in Delhi sore.

The letters *a*, *b*, *c* correspond to the three principal layers of which the skin consists. The horny (*a*) and the mucous layers (*b*) of the epidermis form what is usually implied by the cuticle ; the upper layer consists of hardened epidermic scales, and follows a course almost parallel to the surface, but the lower layer not only consists of more distinctly cellular elements (the prickly-cog-wheel aspect of a great portion of these cells cannot be represented in a drawing made on so small a scale as this), but also forms a coating to the projections of the true skin or *cutis vera* (*d*) termed papillæ (*c*). Into the latter nutritive vessels (*i*) and nerves penetrate. The epidermic layer—the mucous portion of it especially—not only dips between the papillæ

for the purpose of supplying them with a covering, but also dips still more deeply into the tissue of the true skin, and thus aids in forming to a greater or less degree the walls of all the tubular structures which open on the surface of the body. These are hair- (*f*) and sebaceous follicles (*h*),

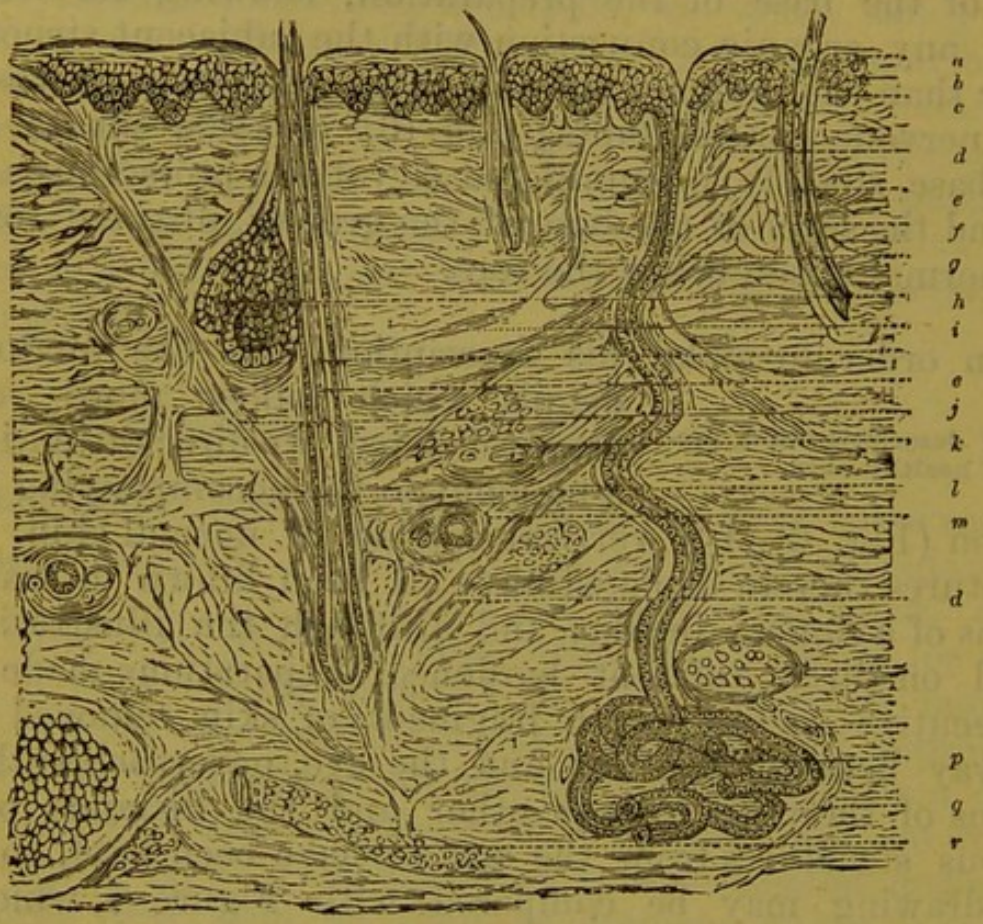

FIG. 6. A VERTICAL SECTION OF HEALTHY SKIN × 60.
(Sketched from three preparations, with a camera ludica.)

a, Herny, and *b*, Mucous layer (*Rete Malpighii*) of the Epidermis; *c*, Papillary layer of Corium (*d,d*); *e*, Hair; *f*, Hair follicle; *g*, Duct of sweat gland (*p*); *h*, Sebaceous gland; *i*, Blood-vessel sending up branches to papillæ (*c*); *j*, Arrector pili; *k*, Section of vessels with their surrounding *adventitia*; *l*, Delicate fibrous tissue continuous with adventitia of blood-vessels and lymphatics; *m*, Section of sudoriparous duct and blood-vessels; *n*, Areolar tissue and fat cells; *o*, Section of vessels within the capsule (*q*) of the convoluted portion of sweat gland (*p*); *r*, Blood-vessel filled with corpuscles, giving off a twig to the root of the hair.

and the ducts of the sweat lands (*g*). These structures, divided, however, transversely or obliquely, may be distinguished in almost any section of the skin that may be examined, as well as the connective and elastic tissue and the aggregations of fat cells in the areolar tissue below, which go to form the greater portion of the true skin. Scattered in the meshes of these fibrillated tissues the above-mentioned glandular and other structures are found,

together with numerous vascular textures, sanguineous and lymphatic.

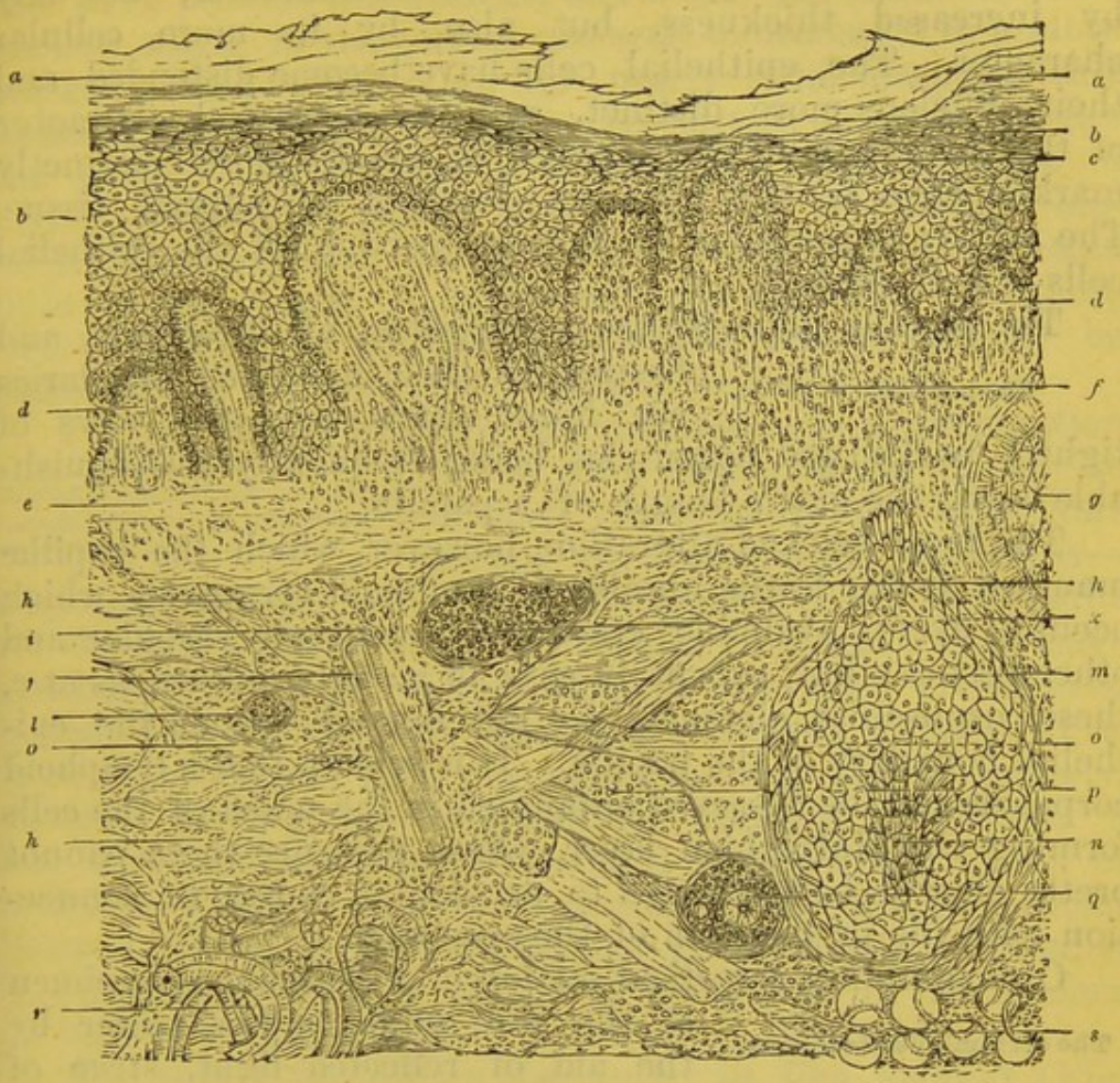

Fig. 7. Vertical Section of a 'Delhi Sore' × 60.

(Sketched from three preparations, with the aid of a camera lucida.)

a, a.—Horny layer of epidermis coated with a thin encrustation. *b, b.*—Mucous layer of epidermis (*Rete Malpighii*) thickened, and the epithelial cells enlarged. *c.*—Commencement of rupture of epidermic layers, and walls of papillæ (*d, d*). *e.*—Vessels proceeding to papillæ. *f.*—The new growth composed of lymphoid cells, which at *h h,h* is seen in intimate relation with delicate shreds of fibrous tissue (the *adventitia* of the vascular and glandular structures?). *g.*—Partially disintegrated sebaceous follicle. *i.*—Line of section of tissue surrounding a sweat duct (*j*), prolongations of which (*h*) are seen studded with the lymphoid corpuscles. *k.*—A space filled with lymphoid corpuscles (a 'colony'). *l.*—Section of blood-vessel surrounded by an aggregation of lymphoid corpuscles. *m.*—Disorganised hair follicle showing the remains of a hair within the sac (*n*). *o, o.*—Decussating bands of connective tissue giving rise to interspaces (*p*), which are packed with lymphoid cells. *q.*—Section of sudoriparous duct surrounded by lymphoid cells; a blood-vessel is also visible within the general sheath. *r.*—Convoluted part of a sudoriparous gland. *s.*—Fat cells with corpuscular elements among their investing areolar tissue.

The various changes which occur in the skin in Delhi sore: The cuticle.

A very cursory glance at the illustration of a section of similar structures as modified by the morbid process associated with Delhi sore will suffice to indicate in a general way the principal alterations which the tissues have undergone. The horny layer of the cuticle (Fig. 7, *a*)

is found to have become thickened, except at the site of actual breach of continuity, and the mucous layer (*b*) has become much more pronounced in its character, not only by increased thickness, but also by its more cellular character. The epithelial cells have become distended and their nucleus more distinct, and the epithelial character of the inter-papillary processes is much more distinctly marked than is the case in sections of normal tissue. The prickly appearance of a large portion of the epithelial cells is well marked.

The papillæ.

The papillæ likewise are enlarged in all directions, and frequently their contained capillaries are found much congested, rows of tightly packed red corpuscles being frequently distinguishable along the entire length of a papilla.

The most marked alteration, however, which the papillæ manifest is due to the number of lymphoid corpuscles which occupy every available crevice between their vascular and other tissues; but, except in case of actual rupture, as at *c*, these corpuscular elements do not extend beyond the epithelial boundary of the papilla. It is seldom that a lymphoid corpuscle can be observed entangled in the midst of the cells forming the Malpighian layer, whose presence there cannot pretty clearly be attributed to accidental causes in connection with the preparation of the specimen.

The corium—Vertical striæ.

On examining a vertical section of a hardened specimen of the sore under a low power by the aid of reflected light, striæ of these corpuscular elements may be observed descending through the corium in a direction towards the base of the tumour and continuous with the lumen of the papillæ. When thus examined, the striæ present a whitish, pearly aspect. These striæ manifestly correspond to the pinkish striæ which we have just described as being conspicuous in perfectly fresh preparations, owing to the congested condition of the blood-vessels along which the lymphoid corpuscles are in great part distributed. The colouring matter, however, of the red blood cells gradually disappears in course of preservation.

The prolongations of inter-papillary spaces.

The spaces between the striæ are occupied in the upper part of the section by prolongations formed of epithelial cells continuous with the rete Malpighii, which gradually assume a more spindle-cell aspect the further they

are removed from the ordinary level of the mucous layer, and in the lower part by connective tissue. Where, however, the striæ become less evident, and when the bands of connective tissue in the corium are seen to decussate in a more marked manner (Fig. 7, *p*), the pearly striæ disappear and isolated aggregations of similar aspect may be seen between the meshes of the fibrous tissue. The application of a higher magnifying power shows that the corpuscular elements forming these pearly (when examined by reflected light) areas consist of lymphoid cells identical with those which occupy the papillæ, and which are what may be considered as the strictly new growth in Delhi sore.

Modifications of the normal tissues. The hair and sebaceous follicles.

Various other changes are manifested in a preparation of the sore, which, however, may be ascribed more manifestly to modifications of pre-existing structures—modifications, too, which presumably are the indirect results of the development of the corpuscular elements which have just been referred to. These changes are most pronounced in the case of the hair and the sebaceous follicles (Fig. 7, *m. g*). The hair itself disappears more or less completely, at most leaving but very trifling traces in the form of a few hardened scales (*n*), or perhaps merely a small heap of molecular *débris*. As already mentioned, the altered follicles become pushed forward by the new growth until, eventually, in advanced cases they are found lying free on the surface of the sore (Figs. 1, 2).

The sebaceous follicles.

The sebaceous follicles also suffer in like manner (Fig. 7, *g*); indeed, it is very seldom that they can be identified as glandular structures at all when the particular sore examined is not a very recent one. There does not appear to be any infiltration of lymphoid corpuscles into either the hair or the sebaceous follicles; the changes in both consist for the most part, apparently, in an increase in the size and the more pronounced character of the epithelial cells which enter into their formation, just as was observed to take place in the mucous layer of the epidermis. With reference to the sebaceous follicles, however, we were not able to satisfy ourselves that more changes than this had not taken place, as some of them appeared to be filled with material consisting of broken-down epithelial elements, or with indistinctly marked lymphoid corpuscles. We are, however, inclined to refer it to the former. The fibrous tissue forming the capsular investment

of both classes of follicles were frequently infiltrated with accumulations of lymphoid cells.

The sudoriparous glands.

The sweat glands, situated in the lower part of the corium (Fig. 6, *p*, Fig. 7, *r*) are not appreciably affected unless the sore is in a very advanced state. Frequently the glandular convolutions may be seen to present an almost perfectly normal appearance (Fig. 7, *r*), even when surrounded by the lymphoid corpuscles. The ducts, however, are generally larger than usual, and sometimes they are seen to have become obliterated, apparently as the result of the pressure exercised by the newly-formed cells of the sore. Occasionally, however, the appearance presented by the cellular lining of the ducts and its convolutions seemed to indicate that, as in the case of the sebaceous glands, some change had occurred, but whether neoplastic or retrograde we were unable to decide.

The vascular structures.

It is in connection with the vascular structures of the corium that the essential features of the disease are most prominently observed. This, however, does not imply that the primary deposit takes place in the interior of the vessels, or even in the interior of the capillaries; for very frequently sections of the blood-vessels parallel to their course may be encountered, which prove that they contain no corpuscular elements other than those normal to them, although it is frequently to be noted that they are very full. The same is observable in transverse sections. The coats of the vessels are, however, generally thickened and somewhat more readily resolved into their cellular elements than is the case in normal tissues.

Relation of the lymphoid corpuscles to the fibrous tissue-investments of vessels and glands.

In endeavouring to trace a connection between the lymphoid cells and the various tissues of the corium, all preparations demonstrate more or less clearly that the distribution of these elements is more intimately connected with the delicate fibrous tissue-investment of the glandular and vascular structures than with any other tissue. In following the course of a blood-vessel, for example, it will be observed that aggregations—colonies of lymphoid cells—have formed in numerous places, and that from these "colonies" ragged processes of delicate fibrous tissue may be recognised which become joined to similar processes in other parts of the preparation (Fig. 7, *h*,*h*,*h*). In other instances these delicate fibrous shreds may be seen to be directly continuous with the *adventitia* of a vessel, and

to become more and more distinctly dotted with lymphoid cells until they are lost in a sheet, so to speak, of similar fibrous tissue at a distant part of the preparation. Similar accumulations of these granular corpuscles may also be found surrounding the blood-vessels when the latter are cut transversely (Fig. 7, *l*), as also surrounding the convolutions of the sweat glands in connection, probably, with the *adventitia* of their vascular tissues.

Relation of the corpuscles to the lymphatics.

The circumstance that the lymphatic vessels may sometimes be seen in the corium to take a course some distance removed from the blood-vessels enables us also to observe that in very early stages of the disease the lymphoid cells, of which we have been speaking, are in more manifest relation to the connective tissue along the course of the lymphatics than elsewhere; but we have not been able to satisfy ourselves that the cells are found within the larger lymphatic vessels; on the contrary, not unfrequently they form larger aggregations in the fibrous tissue which is seen to proceed from such a vessel and at some distance from it.

Isolated "colonies" of lymphoid cells.

In addition to these aggregations or colonies of lymphoid cells which surround the sweat glands, the hair and sebaceous follicles, and the different vascular tissues with distinct walls, aggregations may frequently be observed without perceptible connection with any of these structures (Fig. 7, *k*). It is possible that these colonies may be due to the accumulation of the cells in the interstices formed by decussating fibrous bands, or to their accumulation in the spaces of the *adventitia*.* Possibly both conjectures are correct, seeing that the outline of the colony frequently corresponds to the margins of the spaces formed by the decussating fibres, and that when no such bands are present to modify the shape of the colonies, they are usually round or oval. The average dimensions of ten of the colonies which we measured was $\frac{1}{100}''$ (=0·25 mm.), but they varied from $\frac{1}{166}''$ (=0·15 mm.) to $\frac{1}{62}''$ (=0·4 mm.).

Mammillated projections occasionally present on base of sores.

Sometimes, as already mentioned in describing the microscopic appearances of an extirpated sore (page 43), its base is dotted with minute projections about

* We have refrained from giving any name to these spaces so as to avoid the possibility of misconstruction, seeing that different writers make use of the same designations for very different structures in accordance with the particular view adopted.

the size of the head of a pin, which become more evident after the preparation has been dried or hardened in spirit. These little prominences are found to consist in some cases of the convoluted portion of sweat glands surrounded by aggregations of lymphoid cells; in other cases no trace of a sweat gland is to be observed, but an oval or circular colony of cells, surrounded by a scarcely perceptible membranous envelope, and showing towards its centre the cut orifice of a blood-vessel, are all that can be distinguished.

The relation of the lymphoid cells to the areolar tissue in corium.

There remains one other feature in connection with this cell-growth which deserves special mention; and that is the fact that the reticulated tissue in which the fat cells are embedded is frequently thickly studded with these lymphoid cells (Fig. 7, *s*)—a fact, however, which generally requires the use of re-agents, such as iodine, picro-carmine, or aniline, for its elucidation.

A description of the lymphoid corpuscles.

Having thus briefly described the general features of this cell-growth as seen in vertical and transverse sections of extirpated sores, it will be necessary to describe the arrangement which the cells assume with regard to each other.

It should be premised that the cells as well as the substance in which they are embedded assume very different appearances according to the particular method adopted for their preservation and the different staining processes resorted to. The description which follows will refer to preparations which have been preserved in spirit, in a weak solution of chromic acid, and in a mixture of the two.* With regard to the size of the corpuscles when measured after preservation in spirit, it may be stated that the average of ten measurements of cells taken indiscriminately was $\frac{1}{350}''$ (=·0048 mm.),—the extremes being $\frac{1}{460}''$ (=·0036 mm.) and $\frac{1}{233}''$ (=·0072 mm.).

In order to study the minute structure and relations of these corpuscular elements, it is essential that the sections

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* It may be mentioned in connection with the preservation of specimens, that tissues which have been preserved in solutions of chromate of potash or chromic acid are very apt to become the sites of growth of fungi. One of the specimens of *healthy* skin which we preserved in chromic acid during our stay at Delhi was a few weeks subsequently found to be covered with a thick layer of mould as well as the fluid itself, which, having partially evaporated, had allowed the fragment of skin to project somewhat beyond the surface.

Liability of chromic acid preparations to become invaded by fungi.

should be made as thin as possible. Our sections were for the most part made from hardened preparations which had been embedded in parafin and sliced by means of a broad

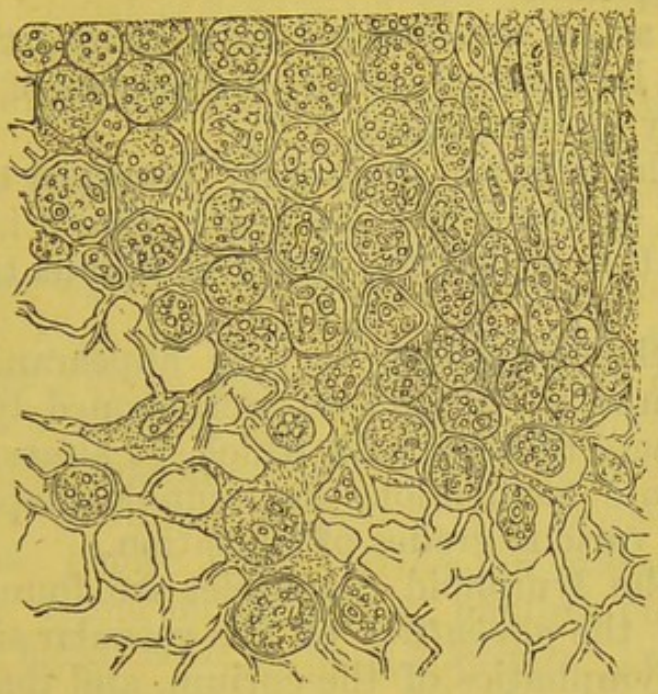

Fig. 8.
Section of a portion of a 'Delhi Sore' which had been preserved in spirit and weak chromic acid—×850 (Hartnack's Obj. No. 9 immersion).

and very sharp razor. The margins of almost any such preparation obtained in this manner will suffice to demonstrate the appearance presented in the accompanying woodcut (*vide* Fig. 8). The cells are observed to be of various shapes and sizes; some are spindle-shaped, with a well-marked oval nucleus, others appear to be intermediate between spindle cells and epithelial cells on the one hand, and lymphoid cells on the other, but the bulk of the cells consists of the granular lymphoid kind. As, however, the relation of these varied cells to each other constitutes one of the leading questions under discussion in modern biological research, it would be presumptuous to attempt to offer any opinion on the matter at present, especially in connection with a subject which has not been investigated for the purpose of attempting to solve so difficult a problem. It is sufficient for our purpose to know—

Summary of the pathology of Delhi sore.

1. That the morbid growth consists of granular lymphoid cells measuring from $\frac{1}{400}$ (=·006 mm.) to $\frac{1}{300}$ (=·008 mm.) of an inch in diameter, in which, without the addition of acetic acid, one or more nuclei may generally be detected.

2. That these cells are embedded in a cement-substance not readily detected in fresh preparations, but becoming firmer and less translucent by the action of spirit and other preservative media.

3. That, as in ordinary adenoid tissue, the corpuscular bodies may be brushed out of the meshes of the substance in which they are embedded.

4. That the cells are frequently observed to be arranged linearly, four or five corpuscles being placed in a row with, very frequently, a delicate string of fibrous tissue on either side.

5. That the corpuscles vary in appearance from mere irregular lumps of plasma to well-formed lymphoid cells, in such intimate relation with which, as almost to be suggestive of organic connection, are spindle-shaped and epidermoid cells in various grades of transition.

6. That the lymphoid corpuscles are found in intimate relation with the *adventitia* of the vascular tissues, notably those of the lymphatics of the corium, and that they tend to become aggregated into "colonies" of various size.

7. And finally, that the cells becoming pushed forward by the subjacent growth of others, gradually find their way to the surface through rents in the papillæ (*vide* Fig. 7).

Such are the salient points which we have been able to observe in connection with the minute anatomy of the Delhi form of the Oriental sore.*

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* During our stay at Delhi we made several attempts to transfer the disease to dogs by means of inoculations of perfectly fresh material derived both from the surface and substance of typical examples of the complaint; and made counter-experiments by irritating small surfaces of healthy skin with acid and with iodine. The results were not such as to call for any detailed account. We found that the irritated surfaces, no matter how induced, ran a somewhat similar course—the purely chemical irritants being to all appearances as deleterious as the matter obtained from the sore. The microscopical elements of which these artificially-induced little ulcers consisted were identical.

CHAPTER VI.

REGARDING THE PROBABLE NATURE OF THE ORIENTAL SORE AND ITS RELATION TO RECOGNISED SKIN AFFECTIONS IN EUROPE.

The diagnosis of Oriental sore.

We trust that our descriptions of the clinical and pathological features of this sore suffice to decide as to the propriety of identifying it with a form of a cutaneous affection which exists in Europe, and of classing it among the recognised skin diseases. For our own part we have little doubt that were a person suffering from such an affection to present himself at any of our English or Continental hospitals without divulging an Oriental history, there would be no great hesitation on the part of the physician in diagnosing the case before him. Given, for example, a case in which a sore is found on the cheek, another on the forehead or back of the hand, with perhaps a scar or two elsewhere, the cicatrices of former sores. Assume that one or more of these are surrounded by a somewhat hardened, slightly elevated, glossy margin; that they are nearly painless, have been very gradually, almost imperceptibly, spreading for weeks or months, although the general health of the patient does not appear to have been materially affected, and that no history of syphilis or scrofula can be ascertained. Putting these leading points together, the physician would in all probability pronounce it a case of one or other of the generally recognised forms of *Lupus*.

Reasons for recognising the sore as a form of Lupus.

When, in addition to the clinical history and microscopical appearance of the affection, the microscopical features of the sore, as given in the last chapter, are carefully considered, the evidence in favour of the correctness of such a diagnosis is almost beyond question. The pathological changes which we found to have occurred in the corium and in the rete mucosum correspond very accurately with what Virchow has described as characteristic of Lupus in his classical work on "Diseased Tumours."* Had Professor Virchow's description been published as one referring to specimens of the Oriental sore as seen at Delhi, we would unhesitatingly have added our testimony to its surprising correctness. His description of epidermal changes, of the changes

* "Die Krankhaften Geschwülste,"—Band II. S. 485, et seq.

in the hair and sebaceous follicles in Lupus find their counterpart in our own description of this sore, and we are particularly struck with the similarity which exists between his description of the epidermoid character of some of the portions of dsieased tissue in Lupus and what we have seen in the Oriental sore, and that, too, at a considerable distance from the epithelial layers.

Professor Virchow on the pathology of Lupus.

Professor Virchow writes: "The Lupus growth consists of young, tough, and generally, vascular, granulating tissue, which as a rule contains small round cells, which may so closely resemble the cells of the rete Malpighii, that it is difficult to differentiate the boundaries between the rete and the Lupus tissue. Frequently it seems as though the boundary had been obliterated, but I cannot admit, what might readily be supposed, that the cutis itself becomes transformed into a rete Malpighii, or that the elements of the rete press into the cutis. A decidedly epidermoid character is not assumed by the cells: they are young cells, of irregular form and of moderate durability. * * * The cells do not lie loose in the areolæ, but are surrounded by a tough, mucous intercellular substance giving a precipitate with acetic acid. The cells are delicate and fragile, and one may readily infer that they are only nuclei. * * * A careful examination, however, will reveal that they are cell bodies, generally rounded, but often oval or even spindle-shaped. They envelope the round or oval, large and generally single nucleus tolerably closely, and the latter is provided with one or two nucleoli. It is only towards the surface that the cells become multi-nucleated, occasionally presenting precisely the appearance of pus corpuscles."*

Thoma, Lange, &c., on Lupus.

Subsequent to the period at which this description was written several distinguished observers have paid special attention to the pathology of Lupus, and notably so during the present and past year. Thoma also directs attention to the gradual extinction of the boundary line between the corium and rete Malpighii—such an extinction as may be observed delineated in our figure of a section of the Oriental sore (Fig. 7, *c*); and lays stress on the point that the cell formations which take place in the corium are the essentially Lupus elements. At

* Op. cit., pages 487-8.

first, he says, cell-growths occur in the perivascular spaces of the blood-vessels of the skin,* aggregations of lymphoid elements which gradually penetrate all the interfascicular spaces of the corium, separating the connective tissue filaments normal to the corium.†

Still more recently Lange has published a carefully written paper on the "Histology of Lupus," accompanied by figures which might almost have served as illustrations to many of our own preparations of the "Delhi Sore."

We might go on citing authorities concerning this matter almost indefinitely, but as it is not our intention to discuss the various doctrines maintained regarding the particular tissues primarily involved in the affection, or to express any opinion on purely histological points, enough has been written to show that the microscopical changes which characterise the "sores" ordinarily met with at Delhi, and which are considered endemic to this and other localities, differ in no material manner from the changes which have been described as taking place in the various forms of Lupus in Europe. To those who desire a lucid resumé of the various doctrines advocated in connection with the pathology of Lupus, we would recommend the perusal of the chapter on the subject in the last edition of Neumann's work on "Skin Diseases."‡

No single pathological appearance diagnostic either of Lupus or Oriental sore.

Although none of the various pathological changes which have been described in connection with Lupus, and which we now refer to in relation with the Oriental sore when taken singly, can be designated as peculiar to either the one or the other, seeing that similar changes, though possibly differing in degree, are known to occur in other cutaneous affections, still, taking the appearances in the aggregate, they are sufficiently characteristic, more especially when, in addition, the clinical features of Lupus and of the Oriental sore are considered and compared. There can then be little doubt but that the diseases correspond in all the main points, and may be looked upon as essentially the same.

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* This view is in accordance with the researches of Dr. Thin regarding the origin of Lupus Erythematosus; *Lancet*, January 16th, 1875.

† Virchow's *Archiv.* Band. LXV; Heft. 3; *S.* 335—1875.

‡ "Lehrbuch der Hautkrankheiten," von Isodor Neumann; vierte Auflage—Wien 1876.

Whilst this paper was in course of preparation, we had the opportunity of perusing a very carefully written account by Dr. Geber of a sojourn in Aleppo for the purpose of investigating the nature of the affection known as the "Aleppo Bouton."* The sores referred to under this designation are, as already intimated, considered by all authorities to be, in all essential points, the same as those encountered in other parts along the Mediterranean, in Egypt, Arabia, India, and other Eastern countries. Dr. Geber has come to the conclusion that several kinds of affections are designated by the same term in Aleppo, but that all of them may be readily identified by any experienced dermatologist. For the most part, he looks upon the sores which prevail as more or less typical of Lupus; but a considerable number of the 'boutons' investigated proved to be of syphilitic or scrofulous origin.

Dr. Geber's researches in Aleppo.

These observations are in complete accord with our own experience in Delhi, with the exception that we did not observe any instance in which cases had been diagnosed as Delhi sores, by a qualified observer, which had any history to indicate that they were due to syphilis or scrofula. Errors of diagnosis, doubtless, occur in the bazars and among the population generally, but the cases which medical practitioners recognise as Delhi sores are, we believe, for the most part cases of one or other of the varieties of Lupus.

Dr. Geber's experience at Aleppo accords with our own at Delhi.

It is, however, highly probable that, owing to climatic and other differences, the disease may be modified in some degree from its European prototype; we know that it differs from it in being more localised to certain districts; in this, however, it is not altogether peculiar, for there are some other diseases which manifest distinctly endemic proclivities in this country without any such proclivities being recognised in England. Dr. Geber cites an instance of a school in Aleppo in which he identified 24 cases of Lupus (in addition to other skin affections) among 130 children, all of which were recognised there as "boutons." It would be hardly possible to find a school with such a proportion of sores in England, or to meet with such a number of

The endemic feature characterising Oriental sore.

* 'Erfahrungen aus meiner Orientreise.' *Vierteljahreschrift für Dermatologie.* Heft 4. Wien 1875.

persons in the streets marked with sores or their cicatrices as may be met with in Delhi. It seems, then, but natural to infer, that although the character of the sores present so much in common with Lupus as seen in Europe, some peculiar conditions exist in the locality which are sufficient not only to induce or predispose to the disease, but also possibly, in some respects, to modify its character, so that it would be well for purposes of classification to give it a specific designation. We would propose, therefore, that *Lupus endemicus* might be adopted as a sufficiently explicit definition of its nature and habitat.

SUMMARY.

THE report which we now bring to a conclusion may be thus briefly summarised:

1. Assuming that the cutaneous affection which we have studied at Delhi is, practically, of the same nature as the sore which is prevalent in Mooltan, Lucknow, Lahore, Scinde, and other parts of India, as also the chronic sore known in Aleppo, Biskra, Bagdad, &c., as 'bouton,' it comes under the general designation suggested by Dr. Tilbury Fox of 'Oriental sore:'
2. Our information of the distribution of the sore in India is taken from the statistics regarding 'abscess and ulcer' collected from all parts of the country, but our pathological observations are, for the most part, based on typical examples of the affection witnessed at Delhi:
3. Whereas of late years the statistical returns indicate considerable diminution in the number of hospital admissions among European troops from 'abscess and ulcer,' and among native troops also in such stations as are garrisoned by the two classes of soldiers; there is no such manifest decrease in the stations occupied solely by sepoys:
4. This discrepancy may be due to more attention having been paid to the sanitary requirements of those stations at which European troops are located:
5. That although at Delhi this inference does not constantly hold strictly correct, nevertheless it appears to do so at those seasons when the European and native soldiers are placed under equally advantageous conditions as to water:

6. In those years, when sores were notoriously prevalent among both the European and native troops stationed in Delhi, their water-supply was derived from wells. Latterly, the European troops in the Fort have been supplied with water from the river Jumna, whereas the native troops still resort to the wells. The wells, however, are flooded with water from the canal, which is derived from the Jumna, some miles distant. The canal supply occasionally fails, the well water assumes the character normal to the locality, and cutaneous disorders are a not uncommon sequence:
7. So far as our own observations go, there is no evidence of any parasitic agency in the production of the disease, and it appears probable that the deleterious effects are due to the chemical constituents of the water. In Delhi the quantity of salts with which the water is impregnated and its extreme hardness in so many of the wells is the most noteworthy feature. The unoxidised organic contents of the water would not appear to be of material influence, seeing that the water is not worse or even so bad as in many of the stations in Lower Bengal, where this cutaneous affection is, practically, unknown:
8. Although we are not in a position to speak definitely regarding the character of the wells in other military stations where the Oriental sore prevails, owing to the lack of analyses of assured accuracy, yet it appears highly probable, judging from the geographical position of the stations and from the statements of residents of several of them, that the well waters manifest properties similar to those which they possess in Delhi. The well waters in many of the places where the sore prevails, in Egypt, Asia Minor, Syria, and other countries, are also notoriously more or less brackish:
9. It seems, therefore, probable that although the salts, which cause the hardness of a water, may of themselves not be the actually deleterious ingredients, nevertheless this quality may serve as an index of properties in it which tend to favour the production of cutaneous disorders. Several salts exert a peculiar action on the skin; those of Iodine and

Bromine, for example, produce very characteristic eruptions:

10. With regard to the special skin affection in question, we have no hesitation in suggesting that the disease, as commonly observed at Delhi, setting aside all cases which are manifestly due to syphilis, scrofula, and the like, is in no way distinguishable from one or other of the various forms of Lupus; its clinical history is similar, as is also its morbid anatomy; and the treatment which has proved the most satisfactory is that which is generally recommended for Lupus:
11. It is probable, however, that, owing to climatic and other influences it may be somewhat modified from its European prototype as suggested by the fact of its prevalence being limited to particular districts—a feature which, so far as we are aware, does not characterise it in Europe in any special manner; and
12. Finally, we have suggested that the tendency which this form manifests to become endemic may be taken advantage of for purposes of nomenclature, and have therefore proposed that this form of Oriental sore should receive the designation *Lupus endemicus*.

CALCUTTA,
November 1876.

Govt. Central Press.—No. 7 S. C.—14-2-77.—100.