A REVIEW OF THE DYSENTERY BACILLI OF INDIA,
WITH SPECIAL REFERENCE TO CERTAIN RECENTLY DESCRIBED TYPES.

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INTRODUCTORY.

In two previous papers (Boyd, 1931 and 1932) an account is given of work carried out in Bangalore and Poona with the object of differentiating the strains of dysentery bacilli previously classified in India as "inagglutinable Flexners." It is shown that the majority of these anomalous organisms can be grouped into distinct types of definite antigenic composition.

A scheme of investigation based on these findings has been drawn up along the lines indicated in the second article, and has been in operation in all military laboratories in India since July, 1932. It has proved successful in enabling all known types of dysentery bacilli to be identified quickly and with precision, and as a corollary has facilitated the detection of atypical strains, which have in their turn been made the subject of special study.

In carrying out this investigation, a comprehensive definition of the term "dysentery bacillus" has been followed. The strict definition of a dysentery bacillus must of necessity be "a bacillus capable of causing the disease known as dysentery," and with rare exceptions, such bacilli have certain morphological and cultural characters in common. They are non-motile coliform bacilli which do not liquefy gelatin, and do not produce acid from lactose in twenty-four hours, but which acidify glucose in that period. There are, however, certain organisms having these characters
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which do not, as far as our present knowledge goes, cause dysentery: but to avoid the possibility of missing any dysentery-producing type, all strains having the above characters have been carefully investigated.

The search for dysentery group organisms has not been confined to material from patients showing active symptoms of this disease. All strains of this kind found in the routine examination of menials and convalescents have also been investigated. In the period under review, 35,126 menials were examined, and a total of 119,581 platings made from their stools. In addition, several thousands of platings were made of the stools of enteric convalescents. The results of this work constitute a massive control which has an important bearing on the question of the pathogenic action of the various types.

The routine measures which have been followed ensure that all dysentery group organisms from every military laboratory, and from whatever source isolated, are thoroughly examined, and it is therefore considered that the figures given in this article are representative in character and make no omissions of any importance.

The present paper is a study of the results obtained in the years 1932, 1933 and 1934, during the latter two and a half years of which period the scheme has been followed. The figures and other data which form the basis of the study are taken from two sources. Those relating to organisms other than "new" types are from the Annual Reports of Command, District and Brigade Laboratories. Those concerning the "new" types are from special pro formas which have been used in connection with this investigation, and which accompany a strain through the different laboratories in which it is examined, and finally are forwarded to Army Headquarters.

The objects of the paper are twofold:

(a) To make an analysis of all dysentery group organisms isolated in this three-year period in order to show the frequency with which the different types occur, and to emphasize the fact that the scheme embraces every type of importance which is to be found in India at present.

(b) To give a more detailed account of the cases in which the "new" types were found, and to discuss the evidence of the pathogenic action of these organisms.

Analysis of Dysentery Group Bacilli isolated in the Years 1932, 1933 and 1934.

Full details of isolations by Commands are shown in Table I.

In this table Andrewes' types (which Gardner has aptly termed the V-Z spectrum) are shown grouped together and not as individual types. While the writer's experience indicates that various criticisms of these types can be made, the fact remains that a serum which is polyvalent for the group meets all practical requirements so far as identification is concerned.
TABLE I.—ANALYSIS OF DYSENTERY ORGANISMS ISOLATED IN 1932, 1933 AND 1934.

<table>
<thead>
<tr>
<th>Non-Mannite Fermentors *</th>
<th>Mannite Fermentors</th>
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<tbody>
<tr>
<td></td>
<td>New types</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slips</td>
</tr>
<tr>
<td>Northern Command</td>
<td>345</td>
</tr>
<tr>
<td>Eastern Command</td>
<td>134</td>
</tr>
<tr>
<td>Western Command</td>
<td>132</td>
</tr>
<tr>
<td>Southern Command</td>
<td>198</td>
</tr>
<tr>
<td>Burma District</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>890</td>
</tr>
<tr>
<td>Percentage of Grand Total</td>
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</tbody>
</table>

Total number of strains investigated = 5,499.

* A small number of atypical non-mannite fermenting bacilli, which are still under investigation, are not included.
† These strains were isolated and discarded, labelled "Flexner (inagglutinable)," in the first six months of 1932 before the existing scheme of classification was in operation.
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Numerical Incidence of the Different Types.

It will be seen that, during the three years under review, in round figures 20 per cent of all dysentery-like bacilli isolated were non-mannite fermentors (B. dysenteriae Shiga and Schmitz), 52.5 per cent were of Andrewes' types (V-Z spectrum), just under 10 per cent were B. dysenteriae Sonne, and over 13 per cent were of the "new" types.

In all, 4.53 per cent of the strains isolated do not fall within these groups.

Of these, 1.73 per cent were "atypical" strains isolated in the first six months of 1932, before the scheme of classification was adopted, and before sera for the new strains were available for general use. Under the instructions then in force they were reported as "Flexner inagglutinable" and were discarded. There is every reason to believe that the majority of them belonged to one or other of the "new" types.

A further 1.76 per cent (exclusive, of course, of B. dysenteriae Sonne, which is shown separately) were late fermentors of lactose or saccharose or both. These strains have been specially investigated by Major R. A. Hepple. His work confirms the previously formed opinion, that owing to the feebleness of their agglutinogenetic properties, serological classification of this group is impracticable. There is no evidence that they exercise any pathogenic action. The majority of them were not isolated from cases of dysentery, but were found in the normal stools of menials or others undergoing "carrier" tests. The present practice is, therefore, to regard late lactose- and saccharose-fermenting strains (other than Sonne) as a definite, if heterogenous, group having no causal relationship to dysentery. The gelatin-liquefying properties of these organisms have not been properly tested.

The remaining 1.04 per cent are the only strains which do not fall definitely into one group or another. They will be considered in detail at a later stage, when it will be shown that the number of "unknowns" can be still further reduced.

The total number of strains which cannot be labelled is therefore well under 1 per cent, which would seem to show that, so far as India is concerned, the new system includes every strain of any practical importance.

Geographical Distribution of the "New" Types.

The distribution of the "new" types, as a whole, is not uniform throughout India. For example, isolations are proportionately much lower in the Eastern Command and Burma District than elsewhere. There is reason to believe that this has an artificial explanation, and that in future years the disparity will be less.

Certain of the types are much more common in some districts than in others. Thus, types 103 and P119 (which are very closely related to, and indeed should form part of, the V-Z spectrum) are of relatively common
occurrence in the Northern and Southern Commands, but are rare in the Western Command, while members of the dulcite-fermenting group (88, P274, D1) are more frequently found in the latter Command than elsewhere.

Despite these variations, which may well be of only temporary significance, the distribution of these organisms demonstrates that they are not merely local strains of no general importance, but are organisms which have a definite and widespread association with cases showing the symptoms of bacillary dysentery.

Source from which these Bacilli were Recovered.

With few exceptions the recognized dysentery bacilli, and the named "new" types, were isolated from cases suffering from dysentery. In contrast to the findings in dysentery cases, it is noteworthy that in the course of routine examination of menials for the carrier condition, dysentery bacilli have been found only on rare occasions, although all the types have at one time or another been encountered in these circumstances. Without doubt the explanation of these findings is that the individuals from whom the organisms were isolated suffered from mild chronic dysentery. In every case which came under his personal investigation the writer has been able to confirm this point by the detection of mucus exudate in the stools. In discussing the "new" types, reference will be made to all isolations from individuals not showing active symptoms.

Further Details Regarding the "New" Types.

Data which Constitute Evidence of Pathogenic Action.

Gardner (1929) cites the following four points as proof that bacilli of the Flexner group cause dysentery.

1. The great majority of persons whose excreta contain Flexner group bacilli are suffering, or have recently suffered, from clinical dysentery. The bacilli are selectively situated in the intestinal lesions.

2. The great majority of those who neither have, nor have recently had, dysentery harbour no Flexner bacilli.

3. The blood-serum of persons suffering from dysentery and harbouring Flexner bacilli in their intestines nearly always gives supernormal values in the agglutination and complement-fixation tests at some time during the disease.

4. A number of instances of accidental laboratory infection of human beings with pure cultures of these bacilli are on record, the result of the infection being indistinguishable from bacillary dysentery.

To these may be added a fifth point, namely, the recovery of one suspicious type, and of no other pathogenic organism, from a series of cases of dysentery occurring as an isolated outbreak. The presumptive evidence in cases of this kind is very strong.

It may be said at once that in the case of the "new" types, evidence
of the kind postulated in point 4 is, so far, lacking. While admittedly the existence of evidence of this nature would strengthen the case, its absence is of no positive significance. No fatal case resulting from infection with one or other of these organisms has occurred and hence no attempts at cultivation direct from intestinal ulcers have been possible. Neither have complement-fixation tests been done; but in view of the agglutination results this is of little importance. The number of individuals of the category mentioned in point 2 who have been examined is, as already mentioned, approximately 35,000.

In considering the pathogenic action of these organisms, the above points will receive special attention.

103.—This type has no claim to be regarded as new, as the writer has been informed by Dr. W. M. Scott, Ministry of Health, who kindly examined certain strains sent to him, that it is identical with one of the strains previously described as B. dysenteriae Y, which, by some mischance, was not included in the series investigated by Andrewes.

It is closely allied to the V-Z series, although it is only agglutinated to a fraction of the titre of a serum polyvalent for those organisms.

As has previously been described, it undergoes a striking mutation after varying periods of life in artificial culture, and produces a highly agglutinable variant which closely resembles the Y member of the V-Z spectrum. This mutation has been observed from time to time in the strains kept for the manufacture of high titre serum in the Enteric Laboratory, Kasauli; and it appears advisable to replace stock strains at frequent intervals by newly isolated strains which have been carefully identified. It is highly probable that the strains which were sent three years ago to the National Collection of Type Cultures have undergone this mutation and now exist in the form of variants indistinguishable from Andrewes' Y.

Of the 135 isolations shown in Table I, 134 were from cases showing the clinical picture of bacillary dysentery. No details as to severity are available regarding 5. Of the remainder 16 are recorded as severe, 43 as moderately severe, and 70 as mild. In one case the organism was isolated during the routine examination of a patient convalescent from paratyphoid A fever, who at the time showed no symptoms of active dysentery.

In 103 cases the isolation was made from blood and mucus exudate, macroscopically and microscopically typical of bacillary dysentery. In 30 cases the stools contained blood and mucus or mucus alone, but microscopically the exudate was indefinite. In the paratyphoid case mentioned above no exudate was present. One case is unrecorded.

Mixed infections occurred as follows: With W, 1 case; with V, 3 cases; with Schmitz, 1 case; with P119, 1 case; with E. histolytica, 3 cases.

In cases of dysentery the collection of serum for agglutination tests is often difficult, as the patients usually recover and are discharged from hospital prior to the optimum time for taking serum, which is about the
twentieth day after onset of the illness. For this reason many tests have been made before agglutinins had an opportunity to develop to their maximum, and the number of positive results has without doubt been reduced in consequence. Unfortunately records are not sufficiently complete to enable the exact day of disease when the blood was taken to be given. These remarks apply equally to all tests of the kind recorded in this article.

In 58 of the above cases the serum was tested for agglutinins for the homologous organism. Of these, 37 were negative, 5 produced agglutination in a dilution of 1:25, 7 in 1:50, 5 in 1:125, and 4 in 1:250 and over.

Gardner's points 1, 2 and 3 are therefore satisfied.

P119.—As far as can be ascertained, this type does not occur in any of the European classifications, but it has been recognized in Japan, where it figures as 'No. XII of Aoki's classification. Further reference to this will be made in a later communication.

Like 103, it is very closely related to the members of the V-Z spectrum, and particularly to X. It possesses, however, an antigen peculiar to itself, and as it is only feebly agglutinated by a serum polyvalent for the V-Z series, it must be regarded as a separate type.

This organism was recovered from exactly 100 individuals of whom 98 showed the usual symptoms of bacillary dysentery. Of these cases, 12 were classed as severe, 34 as moderately severe, and 50 as mild; in 2 no record of severity was made. These 2 isolations were from menials undergoing carrier tests, and it is significant that, although they presented no symptoms, mucus was present in the stools of both.

In 83 of the cases, the stool from which the organism was isolated consisted of blood and mucus showing typical bacillary exudate; 12 showed blood and mucus or mucus and indefinite exudate. The records relating to the remaining 5 are incomplete.

Mixed infections occurred as follows: With Shiga, 1 case; with V-Z spectrum, 12 cases; with Sonne, 1 case; with 103, 1 case; with 88, 1 case.

Agglutination tests with the patient's serum against the homologous organism were carried out in 39 cases; 17 were negative; 2 showed agglutination in a dilution of 1:25, 8 in 1:50, 8 in 1:125 and 4 in 1:250 or over.

Points 1, 2 and 3 are therefore satisfied. In both 103 and P119, the very close antigenic relationship which they bear to the V-Z series seems a further argument in favour of their pathogenic rôle.

170.—This type cannot be identified in any of the well-known classifications, and does not appear to have been previously described.

It possesses a distinct antigen peculiar to itself, and has no serological relationship either to the V-Z spectrum or to any other dysentery organism investigated by the writer.

Of the 134 individuals from whom it was recovered 132 were suffering
from symptoms of bacillary dysentery. Of these cases 6 were severe, 32 were moderate and 93 were mild, and 1 is incompletely recorded. The remaining two isolations were from menials undergoing routine examination.

Eighty-eight of the cases showed blood and mucus and bacillary exudate, 40 showed blood and mucus or mucus with indefinite exudate, 4 showed no exudate, and 2 are unrecorded.

Mixed infections occurred as follows: With V-Z spectrum, 1 case; with P274, 1 case; with Sonne, 3 cases; with E. histolytica, 3 cases.

Agglutination tests with the patient’s serum against the homologous organism were carried out in 68 cases. 49 were negative, 2 showed agglutination in dilution of 1 : 25, 12 in 1 : 50, and 5 in 1 : 125. As shown by rabbit inoculation, this organism has indifferent agglutinogenetic properties, with which finding the above results are in keeping.

It will be seen therefore that Gardner’s points 1, 2, and 3 are fulfilled by this organism.

88.—This organism, which is numerically the most common of the “new” types, presents several features of great interest.

In common with the four types which follow, it differs from the V-Z races and from the three types just described, in being a late dulcite-fermentor. This property is, however, not constant, being absent in about one-third of all strains isolated.

Although differing in its biochemical reactions, 88 has been shown by Dr. W. M. Scott to be identical in its antigenic composition to the organism known at home as the Newcastle dysentery bacillus, which has been proved responsible for several small outbreaks of dysentery in England and elsewhere. This antigenic similarity has been confirmed by workers in India (Lieutenant-Colonels R. F. Bridges and D. T. M. Large). Further, a strain having the biochemical characters of Newcastle, and the usual serological characters, has recently been isolated from a case of dysentery in Bareilly.

Table II shows the more important biochemical reactions of 88 (and of P288, P274, D1, and D19, which are identical in this respect), of Newcastle, and of B. alkalescens (Andrewes). The last of these organisms has never been found in association with cases of dysentery in India, but has been isolated from normal stools.

The discovery of the Newcastle dysentery bacillus in India is a matter

<table>
<thead>
<tr>
<th></th>
<th>Lactose</th>
<th>Glucose</th>
<th>Mannite</th>
<th>Dulcite</th>
<th>Indol</th>
</tr>
</thead>
<tbody>
<tr>
<td>88, P288, P274, D1, D19</td>
<td>No change</td>
<td>Acid</td>
<td>Acid</td>
<td>Acid (late) 10th day</td>
<td>—</td>
</tr>
<tr>
<td>Newcastle</td>
<td>No change</td>
<td>Acid and Gas</td>
<td>No change or Acid and Gas</td>
<td>No change or Acid and Gas</td>
<td>—</td>
</tr>
<tr>
<td>B. alkalescens</td>
<td>No change</td>
<td>Acid</td>
<td>Acid</td>
<td>Acid 3rd day</td>
<td>+</td>
</tr>
</tbody>
</table>
of considerable importance, as it has hitherto been the practice in military laboratories to discard non-motile gas-forming organisms isolated from cases of dysentery. (Repeated observations have led to the conclusion that here B. Morgan is not a cause of dysentery.) The routine method of investigation has now been altered to ensure that such strains do not escape notice.

88 shows a fairly close antigenic relationship to the V-Z spectrum, but is only feebly agglutinated by a V-Z polyvalent serum. It possesses a main antigen peculiar to itself.

This organism was isolated from 240 cases, of which 231 presented the symptoms of bacillary dysentery. Eighteen were severe, 80 were moderately severe, 125 were mild, and 8 are incompletely recorded. Of the remaining cases, 8 were menials undergoing routine examination and 1 was a convalescent case of typhoid fever.

One hundred and thirty-seven of the cases showed typical blood and mucus and bacillary exudate; 54 showed blood and mucus or mucus and indefinite exudate; 10 showed no exudate; and 12 cases are incompletely recorded.

In 1 case 88 occurred in association with V, in another with Schmitz, in another with 170, and in 2 cases with Sonne, while in 9 cases it was associated with E. histolytica.

Agglutination tests with the patient's serum against the homologous organism were carried out in 68 cases. Of these, 52 were negative, 1 showed agglutination in a dilution of 1 : 25, 7 in 1 : 50, 4 in 1 : 125, and 4 in 1 : 250 and over.

This type, therefore, fulfils Gardner's first three criteria. A further point, namely its antigenic similarity to the Newcastle bacillus, which has been shown to be the cause of localized outbreaks of dysentery elsewhere, seems to place the question of its pathogenic action beyond reasonable doubt.

P288.—As far as can be ascertained, this type has not been described outside India. It is relatively uncommon and in the three years under review it was recovered from only twenty-six cases.

It has an antigen peculiar to itself, and shows no cross-agglutination either with the V-Z spectrum or with any of the other types.

Twenty-five of the 26 isolations were from cases of typical bacillary dysentery, of which 1 was severe, 11 were of moderate severity, 13 were mild. The remaining case was a menial undergoing routine examination.

In twenty-two of the cases the stools showed typical blood and mucus and bacillary exudate, and in three blood and mucus or mucus and indefinite exudate.

In one case P288 occurred in association with E. histolytica.

Agglutination tests with the patient's serum and the homologous organism were carried out in eight cases. Five were negative, 1 showed agglutination in a dilution of 1 : 12, 1 in 1 : 50, and 1 in 1 : 500.

It is deemed advisable, for the sake of completeness, to make brief
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mention of a small isolated outbreak of dysentery apparently caused by P288 which occurred in June, 1935. The Indian platoon of a British regiment stationed in Mingaladon, Burma, was affected, and ten cases occurred between June 4 and 19; from the stools of these P288 was readily isolated, no other pathogenic organism being found. Details of this outbreak given by Major D. A. O. Wilson will be published in this Journal shortly.

P288 therefore satisfies the first, second, third and fifth of the above criteria.

P274.—The history of this strain is somewhat chequered and as investigations are incomplete it is not proposed to give any details at present other than a brief outline of the difficulties which have been encountered.

Subcultures of the original strain of P274, and of an identical strain P500, were sent by the writer to the Enteric Laboratory, Kasauli, for the preparation of high titre serum to be used in the new scheme of classification. A serum was in due course prepared which had a titre of 5,000, and, using this, ten strains were identified in various laboratories between July, 1932, and August, 1933.

About August, 1933, whilst periodic routine tests of the serum were being made at Kasauli, it was discovered that the titre had suddenly fallen to 500. Reflection at a later date indicates that this sudden fall in titre was probably due to the use of a new batch of bacterial suspension for testing the serum. At the time the significance of this point was not appreciated, and it was assumed that the serum had deteriorated.

A fresh serum was accordingly prepared and issued, and between August, 1933, and December, 1934, twenty-three strains of P274 were identified in various laboratories.

Now comes the interesting point. Prior to August, 1933, a number of strains of "inagglutinable Flexner" had been received for investigation at Kasauli. When these were tested with the new P274 serum no fewer than thirteen of them agglutinated to the titre of the serum.

The possibility of these unexpected results being caused by mutation in the strains of P274 was considered, but was discarded in favour of the simpler explanation that the serum issued to laboratories had deteriorated even more quickly than that stored in Kasauli.

Some recent work has challenged this hypothesis in rather a striking way. Since the discovery of the Newcastle dysentery bacillus in India, gas-forming strains are being tested with a serum which is polyvalent for all the dulcite-fermenting strains, of which 88 (antigenically identical with Newcastle) is one. Two gas-forming strains which were agglutinated by this serum were discovered and presumed to be Newcastle bacillus, but when these were tested with monovalent serum it transpired that they were clumped, not by 88, but by P274 serum.

This problem has been carefully investigated by Major F. G. A. Smyth, who will publish full details in due course. It has been found that P274 serum will agglutinate these gas-forming strains in much higher dilution
than it will agglutinate its homologous organism; yet this is undoubtedly a heterologous agglutination, as absorption of P274 serum by the gas-forming organism, while it removes all agglutinins for the latter, has little effect on the agglutinin content of the serum for P274 itself.

These facts strongly suggest that the existing strain of P274 is a variant which contains two or more antigens, of which at least one was lacking in the original strain. The mutation which has taken place from the original strain bears points of resemblance to that which has occurred in *B. dysenteriae* Schmitz (Boyd, 1935), but there are certain anomalous findings which have still to be cleared up. All freshly isolated strains which agglutinate with P274 serum are now being collected and compared. Until the question is settled, the validity of the strains which have been named P274 is open to suspicion, and it is therefore premature to give any analysis of results.

The experience carries a moral which cannot be too strongly emphasized. It is this: No classification of dysentery bacilli is of real value unless it is founded on results obtained from *recently isolated* strains. Mutation during artificial life especially in the mannite fermenting series is by no means a rare occurrence, and may involve a change in the antigenic pattern of the organism which will completely invalidate any conclusions formed, in so far as they are applied to newly-isolated strains. This is no mere academic criticism, for many attempts at classification have gone astray through lack of appreciation of this point.

D1.—This organism has an antigen peculiar to itself and shows no cross-agglutination with other strains.

Thirty-seven of the 41 cases from which it was isolated were clinically bacillary dysentery. Two were severe, 5 were of moderate severity, 26 were mild, 4 are incompletely recorded, and 3 were menials undergoing routine examinations who showed no symptoms.

In 27 cases the organism was recovered from typical stools of blood and mucus showing microscopically bacillary exudate. In 7 cases the stools contained blood and mucus or mucus, but microscopically showed indefinite exudate. In 3 cases information is not available.

On no occasion did the organism occur in association with other dysentery bacilli, but twice it was isolated in mixed infection with *E. histolytica*.

Agglutination tests with the patient’s serum and the homologous organism were performed in 8 cases. Six were negative, in one agglutination occurred in a dilution of 1: 85, and in another 1: 250.

Although the evidence of serological response by the patient is not so full as might be desired; this is chiefly because of the small numbers tested. Points 1 and 2 are fulfilled.

D19.—This is a rare type which hardly merits individual attention, as it has been isolated on only five occasions in three years. The original strain was one of a collection made by Major W. Walker in Secunderabad. No isolations of this organism were made by the writer during his three years in Bangalore and Poona.
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A late dulcite-fermentor, it is unrelated in its antigenic composition to any of the other types.

All five cases from which it was isolated were clinically bacillary dysentery. Two were moderately severe, and 3 mild; 3 showed bacillary exudate, 2 indefinite exudate. D19 occurred in association with W in one case and with Sonne in another. These were the two moderately severe cases.

Agglutination tests were carried out with the patient's serum and the homologous organism in three cases: two were negative, but in the third (which was not one of the mixed infection cases) agglutination occurred in a dilution of $1 : 250$.

It is perhaps worthy of note that this strain has well-marked agglutinogenetic properties. The evidence satisfied Gardner's first three points, but is too scanty to permit of definite conclusions being drawn.

Atypical mannite-fermenting strains (excluding lactose-saccharose fermentors).

Fifty-seven strains of this kind were isolated. Of these, twenty-three were dulcite fermentors, and were not sent to Kasauli. They were not specially investigated, but there is good reason to believe that a proportion were $B. alkalescens$ (Andrewes), although definite evidence on this point is not available.

The remaining thirty-four strains have been investigated by Lieutenant-Colonel R. F. Bridges at the Enteric Laboratory, Kasauli, and it is by his courtesy that the following results are available.

(1) One strain proved to be the Newcastle bacillus already mentioned. Strictly speaking it should not be classed as atypical, but should be bracketed with 88.

(2) Thirteen strains were proved by agglutination and absorption tests to be identical with P143, one of the less common strains isolated in Poona.

The following is an analysis of the 13 cases from which P143 was isolated. All were typical cases of bacillary dysentery. One case occurred in Kasauli, 1 in Sialkot, 1 in Razmak, and the remainder in Quetta. One case was severe, 4 were moderate, and 7 were mild; information is not available regarding the remaining case.

The stools contained typical blood and mucus in all cases, and all except one showed bacillary exudate microscopically. In one case $E. histolytica$ was discovered; in the remaining 12 no other organism of a pathogenic nature was found.

Agglutination tests with the patient's serum and the homologous organism were carried out in two cases and were negative.

Gardner's first two points are satisfied but other evidence of pathogenicity is not yet forthcoming.

(3) Five strains proved to have some antigenic relationship to one

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1 See *Journal of the Royal Army Medical Corps*, 1932, Vol. 59, p. 332.

The antiserum for all these strains was transferred to the Enteric Laboratory, Kasauli, to serve as a starting point for further investigations.
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another, 2 being of one type and 3 of another, the 2 types showing a moderate degree of cross agglutination. Although neither was agglutinated by the usual diagnostic sera, the serum prepared from one of these types (the first) has considerable agglutinating powers against organisms of the V-Z spectrum. This type forms indol, and does not ferment dulcite. The other type (three strains) ferments dulcite, but does not produce indol, differing in this respect from B. alkalescens. All five were from typical cases of dysentery.

(4) The remaining fifteen strains bore no serological relationship to one another or to any known organism.

From the above data it is considered that 103, P119, 170, 88, and P288 may be accepted as being capable of causing bacillary dysentery. The evidence regarding D1, and more especially D19 and P143, is less complete but nevertheless points definitely in the same direction. P274 is still sub judice.

**Summary and Conclusions.**

(1) A table is given which analyses the dysentery group bacilli isolated in the military laboratories of India in 1932, 1933 and 1934.

(2) Dysentery group bacilli isolated by the writer in Bangalore and Poona of types and not described in "A System of Bacteriology" (1929) have proved to be widely distributed throughout India, and with few exceptions have been found only in the stools of cases of clinical dysentery.

(3) Using a system of classification in which these strains are included, it has been possible to identify practically all dysentery group bacilli isolated during this period. No further strains of any importance have been discovered.

(4) The evidence as a whole is in favour of the belief that the majority of these 'new' strains (three of which have been found in other countries) are capable of causing dysentery.

**Acknowledgements.**

My thanks are due to all officers, R.A.M.C. and I.M.S., who have worked in military laboratories during these three years, as it is only by their loyal co-operation that it has been possible to make this investigation. The final typing of the "new" strains was carried out by Lieutenant-Colonels Dunbar and Large, and Majors Hepple, Scales, and Mearns; the rather thankless task of attempting to classify the lactose-saccharose fermenting strains was undertaken by Major Hepple, and at all times advice and help of every description, together with all the diagnostic sera, were provided without stint by Lieutenant-Colonel Bridges, who also carried out further investigations of "inagglutinable" strains.

**References.**

Idem. Ibid., 1935, 64, 289.
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