

## ATYPICAL STRAINS OF TUBERCLE BACILLI IN HUMAN TUBERCULOSIS

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VERY early in the work of identifying tubercle bacilli from human sources it was found that some strains did not conform exactly either to the human or to the bovine type. Certain strains, while exhibiting cultural features of one or other type, fell in virulence below the standard of the type to which culturally they belonged. Other strains had the distinctive virulence of the human or of the bovine type but corresponded exactly to neither of these types in cultural characteristics, while a few strains diverged from the standard types both in cultural characters and in virulence.

### 1. DYSGONIC HUMAN STRAINS

In this section I give an account of the cultural characters, proportional frequency and regional distribution of the group of strains which have the virulence of the human type, but grow with less luxuriance than that type on some of the differential media. This group of strains has been designated 'dysgonic human'.

In the years 1913–14–15 Eastwood, F. Griffith (1914) and A. S. Griffith (1914), when investigating the types of tubercle bacilli in bone and joint tuberculosis, observed that some cultures with the virulence of the human type of bacillus did not exhibit on all the differential media used the classical cultural characters of that type. The common or ordinary human tubercle bacillus grows luxuriantly—producing thick creamy wrinkled or warty layers—on all media containing glycerine and forms canary-yellow coloured growths on bovine serum when this is of a golden-yellow colour. The aberrant strains which are the subject of this section, on the other hand, although they grow well and are indistinguishable from eugonic strains on plain egg, bovine serum, glycerine egg and glycerine serum, are dysgonic on glycerine agar, glycerinated potato and glycerine broth. On these media the growths are hardly distinguishable from those of tubercle bacilli of bovine type.

#### *Cultural characteristics*

As already stated the characters of the strains on certain media are indistinguishable from those of eugonic human bacilli. It follows therefore that if cultural tests were restricted to these media dysgonic human strains would go undetected. To ascertain whether or not a strain which grows well on plain egg and glycerine egg belongs to the dysgonic group of human bacilli it is essential to use glycerine agar, potato or broth. Of these three the potato medium is in my opinion by far the best, since it is least liable to vary and is

the easiest to prepare. A good agar medium has, however, the advantage over potato that it enables the delicate filmy growth which some strains make during the first few weeks to be seen. On viewing this growth on agar under the microscope it is found to be composed of minute filmy grey colonies. At other times the growth produced was grey, translucent and finely wrinkled. On further incubation secondary colonies often made their appearance in the initial layers and these grew slowly and persistently, some becoming heaped up, crateriform or convoluted, hollow in the centre, and of a dull yellow, sometimes pinkish colour.

On potato during the first few weeks there is, as on agar, initial growth which varies in thickness from an extremely thin barely visible film to a grey or greyish yellow moist granular layer, always decidedly inferior to that of eugonic bacilli. Very thin growth could sometimes not be detected on the surface of the potato, but its presence there could be inferred later by the extension of the delicate grey growth on to the walls of the tube in contact with the potato. On further and even prolonged incubation there was in some tubes no evidence of further growth. But in the majority of tubes towards the end of the second month, and occasionally later, small opaque pearly-white colonies could be seen against the blue background of the potato, springing up from the grey or greyish yellow initial basal layers. Sometimes only one colony appeared and none subsequently, but usually there were several and these, as on agar, grew slowly, attaining in some instances large dimensions. The number of these secondary colonies has varied from one to a dense outcrop. The colonies usually appear successively, and in such tubes after 6 to 9 months' incubation colonies of many different sizes and shapes are present.

Viewed under magnification the surface of the potato with an abundant outcrop has a very striking appearance by reason of the bizarre shapes of the colonies. They take the form of upright or slanting processes, either roughly cylindrical or clubbed at one or other extremity. Some of the cylindrical processes bend round to meet the surface again, forming a hoop, or they coil round themselves and others and resemble the casts of worms. Other colonies are more ordinary in shape and range from a small granular body up to a large mass; the larger colonies are dull, yellow, or sometimes pinkish in part and have a warty, mulberry-like outline or are highly convoluted. Sometimes from these large irregular colonies there may be one or more thread-like outgrowths which after a devious course may unite again with the parent colony at some place remote from its starting-point, giving where there are several threads a Laocoon effect.

The strains retain their peculiar characteristics after passage through animals and also after the most prolonged artificial cultivation, provided that they are not grown upon media containing glycerine. For example, one strain which had been maintained on plain egg for more than 25 years was still dysgonic when transferred to glycerinated potato. But if one of the secondary colonies on potato is removed and separately subcultured on egg and then

tested on potato it will be found that the strain now grows luxuriantly on glycerine potato and glycerine agar and is indistinguishable in these respects from eugonic human bacilli. This result has been obtained with every secondary colony from potato of the many different strains which have been tested in this way. The increased capacity for growth on glycerinated potato is permanent and is not lost by passage through the animal body: moreover, the virulence of the modified strains is the same as that of the original strains.

An increased capacity to grow upon the previously unfavourable glycerine media (potato or agar) may also be acquired by subculture on glycerine egg, but this has been a rare event. Two of the early strains became fully eugonic through subculture on glycerine egg, but further attempts with this media have failed although the strains were subcultured for many generations. The conclusion I came to from these early results (colonies from potato were not subcultured until later) was that very few of the dysgonic human strains were unstable on glycerine media. With one exception all the dysgonic human strains I have tested have eventually produced secondary colonies on glycerinated potato, subcultures of which are eugonic on glycerinated potato, agar and broth. As I have previously stated, the number of these secondary colonies has varied widely with different strains. These differences may be attributed to variations in the proportions of the elements of a culture which are capable of adapting themselves to utilize glycerine more fully for their growth.

It may be asked why this adaptation occurs so rarely on glycerine egg and so constantly on glycerinated potato. On glycerine egg the bacilli grow a little better than on plain egg and therefore must utilize the glycerine to some extent. The explanation may be that the constituents of the egg in the glycerine egg medium are adequate for luxuriant growth without altering the metabolic activity of the bacilli, whereas on glycerinated potato the substrate is soon exhausted and continued growth can proceed only where bacilli develop the power fully to utilize glycerine for their growth.

#### *Occurrence and relative frequency*

Dysgonic human strains have been found in all the principal forms of human tuberculosis and there is no evidence that they differ at all from eugonic strains in virulence for the human subject. The proportional frequency of the strains in the different forms of tuberculosis is shown in Table 1.

The total number of cases yielding dysgonic human strains was 73 or 1.9 % of the cases examined. The percentage frequencies of bovine and human bacilli in the series were 17.2 and 80.9 respectively.

In two cases of pulmonary tuberculosis due to dysgonic bacilli the sputum was examined a second time after intervals of 227 and 262 days respectively and in each instance again yielded a dysgonic human strain. In a case of tuberculous meningitis dysgonic human strains were obtained from the meninges and the mesenteric glands. No case of a mixed infection with dysgonic and eugonic human bacilli has yet been demonstrated.

The occurrence of dysgonic human bacilli alone in the sputum of cases of human pulmonary tuberculosis and their stability after long periods of residence suggests that the agent of transmission of these bacilli is human sputum. No instance of familial infection with the organism has, however, yet been established.

Table 1. *Cases investigated in Great Britain*

Form of tuberculosis	Eugonic human	Dysgonic human	Bovine	Total
Bone and joint	586	15	179	780
Cervical glands	71	1	84	156
Meningeal	213	2	80	295
Genito-urinary	82	1	25	108
Lupus and scrophuloderma	136	4	124	264
Autopsies	180	2	61	243
Phthisis pulmonalis	1815	48	103	1966
Total	3083	73	656	3812

The figures given in this table relate to Dr Griffith's investigations only, as he had not compiled the table he describes. [Ed.]

#### *Distribution*

Dysgonic human strains are widely distributed and have been found in England, Scotland, Europe (chiefly in Denmark by Jensen) and Nigeria. Cases of tuberculosis due to the organism occur with greater relative frequency in Scotland than in England and, curiously, their percentage frequency in pulmonary tuberculosis, like that of bovine bacilli, is higher in the rural districts of north-east Scotland than in other parts of Great Britain. The figures for pulmonary tuberculosis are shown in Table 2.

Table 2

	Eugonic human	Dysgonic human	Bovine	Total
North-east Scotland:				
Aberdeen city	400	14	19*	433
County cases	464	23	50*	537
Rest of Scotland	490	8	31	529
England	461	3	3	467

\* Includes one mixed infection of bovine and human.

In Nigeria a number of strains of tubercle bacilli have been obtained by Dr J. A. Young from tuberculous natives during life or after death. Fifty of these have been examined in Cambridge and no fewer than twenty-eight were proved to belong to the dysgonic human group, the proportion being higher than in Scotland. But in striking contrast to Scotland cases of bovine infection are rare in Nigeria, only one of the fifty cases investigated yielding a strain of that type.

## 2. TWO ANOMALOUS STRAINS

*M. 668*

This strain was derived from the cerebro-spinal fluid of a woman, aged 27 years, who died of meningitis. The woman had had a perfectly normal and healthy childhood and no ill-health at any time until complaint of headaches a few weeks before her death. The cerebro-spinal fluid gave a cell-count of 80 per c.mm., largely mononuclears.

The fluid was inoculated subcutaneously into a guinea-pig by Dr J. Menton, Stafford, who killed the animal 42 days later and sent to me the spleen and an inguinal gland. The spleen showed no lesions, but the gland contained caseous areas from which the culture was obtained.

The primary colonies on egg and glycerine egg and the early subcultures on the differential media were indistinguishable from those of tubercle bacilli of the bovine type. It was therefore very surprising to find, on testing the virulence, that the strain produced only slight tuberculosis in the rabbit and typical severe tuberculosis in the guinea-pig, that is to say, the strain though 'bovine' culturally, exhibited the pathogenic peculiarities of bacilli of the human type.

In consequence of these equivocal results the case could not be included in the statistics relating to types of tubercle bacilli in tuberculous meningitis which I published in 1934. Further investigations were undertaken in order if possible to determine to which type—human or bovine—the strain belonged.

The results of the bacteriological investigations of the strain are summarized.

*Cultural characters.* Thirteen strains in all have been examined, one from the original guinea-pig and twelve from animals—seven guinea-pigs, four rabbits and one goat—which had been used for virulence tests. All the passage strains were dysgonic and identical with the original strain.

In primary cultures on egg at 3 to 4 weeks the colonies were flat, filmy and transparent with pimple centres. After long incubation—3 to 22 months—the colonies exhibited the following characters. The centres were raised, smooth domes, generally less than 1 mm. in diameter, of an old-ivory colour; the margins were widespread, transparent or translucent, expansions with fern-like surface markings; where not very numerous the colonies fitted into each other but remained separate forming a mosaic. Some cultures on egg through the guinea-pig developed rather large prominent opaque colonies. Subcultures of these on glycerine media were dysgonic.

On glycerine egg in primary culture the colonies in the different experiments varied in number—from one or two to moderate—and were always fewer than on plain egg. In one experiment (G.P. 6752) no colonies grew on glycerine egg although on plain egg they were moderately numerous. The original primary culture on glycerine egg showed scattered colonies (on plain egg the colonies were numerous) with small raised centres and flat, almost transparent margins. The tube was kept in the incubator for 4½ years, without much

drying of the medium. The colonies then practically covered the surface, their centres were either pinhead-sized, smooth, old-ivory coloured domes or were formed of clusters of small smooth domes; their margins were widespread and filmy, transparent peripherally and translucent in the middle zone, with radial fern-like surface markings and one or two slight concentric thickenings.

For  $4\frac{1}{2}$  years the strain was maintained on plain egg and frequently tested. After  $2\frac{1}{2}$  years' subculture the strain still produced thin moist layers on egg. On glycerine egg after many generations (35) the growths were sparser than on egg, being composed of more or less discrete colonies, as contrasted with the uniform layers on egg. On glycerine potato after many months incubation, up to 9, there was either a thin moist grey layer with an outcrop of pearl-like colonies up to a pinhead in size, or a greyish finely granular layer composed of small colonies; larger cream-coloured finely granular colonies, up to 5 mm., occasionally developed.

In the course of time the strain began to grow more luxuriantly, but even after  $4\frac{1}{2}$  years' maintenance on plain egg (50 generations) the best growth produced on three potatoes was an ashen-grey granular layer which later acquired a creamy tinge but attained only a moderate thickness without becoming wrinkled. On glycerine agar the strain produced a grey, in places greyish-white, ground glass layer of no great thickness.

On the other hand, after having been subcultured on glycerine egg for some time the strain grew on glycerine potato with greater luxuriance than the cultures which had been maintained on plain egg. The best growth was thick, cream-coloured with a bossy, convoluted surface, not uniformly wrinkled like eugonic human bacilli. This increased luxuriance is not inconsistent with the earlier dysgonic characteristics since, as is known, some strains of typical bovine bacilli can become adapted to grow luxuriantly on glycerine media.

*Pathogenicity.* The pathogenicity of the strain was tested on two goats, eleven rabbits, sixteen guinea-pigs and one vole.

*Goat 172*, inoculated subcutaneously, dose 10.0 mg., died 58 days later. *Autopsy.* At seat of injection caseous abscess,  $1\frac{3}{4}$  in. in length  $\times$   $\frac{3}{4}$  in. in thickness. Left prescapular gland 3 or 4 times size of right, hyperplastic, without sign of caseation. The lungs showed about six minute grey translucent foci. No lesions elsewhere. Cause of death not obvious.

*Goat 173*, inoculated intramuscularly, dose 15.0 mg., died of pneumonia, not tuberculous, 56 days later. *Autopsy.* At seat of injection small flat fibroid tumour with a central abscess. Left prescapular gland enlarged and on section showed scattered minute opaque foci and a caseous nodule 2 mm. in diameter. Except for one minute opaque tubercle in the lungs there was no sign of tuberculosis elsewhere.

*Rabbits.* Of the eleven rabbits seven were inoculated with the original strain and four with strains recovered from animals. The results of these experiments are summarized in Table 3.

*Guinea-pigs.* Of the sixteen guinea-pigs two were inoculated intraperitoneally, dose in each case 0.1 mg. and fourteen subcutaneously, doses 0.1 mg. in eleven and 1.0 mg. in three instances.

Four of the subcutaneously inoculated guinea-pigs died prematurely in from 12 to 21 days; three of these showed local tuberculosis only and one (died 19 days) local tuberculosis, extensive miliary tuberculosis of the spleen and a few foci in liver and portal gland. The remaining twelve guinea-pigs died

Table 3

No. of rabbit	Strain	Method of inoculation	Dose in mg.	Duration of life days	Result
3905	Original	Intrav.	0.01	K. 71	Lungs, seven tubercles up to small pin-head. No other lesions
3904	"	"	0.1	K. 49	Lungs, only a moderate number sub-miliary tubercles. Kidneys, sparse minute tubercles. Liver, one or two minute grey points
4186	"	"	0.1	D. 25	Lungs, moderate number minute tubercles. Liver, scattered microscopic grey points
3930	"	"	1.0	K. 128	Lungs, scattered miliary tubercles, most in caudal lobes which showed at each posterior tip a pea-sized caseous abscess and in their margins slight tuberculous deposit. Kidneys, each a few small tubercles and one caseo-pus in the calyces. Nothing elsewhere
3931	"	"	1.0	K. 93	Lungs, moderate T. human type. Kidneys, moderate number small caseous tubercles in cortices, caseous foci and streaks in medulla and caseo-pus in some calyces. No lesions elsewhere
3877	"	Subcut.	1 pr. cult	K. 108	Small local lesion and three or four minute tubercles in lungs
3888	"	"	5.0	K. 55	Local lesion and glands only
4128	R. 3930	Intrav.	0.1	K. 104	Lungs, about twelve tubercles. Kidneys, six tubercles
4233	R. 3931	Subcut.	10.0	K. 172	Very small local lesion. Lungs one, kidneys three tubercles
4234	R. 4186	"	20.0	K. 102	Small local abscess with sinus. Nothing elsewhere
4093	Goat 173	Intrav.	0.1	K. 103	Slight T. lungs and kidneys

The last four experiments show that the strain was not increased in virulence for the rabbit after residence in the tissues of either the rabbit or the goat.

in from 28 to 92 days of typical severe general tuberculosis, the liver and spleen showing extensive necrosis.

The results of the tests on the goat, rabbit and guinea-pig show unequivocally that the pathogenic effects of the strain are those which characterize tubercle bacilli of the human type.

*Vole.* One vole was injected subcutaneously in the left groin with 1.0 mg. of the strain when it had been nearly 4½ years under cultivation. The vole died 82 days later. At the seat of injection the skin showed a small opening

through which the local lesion had probably discharged itself. Left inguinal gland, 8 mm. in diameter, was converted into a caseous abscess; deeper in the groin a small gland contained a caseous tubercle; on right side a similar group, but the larger gland was only 5 mm. in diameter. Both iliac glands were enlarged, left more than right, and caseous throughout. Portal gland was partly caseous. Coeliac, right renal and a lumbar gland each contained a caseous tubercle. Mesenteric glands showed a few opaque foci. Both submaxillary glands were caseous. There was a caseous tubercle on the mesentery and a caseous focus in the wall of colon. Spleen, enlarged, contained three or four caseous foci; liver, a few minute opaque foci. Lungs were patchily congested and hepatized, but no grey solid areas.

*Microscopically.* Tubercle bacilli were very numerous in an iliac and a submaxillary gland and in the hepatized lung and moderately numerous in the spleen and liver.

The effects produced in the vole were more severe than in any vole injected with eugonic tubercle bacilli of the human type and resembled those produced by bacilli of the bovine type.

#### *Summary*

Strain *M* 668 was derived from the cerebro-spinal fluid of a woman, aged 27 years, who died of meningitis.

In primary culture and in early subcultures on the differential media the strain was dysgonic and the colonies were indistinguishable from those of tubercle bacilli of the bovine type.

After successive subcultivation on the differential media (up to 4½ years in some instances) the strain began to grow slightly more freely, especially when grown on glycerine potato after having been subcultured on glycerine egg. This, however, is not inconsistent with its earlier dysgonic character since some strains of typical bovine tubercle bacilli can become adapted to grow luxuriantly on glycerine media.

In experiments on 2 goats, 11 rabbits and 16 guinea-pigs, either by inoculation of the strain direct or after passage, the pathogenic effects were similar to those produced by tubercle bacilli of the human type.

The strain was tested on a vole and the disease produced resembled that following inoculation of tubercle bacilli of the bovine type.

#### *M. 911*

This strain was obtained from a boy, aged 10, suffering from tuberculosis of the lumbar spine. The original material was aspirated pus which yielded cultures directly and through the guinea-pig. One colony only grew on four tubes sown with the pus; when 6 weeks old the colony was whitish, hemispherical and less than a pinhead in size; it was increased by spreading and on subculture on glycerinated potato produced in 15 days a fairly thick, buff, wrinkled layer. This strain was described as eugonic human and discarded



before the abnormal properties of the guinea-pig strain were brought to light. The guinea-pig was inoculated subcutaneously with the original pus and was killed 30 days later. The autopsy showed an ulcerating caseous local lesion, great enlargement and caseation of the inguinal glands, early caseation of the sternal and portal glands, numerous caseous nodules in spleen and numerous small necrotic foci in liver—a severe result in so short a time.

Cultures were sown with caseous substance from an inguinal gland. The colonies on egg were small and flat with pimple centres and for this reason the virulence of the strain was tested on a rabbit. The rabbit was injected intravenously with one-thousandth of a primary culture on egg.

While this experiment was in progress the cultural characters of the strain were determined on glycerinated potato, on which medium it produced luxuriant growths, like the direct strain. The death of the rabbit in 84 days from severe tuberculosis of the lungs was therefore very unexpected and the possibility of the guinea-pig strain being a mixture of human and bovine bacilli was considered and examined. The bacilli were recovered in culture from the rabbit and passed through a series of rabbits, cultures intervening. All the passage strains proved identical in cultural characters with the original strain. The following is a description of the cultural characters of the strain. When fully developed the primary colonies on egg had smooth, domed, old-ivory-coloured centres averaging about 1 mm. in diameter and extremely thin filmy margins visible only by reflected light, when delicate fern-like surface markings could be seen; on one tube the colonies had transparent or slightly translucent margins which were frilled peripherally and smooth around the raised centre. Nearly all the growths on the plain egg medium became studded with secondary colonies; these were smooth, whitish and spheroidal and a few were aggregates of five around a hollow centre and one was umbilicated. No branched forms were seen microscopically.

On primary glycerine egg the colonies were as numerous as on egg and formed a thickish warty layer of aggregated colonies, often with a pinkish tinge.

On bovine serum the strain formed a greyish white soft layer, not pigmented, slightly cream-coloured when scraped up.

On glycerinated potato all strains produced a thick, creamy, highly wrinkled layer.

The strain therefore was eugonic, but the primary colonies on plain egg partook of the characters of those of the bovine type.

The virulence of the culture through G.P. 7091 was tested on five rabbits. The results after intravenous inoculation varied from severe tuberculosis of the lungs (death in 84 days) to slight generalized tuberculosis; after subcutaneous inoculation of 20.0 mg. slight disease, chiefly of the lungs, was produced. The slight disease was not more than might have followed inoculation of ordinary eugonic human bacilli. Cultures recovered from these rabbits resembled in cultural characters the original strain.

*Passage Experiment with strain M. 911, through guinea-pigs*

Culture G.P. 7091	
R. 4291, 0.001 mg. intrav.	
D. 84, G.T. see table	
Lung culture	Kidney culture
<p>R. 4331, 0.001 mg. intrav. K. 172. Moderate G.T.</p>	<p>R. 4382, 0.001 mg. intrav. D. 36. Moderate, no tubercles in lungs and spleen and dust-like foci in liver. All glands and ? marrow contained tubercles</p> <p style="text-align: center;">Popliteal gland culture</p> <p>R. 4345, 0.01 mg. intrav. K. 96. Moderate G.T. Nail-shaped nodules in kidneys</p> <p style="text-align: center;">Kidney culture</p>
<p>R. 4394, 0.001 mg. intrav. D. 97. G.T. moderate, severe in lungs, slight elsewhere</p>	<p>R. 4395, 0.01 mg. intrav. D. 64, severe G.T.</p> <p style="text-align: center;">Lung culture</p>
<p>R. 4454, 10 mg. subcut. K. 171. Slight to moderate T. lungs only</p>	<p>R. 4455, 10 mg. subcut. K. 158. Moderately severe T. lungs. Scap. glands watery cysts. Kidneys, three tubercles and a few pits</p>
<p>R. 4552, 10.0 mg. subcut. D. 89. Caseo-purulent lesion, 2 in. Scap. glands caseous throughout and softened. Lungs large, congested and extensively replaced by large caseous and caseating masses. Nothing elsewhere</p> <p style="text-align: center;">Lung culture</p>	<p>R. 4551, 10 mg. subcut. D. 30, G.T. moderate miliary T. lungs</p>
<p>R. 4631, 10.0 mg. subcut. K. 323. Small caseous lesion. Nearest glands, small watery cysts. Lungs crepitant, in right three irregular firm caseous areas up to 2 cm. and two small caseous nodules; in left one large firm caseous lesion, one small caseous lesion, 6 mm. in post. tip and two tubercles; otherwise normal</p>	

The culture was recovered from the severely affected rabbit which died in 84 days and passed through five rabbits in succession, cultures intervening between the passage rabbits, the total duration of residence in the rabbit body being 850 days; four of the passage strains were injected into more than one rabbit. The pathogenic effects of the passage strains, like those of the original strain, were irregular and varied from severe to slight generalized tuberculosis; six of the eleven rabbits used in this experiment had generalized disease which, after intravenous inoculation mainly, approached in severity that produced by bovine tubercle bacilli. The cultures recovered from these rabbits, however, resembled in characters those of the original strain and the final passage culture (dose 10.0 mg. subcutaneously) produced in a rabbit after 323 days a local lesion and slight tuberculosis of the lungs only. There was therefore no indication of the presence in the strain of typical tubercle bacilli of the bovine type. The virulence of the strain in fact appeared to diminish on cultivation and during passage through the rabbit.

For the vole the pathogenic effects were indistinguishable from those of the eugonic human type of tubercle bacillus.

Table 4. *Rabbits injected with culture of M. 911 through G.P. 7091*

No. of rabbit	Method of inoculation	Dose in mg.	Duration of life days	Result
4291	Intrav.	0.001	D. 84	Lungs filled chest, extensively consolidated and replaced by coalescing caseating masses
4393	Subcut.	20.0	K. 94	Local T. Lungs crepitant, contained about two dozen caseous nodules and marginal patches 2-5 mm. in diameter. One kidney showed minute focus on surface
4396	Intrav.	0.01	K. 103	Lungs crepitant, slight marginal tuberculosis and scattered miliary tubercles. Kidneys, two small grey nodules on surface and a few caseo-purulent streaks and foci in depth
4466	Intrav.	0.01	K. 133	Moderate T. lungs and slight T. kidneys. Miliary T. of one iris and one lachrymal gland
4467	Intrav.	0.01	K. 134	Moderate to slight T. lungs

### *Summary*

Pus from a lumbar abscess in a boy, aged 10 years, produced severe general tuberculosis in a guinea-pig. A culture from this guinea-pig resembled a bovine strain in primary culture on egg and a eugonic human strain in subculture on glycerine egg and glycerinated potato. The virulence of the strain was high for the guinea-pig and irregular for the rabbit. For some rabbits the pathogenic effects of the strain were much more severe than those of typical human bacilli and approached, but did not equal, those of bovine bacilli. The results in other rabbits were similar to those of eugonic human bacilli. Cultures recovered from the rabbits resembled in characters the original strain, which was therefore not a mixture of the human and bovine types of tubercle bacilli. The strain cannot be described as 'human' or

'bovine' according to the usually accepted distinction between these types in the rabbit, but according to the results in the vole could be classified as belonging to the human type.

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