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THE RELATION OF BOVINE INFECTION IN THE CHILD TO CLINICAL TUBERCULOSIS IN THE ADULT.*

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The discussions which have taken place relative to the transmissibility of bovine and human tuberculosis have been second only in interest and bitterness to those which took place over the relative merits of tuberculin.

After fifteen years of discussion, much experimentation and the isolation and study of bacilli from many cases of tuberculosis representing different localizations of infection, it has been fairly determined to the satisfaction of the scientific world that:

1. Bovine infection can be transmitted to human beings.

2. That it is accountable for about 10 per cent of tuberculosis, but that the human infection is accountable for most of the disease in the human race.

3. That bovine infection is common in childhood, but rarely found in adults.

The following table, taken from the report from the Imperial German Board of Health, well illustrates the distribution of bovine tuberculosis:

	Total No. Investigated Cases	Types		Per Cent	
		Human	Bovine	In Adults	In Children
Tuberculosis of the lungs	811	807	5	0.66	...
Tuberculosis of the Bones & Joints	99	95	5	0.66	4.3
Meningeal Tuberculosis	33	30	3	0	10.34
Generalized Tuberculosis	178	147	33	2.5	23.18
Tuberculosis of the Cervical Glands	167	120	47	5.8	40.7
Tuberculosis of the Mesenteric Gl.	112	78	35	12.0	51.0
	1,400	1,277	128		

These statistics, however, do not agree with those of Fraser (Journal of Experimental Medicine, 1912), who found 63 per cent of bone and joint tuberculosis to be of bovine origin. Neither do they show as large a per cent of bovine infection as the English commission, which reports 17.6 per cent of pure bovine infection and 5 per cent of associated bovine and human. Of the total number of 108 cases examined by them bovine bacilli were recovered in 22.2 per cent.

From the above table several very important facts may be noted. It will be noticed that there is practically no bovine infection affecting the lung; only 5 out of 811 cases. These 5 were found in adults. In the 99 cases of bone and joint tuberculosis examined, from only 5 were bovine bacilli recovered. Of the total number of cases affecting adults 6.66 per cent were due to bovine bacilli, and of those affecting children 4.3 per cent were due to bovine bacilli. Of the 33 cases of meningitis bovine bacilli were isolated from 3, all being in children. Of the total number of cases of meningitis 10.34 per cent were due to bovine bacilli. Of the 178 cases of generalized tuberculosis, 33 were due to the bovine bacillus. Only 2.5 per cent of the cases in adults showed bovine infection, while 23.18 per cent of those in children showed bovine infection. Of the 167 cases of tuberculosis of the cervical glands, 47 were due to bovine infection. 5.8 per cent of all tuberculosis in adults was due to the bovine bacillus, while 40.7 per cent of that in children was due to the bovine bacillus. Of the 112 case of tuberculosis of the mesenteric glands, 35 were due to bovine infection, 21 per cent of the cases found in adults were due to the bovine infection while 51 per cent of that found in children was due to the bovine bacillus. This shows that bovine infection is particularly common in those types of tuberculosis found in children in which we might suppose infection to have taken place through ingestion. It also shows that the bovine infection is particularly common in children but relatively infrequent in adults.

The important question arises: Why this

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difference in frequency between childhood and adult life? What becomes of bovine bacilli that are taken in during early life? Any investigation intending to throw light upon this question must start with this important fact established, that bovine infection is common in childhood, but extremely uncommon in adult life. In the solution of the problem this clinical fact is probably only secondary in importance to the pathological and bacteriological study of the infection and the characteristics of the bacillus. The following queries are important in this connection:

1. Is it possible that there is such a difference in the susceptibility of the child to bovine bacilli as compared with the adult that that infection cannot take place except with the greatest difficulty in the adult?

2. Is the opportunity for infection with bovine bacilli removed from the adult?

3. Do bovine bacilli when taken into the bodies of members of the human family, as in children, find the soil so uncongenial that they succumb and finally disappear?

4. Is it possible that bovine bacilli finally adjust themselves to their new host to such a degree that his tissues become a perfectly agreeable medium for their growth, and that as a result of such growth they gradually assume the cultural, morphological and infective characteristics of human bacilli?

While these questions cannot be settled by speculation, logical discussion cannot help having a wholesome influence. While the suggestions which I shall make are more in the nature of query than anything else, yet I believe they are important.

Regarding the difference in susceptibility of the child and the adult, is it probable that this is the reason for the difference in the amount of bovine infection in the child and adult? Even if there was a marked degree of difference in susceptibility, there would still most certainly be a fair proportion of bovine infection in the adult, for it is not rational that the adult should so completely lose his susceptibility. Neither is this idea in harmony with the belief which is generally accepted, that the infection in the child stands in intimate causative relationship with and is accountable for a large amount of the clinical disease of the adult. While the adult does not consume the amount of milk that the child consumes, yet he is by no means removed from the danger of ingesting bovine bacilli to a degree commensurate with the freedom from infection which he enjoys.

It seems to me, then, that we must either believe that bovine infection for the most part becomes non-virulent or heals, confining its sphere of activity to the child, or that the bovine bacillus changes its type by residence in the body of man. It produces quite a large proportion of the clinical tuberculosis of childhood, and, as far as can be judged, seems to be well able to adapt itself to the soil and thrive. That it thrives equally well with the human bacillus does not seem probable, for it is natural to suppose that a human bacillus which has grown for generations upon human media would be better adapted to it than a bovine bacillus which has lived under the extremely different conditions necessitated by the different tissues of the bovine family. But that it will and does adapt itself is evident. The possibility which seems most probable to me is that these different bacilli after living in human tissue for a time adapt themselves to the new conditions and gradually become the bacilli which would naturally be produced on human soil.

Such a transmutation of type has been suggested as being the explanation of some of the cases which have been carefully examined, where both bovine and human bacilli were found in the same lesion. It is opposed, however, by experiments which have shown that repeated passage of bovine bacilli through different animals and repeated cultivation on artificial media failed to change them to human bacilli; also the fact that human bacilli have been repeatedly passed through animals without change. But there may still be sufficient difference between a rapid repeated passage

through animals and a prolonged sojourn in the human body, such as must occur if childhood infections produce adult tuberculosis, to make the necessary difference for a change of type.

While experimental and cultural failures may occur, it is quite conceivable that bacilli of the bovine type might be taken into the body of the child and be inactive for a prolonged period and finally, when able to multiply, produce bacilli suited to the human soil or go on to repeated multiplications until the culture adapts itself perfectly to the soil and takes upon itself characteristics of the human bacillus. I think it far more probable that repeated passage through the human animal should be accompanied by transmutation of type than that repeated passage through animals and repeated growth on artificial media should be followed by such changes.

Bearing on this theory is also the fact that bovine bacilli are taken into the body through the same mucous membranes of the gastro intestinal tract that the human bacilli are. They take the same course thereafter, causing local infections in the lymph glands or in non-lymphatic tissue with secondary involvement in the lymph glands.

Thus far we know no difference, although we are probably correct in assuming that bovine bacilli do not infect the human organism as readily as human bacilli do. At this point all changes. The bovine bacilli either produce metastases at once and go on to active tuberculosis, or are never heard of again as bovine bacilli. The human bacilli, on the other hand, may either produce metastases now or at any future time and are still human bacilli.

If bovine infection quiets down and remains inactive for a time, to break down in later life the same as the human infection does, it certainly does not show as a bovine infection when it does become active again. Unless transmutation occurs and the bovine bacilli of the early infection changes and becomes of the human type, we are compelled to assume that bovine infections in childhood do not, except rarely, produce metastases in later life, and that, in this, they are wholly unlike human infections. The most rational explanation of the facts observed requires the acceptance of the idea of transmutation.