Experiment No. II.—A male calf was inoculated with the contents of three tubes of variola virus slightly opaque from a male 28 years old vaccinated in childhood, but suffering from a confluent attack. On the fourth day, a small vesicle was obtained on the abrasion near scrotum; on the fifth day, a second vesicle appeared. In the fourth generation of cultivation on the calf, secondary vesicles were produced.

Experiment No. III.—Virus from a case of confluent small-pox in an unvaccinated child was employed on the posterior part of the scrotum of the calf; a typical vaccine vesicle developed. *The sites of inoculation gave no results* beyond the usual papular elevation.

On the 27th January several Professors of Medicine, who had been invited to an inspection of results on a calf inoculated in part with variola-vaccine and with ordinary vaccine, stated they could not distinguish them. M. Haccius makes the following deductions from their experiments:—

"From the preceding remarks, we are authorized to conclude that the variola virus by its passage through the animals undergoes a transformation or at least a modification in its nature. Favoured by these successive passages, it loses its malignity and acquires the mild character of vaccine in producing a vesiculation localized at the points of insertion. To arrive at the experimental proof it is necessary to observe a particular technical operation, otherwise the result will be *nil* * * * If we had not taken care to use scarified and abraded surfaces it is probable that our inoculations of variola would not have been successful. This procedure is a most important factor for securing success."

Hime.—On the 16th May 1892, Dr. Hime, of Bradford, used variola lymph that was perfectly limpid, transparent and translucent, from a severe case of semi-confluent eruption in a woman aged thirty-seven years. The calf chosen was ten weeks old. Three abrasions and fourteen incisions were made. On the fourth day, all points of insertions having faded away without apparent action, four papules, otherwise than on the site of insertion, appeared. On the fifth day, two more papules of the same description made their appearance. By the eighth day, these papules had become vesicular. The lymph obtained was scanty, but perfectly clear and limpid. Two vesicles had also developed on the site of insertions. This first generation was used upon Dr. Hime's own person and upon a friend; and, although both had been effectually re-vaccinated, the insertions "took." A child was vaccinated also with the second remove successfully. Dr. Hime, on remarking on the results obtained, lays stress on his having chosen the calf instead of the cow.

(*To be continued.*)

ON THE RELATION BETWEEN ATMOSPHERIC PRESSURE AND CHOLERA IN THE BOMBAY PROVINCE.—(WITH CHART.)

BY SURGEON-CAPTAIN H. HERBERT, F.R.C.S.

THIS is an attempt to utilise some of the data accumulated in the Government of India Meteorological and Sanitary Reports. The 'Bombay Province' here referred to excludes Sind, where climate, soil, and cholera prevalence differ much from those of the rest of the presidency. Unfortunately the charts can only be extended back to the year 1877, owing to the want of earlier Meteorological observations.

Meteorological Laws.—A few extracts from the Government of India Meteorological Report are necessary to show the relative importance of what is to follow:—

(*Year* 1887, *p.* 271)—"It is hardly too much to say that one of the most important and striking features in Indian Meteorology is the remarkable persistency of the barometric variations or pressure anomalies. They are generally small in amount, but their duration amidst all the large changes of weather in India indicates most clearly that they represent real and important variations of conditions."

(*Year* 1887, *p.* 272)—"Experience ..... appears to have established;—..... That the larger pressure anomalies are chiefly due to hot weather actions."

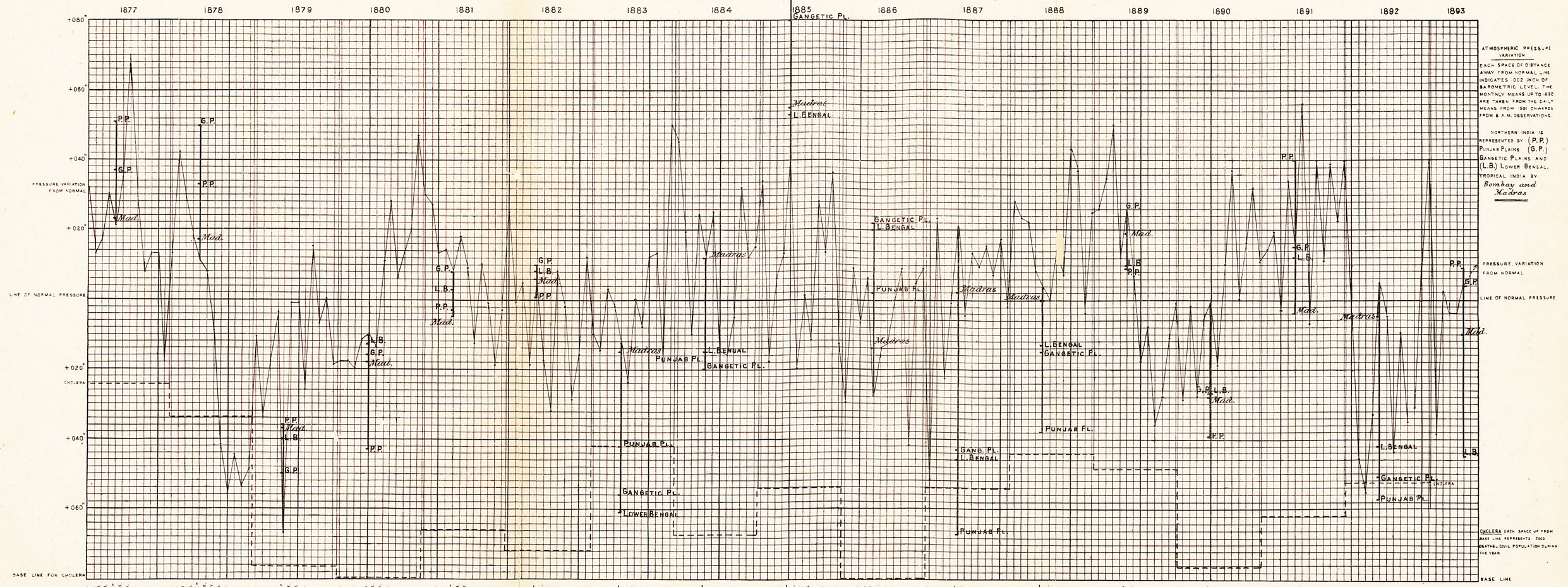
"That an important after-effect of prolonged rainfall is to smooth away or reverse the pressure anomalies existing previously to the rainfall."

(*Year* 1887, *p.* 265)—"If these (barometric anomalies) be small and the rainfall prolonged, the reversal may be permanent. If not, the reversal only lasts for some time when the permanent actions that produced the anomalies reproduce them again in a short time."

From the above and many similar observations in the Annual Reports, it is clear that the most important measurable guide to the weather of the year in India is to be found in the pressure variations, more especially the anomalies (variations from average) produced by hot weather actions, and before the reversing or smoothing away action of the rains comes into play. Thus dealing with monthly units, the pressure of May comes to be the most important of the year. And as regards pressure at least, the period of the S.-W. Monsoon, the rainy season, is the least important of the year, it being often merely a period of transition.

Rough Correspondence between Pressure and Cholera.—An examination of the chart gives evidence of a general rise and fall of the pressure variation (from the normal), roughly divested of its monthly oscillations, with the annual cholera incidence. The elevations and depressions of the cholera line lag a little behind those of atmospheric pressure in places. There is a slight droop in the pressure-curve to the year 1883, which does not correspond with the high rate of cholera in that year. The correspondence is best seen in years of marked abnormability. For instance, the heaviest cholera year

PRESSURE AND CHOLERA OF BOMBAY PRESIDENCY (EXCLUDING SIND.)



in the series is 1877. As regards pressure then (extract from Report for 1878, p 58). "From the summer of 1876 to the autumn of 1878 the pressure of the atmosphere was excessive over the Indo-Australasian region. A period of maximum pressure so intense . . . . has not indeed previously occurred since the commencement of the longest register of which I have present cognizance."

The very low pressure of the early months of 1892 was due to very exceptional heat. It was hence without influence on the cholera rate.

Influence of Hot Weather Pressure Anomaly.—As before mentioned, May is of all months the most important regarding pressure. Sometimes, as in 1886 (to quote from Reports, 1886, p. 91). "The characteristic pressure features of the year . . . . . were not prominent during the cold weather, or in April, but became strongly marked during the abnormally hot weather of May." The chart shews that years free, or nearly so, from cholera have had a negative hot-weather (May) pressure variation. And cholera years, with the exception of 1883, have had a positive hot-weather pressure anomaly.

Influence of Relative Local Pressure Anomaly.—But there is an important element in pressure: the local element.

The chart also displays the relation between the pressure variation of Northern and Tropical India in May of each year. As with the weather so with cholera apparently. A 'relative local anomaly' if strongly marked may be potentially an 'absolute anomaly.' The want of correspondence between the hot-weather pressure and the annual cholera of 1883 is thus partly explained. Though the May pressure of the Bombay and Madras Provinces in 1883 is below the normal, yet it is *considerably less so than that of Northern India* collectively. The pressure of Bombay and Madras here represents a 'positive local anomaly.' And we find the cholera of the year in Bombay and Madras is such as usually goes with an absolute positive variation. (In the Madras Presidency there is the same correspondence between pressure and cholera as in Bombay.) It is impossible yet to say how much this local anomaly must be allowed to over-ride the absolute anomaly. But comparing with other years in the series, the local variation in 1883 will only account for a small portion of the heavy cholera of that year. The only instances in which the hot-weather pressure variations of Bombay and Madras are decidedly in excess compared with those of Northern India are, besides 1883, 1877 (marked), 1888 (prolonged), 1884 (less marked and less prolonged), and 1892 (well marked). These years (excepting 1884) comprise, I think, the only instances in which the annual cholera rate is higher than agrees with the absolute hot-weather pressure anomalies. On the other hand, the years 1885 and 1886 are examples of the opposite condition in local variations. And the annual cholera ratios are seen to correspond with this condition. The cholera of 1884 is undoubtedly lower than should go with the pressure variation of the year, the absolute May anomaly being increased in value by the local anomaly. The 'relative local anomalies' of May 1877 and 1878 are more than neutralised by the unusual duration of the high pressure, before referred to.

It is evident that a consideration of the hot-weather pressure variation as modified by 'relative local anomaly' gives a fair gauge of the cholera of the year; though this is not borne out by the years 1879 and 1880. Comparing the two we see more cholera in the earlier year, though its pressure is more decidedly negative than that of 1880. But judging from a long series of records, it is hardly to be expected that the very heavy cholera of 1878 should at once die down to *nil.* And 1880 shews the result of the long continuance of negative anomaly.

The years 1883 and 1884 require further explanation.

Rainfall Influence.—All the more intense cholera of 1883 in the Bombay Presidency occurred in Khandesh and the Northern Deccan districts; those in fact nearest Berar. Now the Berar Province is made up almost entirely of black cotton soil, and the cholera there is remarkable in occurring practically only in the rains. The cholera in certain years is very severe, and these years are separated generally by intervals of two or three years practically free from cholera. There are never two severe cholera years, the one immediately following the other (as far back as 1868 at least, *i.e.,* as far as my statistics go). The cholera years are always years (except in 1889) of heavier rainfall than the years representing the intervals of freedom. The influence of rainfall here seems to far outweigh that of atmospheric pressure.

Now Khandesh and the Bombay Deccan are very largely made up of black cotton soil; I have not as yet been able to ascertain in what proportion in the different collectorates. And the rules mentioned above for Berar seem applicable in a subordinate way here. For instance, 1883 in Berar was a very heavy cholera year, and it was the year of heaviest rainfall of all the years I have tabulated (since 1871). The rainfall influence evidently extended into Khandesh and the Northern Deccan. These districts practically monopolised the cholera of the year in the Bombay Province. They had also their heaviest rainfall for all the years considered in the charts (since 1877). Precisely in these same districts there is an almost complete absence of cholera in 1884.

Evidently this is an application of the rule laid down for Berar, that severe cholera there never happens in two successive years. And this explains why the cholera of Bombay Province is less in 1884 than the hot-weather pressure would lead one to expect.

Persistence or Recurrence of Anomaly.—Persistence of pressure anomaly throughout the year, or recurrence of a hot-weather variation after the rains (to a less extent) implies strength of anomaly. It is noteworthy that such persistence or recurrence of positive anomaly occurs only in years of well-marked cholera prevalence. A lesser form of persistence is that in which a hot-weather variation is found to extend back unchanged through the previous cold weather.

Temperature Factor in Pressure Changes.—It has seemed to me that a nearer approach to a perfect correspondence between pressure and cholera would be obtained by eliminating the effect of variations in temperature from the former. Heat is considered on the whole favourable to cholera. It, however, lowers the barometric level. And it has been shewn that exactly the opposite condition, a high level of the barometer (in the hot weather at least), goes with excessive cholera in the Bombay Presidency. There is, however, no way of extracting this temperature factor from the pressure variations, unless a purely empirical standard were set up. A certain number, however, of the 'local anomalies,' those, as in 1885 and 1892, where the Punjaub variation greatly exceeds the others, including Bengal and the Gangetic Plains, serve to mark out years when the anomalies generally are due largely to temperature. In these cases the consideration of 'relative local anomaly' practically serves to elimimate the temperature factor.

Connection between Cholera and Pressure.—Throughout the above, I have refrained from suggesting that pressure-changes directly influence cholera. It seems probable that the pressure may be taken as an index to the weather suitable or unsuitable for cholera prevalence. In connection with Pettenkofer's ground-water theory attention may be drawn to Franklin King's work in the United States. He has shewn that even the very smallest barometric changes are reflected in the level of the ground-water. When atmospheric pressure falls the ground-water rises, and *vice versa.* It is possible some influence of the hot-weather pressure on the level of water in tanks, &c., may be shewn to affect the growth and development in them of the cholera microbe.

Possibility of Forecasting Cholera.—A glance at the chart shewes that there are certain types of years as regards pressure, and that there is a certain order in their sequence. The 'persistent' and 'recurrent' years have already been referred to (persistent anomaly throughout the year, or recurrent after the rains). The hot weather anomalies of the years following such are of the same character. 'Persistent' years are 1877, 1879, 1891. 'Recurrent' years are 1884, 1888. (In the year 1885 the recurrence was not lasting—see December and January. The May anomaly of 1886 is thus opposite in character.) In other years a strong variation in the cold and the hot weathers becomes completely reversed in the rains, 1878 and 1889 on the one hand and 1880 and 1890 on the other. In these cases the reversal lasts through the succeeding hot weather. The series of years is too small to establish absolute laws; but supposing with further experience the above rules prove to be invariable, there are nine years out of the sixteen completed ones in the chart in which the character of the hot-weather pressure anomalies could be foretold from the pressures of the previous years. And probably some idea of the magnitude of the anomaly may be taken from the strength of the variation of the preceding year. Among the nine years referred to there are only two, 1885 and 1892, with decided May 'relative local anomalies.' On examination these local anomalies do much to correct what in the absolute anomalies would be rather wide of the mark as regards magnitude of variation judged by what one might expect from the preceding year's pressure. Thus the influence of local anomaly need not, so far as one can see, be in any way a bar to prognostication, but rather the reverse. Possibly, the combined anomalies, local and absolute, and with them the annual cholera prevalence, may be forecast with a greater approach to accuracy than the absolute anomaly alone. And there is a prospect after some more years' experience has been accumulated, of forecasting from some of the less definite types of years of pressure.

To sum up—

I.—There is a general rough correspondence in the curves of atmospheric pressure variations and of annual cholera prevalence in the Bombay (restricted) Province.

II.—When the hot-weather pressure (practically the May pressure) is below normal, there is very little or no cholera during the year. On the other hand, a high hot-weather pressure is found in heavy cholera years.

III.—A fair proportion is apparent between annual cholera and hot-weather pressure when the 'relative local' element of the latter is considered.

IV.—A minor influence is the strength of the pressure anomaly as shewn by 'persistence' or 'recurrence.'

V.—Exceptionally heavy rainfall in the Northern Deccan may occasionally increase cholera there to such an extent as to vitiate calculations based on pressure alone.

VI.—There is a prospect of very fairly accurate forecasts of cholera in the Bombay Province within a few years. In a considerable number of years a rough estimate may even now be formed of the cholera of the immediately succeeding years.

NOTE.—I have not yet worked much at other parts of India. In the Madras Presidency the connection between atmospheric pressure and cholera is nearly as close as in Bombay. In Sind, cholera is an occasional visitant, but I believe it comes in high pressure years. In Bengal and Assam, pressure and rainfall have a mixed influence. In Berar the rainfall influence is paramount. Of the Punjaub and North-West Provinces I have made out very little as yet.

I am much indebted to the kindness of Mr. John Eliot, Meteorological Reporter to the Government of India, for ever-ready help and information.

FURTHER OBSERVATIONS ON THE MODIFIED OPERATION FOR EXTRACTION OF SENILE CATARACT.

BY V. VERGHESE, L.M.S.,
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IN the December issue of your Journal I read an article by Dr. T. E'Gappa on "A modified Operation for Extraction of Senile Cataract," in which he advocates the practice of primary rupture of the capsule by needle as the preliminary step for operation for cataract. I beg to bring to the notice of the readers of your journal that Dr. E. F. Drake-Brockman, Superintendent of the Government Ophthalmic Hospital, Madras, has been practising exclusively this method of operation since the time, as a medical student, I attended the practice of that hospital ten years ago, and I know, as a fact, that he has been doing so since January 1879. The same method was prominently brought to the notice of the profession in England, in an article in the *Medical Times and Gazette*, dated 7th May 1881, by Dr. W. Spencer Watson, who took up the suggestion of a continental Surgeon, Signor Correnti, of Florence. A reference to this method is made earlier in the Transactions of the Royal Medical and Chirurgical Society published in the *Lancet* of March 22, 1879, page 406.

Dr. Drake-Brockman's operation, which I have followed for the last three years, differs slightly, for the better, I think, from the one advocated by Dr. E'Gappa in that the cataract knife is introduced precisely in the same point at which the needle is introduced into the anterior chamber,—*viz.*, the outer and lower quadrant of the cornea as near as possible to the corneal limbus—and not in a different point as suggested by Dr. E'Gappa. By this means less disturbance of the corneal tissue is secured.

It is stated by Dr. E'Gappa that escape of the aqueous humour is a serious disturbing element in the operation. I beg to state that in not a single instance of the two-hundred and odd operations of Dr. Drake-Brockmans, which I had the opportunity of witnessing closely as the Resident Apothecary of the Ophthalmic Hospital, Madras, for a few months, and about a hundred cases that I have myself operated, have I observed any trouble on that score. I have noticed only a few tears trickling out as the needle is withdrawn. The needle, a Bowman's stop-needle, being the kind generally used by me, being somewhat triangular at the point, it strikes me that a note of caution is needed, that, after rupturing the capsule, the needle should be withdrawn on the flat of its point as the aperture would become larger if it is withdrawn edgewise.

I think I should here state that no Ophthalmic Surgeon should think of postponing the operation after once meddling with the capsule of the lens, as there is not only the danger of inflammatory mischief, but serious glaucomatous disturbance is likely to arise owing to increased ocular tension from swelling up of the lens by absorption of aqueous humour. I beg, however, to reiterate that, with ordinary careful manipulation, there need not be fear of any serious outflow of the aqueous.

As regards the advantages claimed for this plan, in addition to those brought forward by Dr. E'Gappa, I beg to state, in Dr. Drake-Brockman's own words, that—

Firstly, it allows of a more extensive laceration of the capsule at the same time that the anterior chamber remains replete with fluid;

Secondly, it permits of a complete exposure, and a more thorough knowledge is gained of the size and character of the cataract;

Thirdly, it permits of the iris to be kept away from the lens, and be rendered less liable to an injury by the cystotome;

Fourthly, it diminishes the tendency on the part of the iris to contract even after the corneal section has been effected,—by this means facilitates the escape of the lens;

Fifthly, by it the possibility of more accurately judging of the extent to which the cornea should be divided to permit of the escape of the lens is attained; and

Sixthly, the less necessity there is for the introduction of traction instruments to effect the removal of the lens, and the less interference there is with the natural position of the structures of the eyeball.

The varying relative sizes of the nucleus and cortex of the lens and the varying consistence of the cortex must make a small opening in the cornea sufficient in some cases and a larger one necessary in others. In Morgagnian cataracts it is often impossible to judge of the size of the nucleus before the escape of the enveloping