THE EVIDENCE FOR COMPULSORY PASTEURIZATION OF MILK

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For many reasons the popularity and consumption of milk are on the increase, so that the time has come for the medical profession in general and health authorities in particular to take stock of their position in this matter. Milk is the vehicle for carrying many unpalatable things: farm dirt, cow manure, filth from milkers' hands, dirt from vessels, as well as other things not unpalatable but often disastrous to man, such as *Brucella abortus*, Koch's tubercle bacillus, and the organisms of enteric fever. There is a school of thought which believes that we must all swallow "a peck of dirt before we die." This should be a consolation to the many who are forced to drink milk with admixture of manure in varying strength, and until the far-off day when all milking will be mechanically performed, with conveyance direct from the cow into sealed sterilized bottles, it seems reasonably certain that milk will continue to contain dirt.

For this there are two reasons: first, that milking-cows are most difficult animals to keep clean, since they produce great quantities of liquid manure; and, secondly, that the milker is a poorly paid worker to whom cleansing of udders and washing of hands are irksome matters, generally inadequately performed. There can be no question that efforts by sanitary authorities to improve the cleanliness of milk production under the various Orders and Regulations evolved by the Ministry of Health have brought about great improvements, and to-day the production of milk is very much more cleanly than a decade ago. Yet they have done little more than remedy gross abuses; the day is far removed when cows will be groomed like horses. However, if it is as yet impossible to ensure that the community shall consume milk free from dirt, there can be no convincing argument in favour of continuing to allow this milk to carry live pathogenic organisms. Very few will now welcome tuberculous milk for its immunizing properties. Vaccination by a method so crude that many succumb to the immunizing dose should find little support in the scientific world of to-day, where any form of immunization with an equal number of fatalities would instantly be abandoned.

Pathogenic Organisms Derived from the Cow

Pathogenic organisms may gain entrance to milk before and after it leaves the cow. In the first group are those arising from cattle infections, the chief organisms being bovine tubercle bacilli, *Brucella abortus*, and streptococci from mastitis. The incidence of bovine tuberculosis in children, as meningitis, cervical adenitis, and lesions of the bones and joints, has been estimated by various workers. Dr. Stanley Griffith (1934) cultured material from the meninges of 214 cases of tuberculous meningitis. In this series, combining results from England and Scotland, 24.3 per cent. proved to be of bovine origin. In England the amount is somewhat lower at 21.8 per cent. and in Scotland considerably higher at 40.5 per cent. Since pasteurization of milk is very much more extensively employed in towns and cities, and the above figures include the excess of infections due to the human bacillus occurring in towns, it is probable that the percentage incidence of bovine meningitis in country districts of England is even higher. In support of this there are Griffith's thirty-three cases from the county of Kent, of which 33 per cent. were found to be bovine in origin. It is significant also that during the first year of life only 15 per cent. were bovine, since cows' milk is more commonly heated when given to babies than to children of higher ages.

The incidence of bovine tuberculosis in cervical glands appears to be greater than that in the meninges. In England Griffith (1929) found 45.7 per cent. of cases (fifty-three out of 116) to be due to the bovine type. In Scotland the proportion is even higher, Mitchell (1914) in Edinburgh finding 88 per cent. and Blacklock (1932) in Glasgow 64.3 per cent. of cases (eighteen out of twenty-eight) of bovine origin. There is, again, a difference between country and town children, for Blacklock remarks "a striking fact that of the twenty-one country children in our series of cases with tuberculous cervical adenitis sixteen (76.2 per cent.) were infected with bovine strains and five with human, while of the seven city children [Blacklock refers to Glasgow, where he says 80 per cent. of the milk is pasteurized] only two (28.6 per cent.) were infected with the bovine type." Finally, in lesions of the bones and joints Blacklock (1932) found 34.6 per cent. (nine out of twenty-six) to be bovine; Griffith 20.9 per cent. (eighty-nine out of 426) in English children, and 28.6 per cent. (eight out of twenty-eight) in Scottish children. Roughly, then, for Great Britain as a whole at all ages, half to two-thirds of the cases of tuberculous cervical adenitis, one-quarter of the cases of tuberculous meningitis, and one-fifth of the cases of bone and joint tuberculosis appear to be of bovine origin.

If we now turn to undulant fever we find evidence of extensive infection of humans by *Brucella abortus* derived from milk. But, owing to the insidious nature of this fever and the difficulty in diagnosis, we have not the same wealth of statistics as are available for bovine tuberculosis. It is only within the last decade that the possibility of infections of the human with *Brucella abortus* has been largely recognized. In 1928 Dalrymple-Champneys (1934) records that only five cases were reported. In 1932, with increasing diagnosis, this number was fifty-seven. There is little doubt that the true number of infections is considerably in excess of this, possibly even ten times that number (Wilson, 1932). Dalrymple-Champneys has collected 147 cases, and reports "that 141 of these were consumers of raw milk—that is, milk which had not been boiled or pasteurized"—and he adds: "It is important to note that two of these patients drank Certified milk, three Grade A tuberculin-tested, and four Grade A." He recommends that, failing the provision of abortus-free herds, "all medical officers of schools should insist upon a pasteurized supply of milk."

There is a similar uncertainty as to the incidence of streptococcal infections resulting from mastitis, sores on the teats, and other septic infections. Such infections are not notifiable, and they go for the most part unrecorded. In America (Rosenau, 1935) between 1907 and 1923 there were seventeen outbreaks of septic sore throat with a total of 3,497 cases. Some of these may have been due to contamination of milk after it had left the cow. In English outbreaks, of which that occurring in Brighton and Hove in 1929 was a classic example, the sore throat is of varying grades of severity, and the worst cases have a variety of complications, possibly with fatal results. As another example of many such milk-borne outbreaks in England may be quoted that which occurred in August, 1935, at Chelmsford, when the number of cases of septic sore throat was of the order of 1,600 (Camps and Wood, 1936).

The Extent of the Danger

The situation thus revealed as to the incidence in England of these three cattle infections is serious. *Brucella abortus* and the haemolytic streptococcus, to an extent at present impossible to estimate, swell the reservoir of undiagnosed and undiagnosable fevers, and the bovine tubercle bacillus causes the deaths of four times as many children as scarlet fever and over half as many as diphtheria. The percentage of cattle infected is clearly very high. The number infected with tuberculosis has been variously placed at between 40 and 70 per cent. It is not clear how many of these are actually excreting tubercle bacilli in the milk, or in the

faeces which subsequently contaminates the milk, but in Manchester in 1929 9.8 per cent. of milk samples were found to contain virulent bacilli, and of samples from 697 farms sending milk into Manchester eighty-eight (12.63 per cent.) gave positive results (Ministry of Health Report, 1931). Dalrymple-Champneys (1934) has said that "experienced veterinarians are agreed that something like 80 per cent. of our milk herds are infected with *Brucella abortus*, and that most, if not all, infected cows excrete this organism in their milk at some time during their infection, which is usually long." The incidence of mastitis is extremely high and affects even the herds producing graded milk. For example, Pullinger (1935) found that milk from ten out of twelve herds producing certified milk and twelve out of fourteen herds producing Grade A tuberculin-tested milk contained mastitis streptococci when examined at intervals over a period of fifteen months. In short, it would probably be no exaggeration to say that three-quarters of the cattle in England would at any one time be found to be excreting one, two, or even three of these organisms in virulent form.

The removal of such extensive infection seems almost hopeless. Even with a State veterinary service, a carefully organized eradication campaign, control of importation and internal markets, and almost unlimited funds, any substantial progress would take long years to achieve. In the meantime tuberculosis alone among the numerous milk-borne diseases would probably cause about 2,600 deaths annually (Economic Advisory Council Report, 1934). Compare this with the dramatic results achieved in Toronto, where, following the institution of universal pasteurization in 1915, no single case of bovine tuberculosis among city children has occurred (Price, 1934).

Pathogenic Organisms Not Derived from the Cow

In the second group of pathogenic organisms contaminating milk are those which may gain entrance to milk after it has left the cow; these are usually of human origin. The opportunities for contamination of milk are abundant—at the time of milking, in the dairy, during transportation, or in the household—and milk may, in addition, be contaminated by flies. There is no doubt that in this way a great number of epidemics of enteric, cholera, dysentery, scarlet fever, diphtheria, and septic sore throat have occurred. Rosenau (1935) reports that in the United States between 1907 and 1923 there occurred seventy-eight outbreaks of typhoid fever with a total of 3,008 cases, fifteen outbreaks of scarlet fever with a total of 2,940 cases, seventeen outbreaks of septic sore throat (these were probably mainly the result of mastitis, not of contamination from outside) with a total of 3,497 cases, and seven outbreaks of diphtheria with a total of 169 cases. Rosenau adds that "since the general adoption of pasteurization for milk supplies of large cities in Massachusetts milk-borne outbreaks occur characteristically in small unpasteurized supplies." "When all these facts are brought together," he continues, "they make a strong indictment against raw milk." Indeed, there is such a wealth of data recording outbreaks of milk-borne diseases due solely to the contamination of milk after it has left the cow that the very weight of evidence serves to confuse and to suggest that that which has existed so long might be allowed to continue unchecked. If more eloquent testimony were needed than that already provided by the long list of milk-borne epidemics which have been placed on record, it is to be hoped that the recent outbreak of typhoid in Bournemouth, which for severity recalls that in Clifton in 1897 (Davies), and which was checked by pasteurization, will have served to bring the risk and the realization of the remedy clearly before the public.

There can indeed no longer be any doubt that the time for more active prevention than that yet exercised has arrived. Bovine tuberculosis is a deadly malady with a double tragedy to parent and child; undulant fever is an insidious disease often baffling to the doctor and the

cause of long periods of ill-health; typhoid and other milk-borne epidemics are the more disastrous because of their suddenness and the difficulty of tracing their origin. Against all this there is a preventive as complete and absolute as is vaccination against small-pox or inoculation against diphtheria. If all milk from to-day were pasteurized there need not be one more child crippled by bovine tuberculosis. Hospital mortuaries in England would be depleted of a third, and those in Scotland of nearly one-half, their present number of victims of tuberculous meningitis; epidemics of milk-borne diseases would cease; and, finally, many persons would be saved from the debilitating effects of undulant fever. It has been said, and many would agree, that "there are only two grades of milk—raw and pasteurized; raw milk has yet to be shown fit for human consumption."

Summary

1. Milk purveyed by present methods may contain dirt and pathogenic organisms.
2. Dirt may be tolerated, but pathogenic organisms should be permitted no longer.
3. Cattle infections contaminating milk while in the udder and a variety of organisms introduced to milk later by human handling are to-day causing sickness; the amount of this has not yet been completely estimated, but it has been shown clearly by many workers to be extensive.
4. The eradication of these infections among human beings cannot be left to await a Utopian state where diseased cattle have been eliminated and all milking is mechanically performed in such a manner that external contamination is no longer possible.
5. Universal compulsory pasteurization presents the only method of preventing the spread of cattle infections and the contamination of milk by human handling.

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H. W. Willis (*J. Pediat.*, January, 1937, p. 65), who records an illustrative case, states that the majority of cases of nicotine poisoning on record are in adults. Of seventy-four fatal cases collected by Franke and Thomas (*J. Pharmacol. and exper. Ther.*, 1933) twenty-eight were from concentrated solutions of nicotine and forty-six from tobacco poisoning. Although only a few cases have been reported in children, their frequent exposure to tobacco makes it a clinical entity with which every physician should be familiar. The possibility of acute nicotine poisoning should always be considered in cases of coma of unknown cause. Treatment consists in artificial respiration and injection of adrenaline into the left ventricle. Willis's patient was a boy aged 5, who became unconscious and vomited continually immediately after an enema consisting of 60 c.cm. of strong tobacco juice in 1,000 c.cm. of water, which was given for threadworms. Recovery took place after three doses of sodium benzoate and copious enemas to eliminate the nicotine.