

Unscientific Food Tests*

The Fallacy of Testing Food Materials by Animal Inoculation

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SOME years ago it was seriously proposed to test the purity and salubrity of drinking-water by means of animal inoculation. Portions of the water to be examined were cultivated in sterilized bouillon at the body temperature, and the resulting cultures after a stated time were inoculated into guinea-pigs, rats or other test animals. If these sickened or died the water was condemned. Fortunately, since some sense of humor still remained among sanitarians, a proposition so absurd was soon laughed out of court. From time to time, however, this discredited "test" is again gravely brought forward even for water, but more often nowadays for some other form of food or drink, such as eggs, oysters, ice cream, gelatin, catchup, etc. One of the latest examples—but probably not the last—of such proposed employment of it is for frozen eggs, attacked originally because of alleged "decomposition" as indicated chiefly by richness in bacteria and the presence of numerous *Bacilli coli*, but afterward by inference as dangerous to health because sometimes fatal to animals on inoculation.

The frozen eggs involved in a recent case with which I happened to be connected were entirely sweet and agreeable in taste and odor when thawed. Similar eggs had been used for many years and in large quantities by bakers in pies, cakes, custards, etc., not only without perceptible injury or complaint of any kind, but with the greatest convenience, economy and satisfaction. *Disregarding these results of long-continued experience, it remained for certain Government bacteriologists and physicians to discover that such eggs were really "decomposed" and dangerous to health, first, because of the large numbers of bacteria which they contained; second, because of the presence among these of some streptococci and many B. Coli; third, because when the raw melted egg was inoculated into test animals some of these died; and, fourth, because after the death of such animals certain supposedly objectionable bacteria, B. enteritidis, B. pyocyaneus, B. alcaligenes, etc., were in some instances found in the blood.* In other words, over against the long experience of the trade and of consumers of the eggs yielding wholly favorable results of innumerable feeding experiments on human beings, it is now proposed to set up a scanty experimentation on animals; and that not by feeding them as man is fed, and not after cooking of the food materials in question, such as mankind employs, by which process most of the microbes present are destroyed, but by direct injection of large amounts of the raw and uncooked egg substance subcutaneously or into the delicate peritoneal cavity of certain lower animals. To the best of my knowledge and belief, the eggs which it is thus sought to condemn were good and wholesome food, eaten raw or cooked.

It is time to protest against "tests" of this sort which are obviously both irrelevant and misleading, for conclusions based on facts of one order cannot properly be applied to problems of a different order. To realize how unscientific and absurd is the proposal under consideration it is only necessary to recall some simple elementary facts and details.

The body of the higher animals, as every one knows, is not a solid mass completely inclosed by the skin, but a semisolid bundle of tissues tunnelled by a long and folded tube, the alimentary canal or food-tube. This tube possesses its own special walls, expressly adapted for preventing raw food and other foreign substances from entering the real body—which lies between the food-tube and the skin—until such substances have been digested and made ready for absorption. Within this tube, food whether raw or cooked, is chemically treated until some of its components—but only some—are admitted into the body proper, the remainder being held in the tube, moved onward and eventually cast out. This fundamental process of preparation or digestion, normally absolutely inevitable, and carefully and even elaborately conducted, is in subcutaneous or intraperitoneal inoculation entirely omitted, so that the latter procedure is in no wise comparable with the former. Hence, the results, also, of the one process bear no natural or necessary relation to those of the other. As for the preparatory process of cooking, everyone knows that this not only ordinarily causes profound chemical and physical changes, but also destroys most microbes and many toxic organic substances; so that here again the thrusting of raw food-stuffs into the real body becomes a crude and severe procedure, a kind of rough surgical interference, totally

different from the normal taking of the same materials into the body by way of the food-tube—perhaps already cooked.

In order to see just where we stand in this matter, we have only to compare the effects of substances of various kinds when taken by the mouth with those of the same substances injected into the real body hypodermically or intraperitoneally. We shall naturally think first of drugs, since it is in the use and abuse of these that resort is oftenest had to direct inoculation. We shall begin, perhaps, with morphin, remembering the familiar fact that a quantity of this drug, which taken hypodermically would quickly kill, can be taken with impunity by the mouth. The same thing is true in a general way of most drugs and poisons, the arrow-head poison (curare) of the South American Indians, for example, being often without marked effect when eaten, but highly poisonous when inoculated into the real body. Most alkaloids, and the toxins of diphtheria, tetanus, typhoid and other infections act either comparatively feebly or not at all when taken by the mouth, but with comparative severity by direct inoculation.

Passing from drugs, alkaloids and metals to beverages, we recall how different is the effect of brandy and other alcoholic drinks when taken through the mouth and when the same quantity is injected subcutaneously. Again, the germs of two of the worst diseases that afflict the human race, namely, lockjaw and anthrax, while extremely dangerous on inoculation, are comparatively innocuous if taken through the mouth.

As for any bad effects on health of the ordinary foodstuffs used from time immemorial by mankind, very little was heard until about 1890, and a careful investigation will show that the evidence of such bad effects accumulated since that time is mostly inconclusive and unsatisfactory. It seems likely that the evolution in the human race of the habit of discriminating among raw foods, and of using chiefly particular materials, such as certain meats, fish, eggs, fruits, nuts, etc., while avoiding others, has arisen as the result of long and hard experience—experience being only another name for long-continued individual or racial experimenting.

Panum (1856), Selmi (1878) and afterward Brieger (1890) appear to be chiefly responsible for the popular belief that "ptomain" are common in spoiled foods, but both investigation and experience since their day have weakened rather than strengthened the idea of dangers of such poisoning. In point of fact, the whole subject of ptomain poisoning and of food poisoning in general stands to-day in great need of re-examination, and until the results of this are forthcoming we are justified in speaking and writing of either with the utmost reserve. When, remembering the enormous quantities of partially decomposed meats, eggs, fish, shell-fish, milk, fruits and vegetables eaten every day either raw, cooked, or half cooked, not only without apparent injury, but with positive relish and advantage, we think at the same time of the infrequency of cases of ptomain poisoning proved or even alleged—when, for example, we think of the immense amounts of fermented or partially decomposed milk, buttermilk, ice cream, meat, fish, game, cheese, sauerkraut, and the like, constantly consumed without inconvenience of any kind and with positive benefit, it is easy to see how extremely rare must be the occurrence of harmful substances in harmful quantities, at least during the earlier stages of decomposition or decay of ordinary food materials.

Returning now to the proper testing of the purity or salubrity of food materials, it is an old and true saying that the proof of the pudding "is in the eating"—not in its inoculation into animals. This latter test is irrelevant because unnatural, and hence for determining the purity or healthfulness of food materials absolutely worthless. If it may be used for one food substance it may be used for all, and the absurdity is obvious of seeking to determine the suitability of meats, eggs, milk, fish, etc., for human food by trying them on animals, and that not by feeding but by inoculation. Even that popular test in which we are advised to "try it on a dog" does not contemplate surgical inoculation, but only the ordinary process of feeding by the mouth.

Thus far I have entered no protest against the testing of food materials on the lower animals rather than on human beings, but as a matter of fact such experiments are only allowable when for some good reason they cannot be made—as in the case of eggs and other

common foodstuffs they easily can be made—on human beings. Moreover, because of the wide differences between man and the lower animals any results of such experiments on the latter can be accepted for human beings, if at all, only tentatively and with much reserve. It is a significant fact that the lower animals do not appear to be susceptible to typhoid fever, either by inoculation or by feeding. Conversely, none of the disease to which hens are susceptible appear to be transmissible to man.

What then, if any, we may ask, is the true significance of results obtained by the testing of food materials by the inoculation of animals? The answer is that if the animal survives and suffers no apparent inconvenience, it must be because no microbes or other substances were injected capable of doing that particular animal harm when taken in that dangerous fashion. This does not prove, however, that if the substance were taken through the mouth, no harm would have come, though it makes such a result unlikely, for the reason that the inoculation test is as a rule far more severe than the feeding test. If, on the other hand, test animals are regularly sickened or killed by such inoculation, then the meaning must be that microbes or other substances were injected which were harmful to those animals when administered in this way. But such a result does not prove the unfitness of the material tested for use as food, since the processes of cooking (a kind of external or artificial digestion) and of ordinary (internal or natural) digestion, absorption, circulation and cellular metabolism, may suffice to change it so extensively and to deliver it to the protoplasm of the body so transformed as to make of it, when taken by them in the ordinary way and at their own convenience, a totally different thing from the same material thrust on them in its raw state and whether they want it or not. In short, the mere sickening or death of animals inoculated with raw food materials throws no light whatever on the purity or healthfulness for food of the material injected. Moreover, the finding of this or that microbe in the body of animals after such inoculation neither proves that the microbe came from the food material injected, nor that, if it did so come, it would have survived the processes of cooking, digestion, absorption, etc., to some or all of which it would have been subjected if the material had been administered by feeding instead of inoculation. Finally, there is no proof that, if it had so survived, it would have administered by the mouth have done any harm.

Influence of the Sun's Rays on the Propagation of Hertzian Waves

E. ROTHE, taking advantage of the eclipse of the sun on April 17th, investigated the variation in intensity of signals as compared with those ordinarily received. To this end experiments were carried out from the Eiffel Tower on March 4th, 11th, 18th, and 25th, and April 1st, in order to discover the best means for making the necessary measurements. On April 4th signals were transmitted every two hours between 6 A. M. and midnight, the strength of signals being measured at Nancy on a thermo-galvanometer. The results are given below:

6 A. M.	8	10	12 noon	2 P. M.
Thick haze	Hazy			
38 mm.	36	41	45	48
4 P. M.	6	8	10	12 midnight
44	44	—	62	69

On the 15th, 16th, and 18th, at 10:40 A. M., the galvanometer readings were constant at 35 and 36 millimeters, as also on the day of the eclipse at the same hour. On April 17th the sky was blue during the whole of the eclipse. A single cloud formed in front of the sun between 11:20 and 11:25. Simultaneously with the measurement of the intensity of signals the variations in temperature, pressure, intensity of light, velocity of wind, etc., were observed. The results are embodied in curves in the original; these show a correlation between the eclipse, the fall in temperature, the wind velocity, and the intensity of signals. The author speculates whether the augmentation in the strength of the signals is to be attributed to solar radiation or atmospheric variations, and suggests a comparison of results obtained at various stations.—*Science Abstracts.*

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