Dunham Jackson: "Resolution into involutory substitutions of the transformations of a non-singular bilinear form into itself."

F. W. Reed: "On singular points in the approximate development of the perturbative function."

Also notes and errata for volumes 8–10, index of the volume and indices by authors and by subjects of volumes 1–10.

THE November number (Volume 16, number 2) of the *Bulletin of the American Mathematical Society* contains: Report of the summer meeting of the society, by F. N. Cole; "The groups which may be generated by two operators s_1, s_2 satisfying the equation $(s_1s_2)^\alpha = (s_2s_1)^\beta$, α and β being relatively prime," by G. A. Miller; "A note on imaginary intersections," by E. W. Davis; "Maurolycus the first discoverer of the principle of mathematical induction," by G. Vacca; "Darwin's scientific papers," by E. W. Brown; "Shorter notices": Burkhardt's Elemente der Differential- und Integralrechnungen, by L. W. Dowling; Von Dantscher's Weierstrassche Theorie der irrationalen Zahlen, by G. A. Miller; Andrews's Magic squares and cubes, by G. A. Miller; d'Adhémar's Exercices et Leçons d'analyse, by Maxime Bôcher; Heger's Analytische Geometrie auf der Kugel, by L. W. Dowling; Borel-Staeckel's Elemente der Mathematik, by Florian Cajori; Love's Mathematical theory of elasticity, by F. R. Sharpe; Manville's Découvertes modernes en Physique, by E. B. Wilson; "Notes"; "New publications."

DELETERIOUS INGREDIENTS OF FOOD[1]

THE Food and Drugs Act, June 30, 1906, states that an article shall be deemed to be adulterated, in the case of food, if it contain any added poisonous or other added deleterious ingredient which may render such article injurious to health. The term food includes "all articles used for food, drink, confectionery or condiment by man or animals, whether simple, mixed or compound." The act does not expressly prescribe what added substances shall be deemed to be poisonous or deleterious, nor does it indicate by what properties they are to be recognized.

At first thought this omission may seem trivial, and specific provision needless, in view of the common knowledge of these matters. More mature consideration, however, leads one to realize that there is no strict definition by which noxious and innocuous substances are differentiated; and accordingly that the recognition of poisonous and deleterious substances is not altogether a simple matter. The situation is relieved somewhat by the fact that the provision applies to added ingredients not foods and not to food itself.

Under the law, then, the question of poisonous or deleterious properties of anything coming within what the law defines as a food need not be considered. Nevertheless, in arriving at standards of the deleterious properties of added ingredients not foods themselves, it is important to consider such properties of foods, since, manifestly, it is not the intent of the law to establish different standards of quality of added ingredients than is possessed by food itself. This is clearly indicated by the statement of the law that food containing deleterious ingredients is to be deemed adulterated because the added ingredient is of such poisonous or deleterious quality as may, by its presence, render the food injurious to health. Hence, if the added ingredient is only capable of becoming deleterious in the sense that food itself is, its addition to food will not render such food injurious to health in the meaning and intent of the law. To illustrate, the addition of spices to food is admitted under the law, because they are foods in the condimental sense. Nevertheless, they are capable of being distinctly deleterious if ingested too liberally, or, in some conditions of disease, if ingested in even the ordinary quantity; that is, their proper use is without deleterious effect, yet they may become injurious by abuse. In the same way, if an added ingredient is not essentially poisonous, but merely capable of becoming deleterious by abuse, it is not a poisonous or deleterious substance in the meaning and intent of the law.

It must not be supposed that this interpretation admits of the addition to food of essen-

[1] Read before the Section of Biology, New York Academy of Sciences, May 10, 1909.

tially injurious substances in quantities not injurious, since the language of the law in the use of the word "may" specifically and very properly provides against such additions. The law reads: "If it contain any added poisonous or other added deleterious ingredient which may render such article injurious to health." It is not whether the quantity does render the food deleterious, but whether the added substance is possessed of a deleterious action which is "the nature, the property, the quality, the effect" of such added substance. If it is, the substance is essentially injurious and its addition to food is adulteration; while, on the contrary, if such added substance is only capable of becoming deleterious in the sense that food itself may, then, clearly, it is not the intent and meaning of the law to regard such added substance as essentially deleterious or its addition to food adulteration because of any such deleterious possibility.

First, then, it is important to appreciate clearly the sense in which food itself may be deleterious. Considering food that is not adulterated and is suitably prepared for ingestion, a normal individual may ingest in a normal manner a certain quantity without injurious or deleterious effect. If the quantity is increased an amount will finally be reached which is in excess of the needs of the body. However, the body is capable of adapting itself for a time to the ingestion of some excess by certain physiological adaptations, such as by the storage of caloric foods, by the rapid elimination of water or by the tonic control of reactions to stimulating foods; but when the quantity is increased beyond the capacity of such adaptations the food becomes injurious to health and a train of symptoms referable to poisonous or deleterious action is produced. This is true notwithstanding the healthfulness of the food in proper amount. This injurious effect is, then, not an essential quality of the food in question, but a quality dependent upon the ingestion of an excessive quantity of the otherwise healthful food, that is, a quality dependent upon the quantitative relation. Every food is deleterious if the quantitative relation be disregarded; it is healthful only within the limts of physiological adaptation to the quantity ingested. When these limits are exceeded it becomes injurious. Such deleterious action, however, is not an essential quality of food, since in lesser amounts, as a rule widely separated from the quantity capable of producing injury, the food does not have such deleterious action; it is a property dependent solely on the quantitative relation.

In contrast to a food let us consider the action of an admittedly poisonous substance, such, for example, as strychnine. It is poisonous because it increases the irritability of motor neurons, so that even a small quantity increases greatly the impulse resulting from a given stimulus. Such an action is not advantageous to the normal body; it is deleterious, a poisonous action. If, now, the quantity of strychnine be diminished till it no longer increases the irritability of motor neurons, no action advantageous to the healthful body remains. The poisonous action in question is one of degree, being greater with large amounts and less with small but always exhibited, so long as the quantity of strychnine is sufficient to produce any effect. It is an essential quality of the strychnine and not one dependent upon the quantitative relation. So long as the strychnine produces any effect at all it exercises the kind of action which makes it a poison. The essential quality of strychnine is, therefore, that of a poison. It is a quality exhibited in all quantities of strychnine capable of producing any definite action. To be sure, there is a range of physiological adaptation on the part of the body to an attenuated toxic effect within which no injurious action is manifest; the quality of the action persists, however, even in the diminished amount. The quality which in amount is deleterious is essential to strychnine and persists so long as the quantity of strychnine suffices to produce any definite action.

In these examples we arrive at conclusions that are of general application. An essential quality is one that is exhibited by small amounts of a substance capable of producing any definite effect. When a given quality of

action is not exhibited by a quantity of substance capable of some other different action, but is exhibited only when the quantity of the substance is a certain greatly increased amount, then the quality is not an essential quality, but one dependent on the quantitative relation.

In the application of these conclusions it is advantageous to recognize the different kinds of "added ingredients." Only those that serve some legitimate purpose in the food need be considered, as other additions would obviously be sophistication; moreover, it is convenient to classify such added substance according to the particular purpose that they serve. Thus, colors and preservatives are classes of added ingredients; they are not foods and yet may serve obvious purposes. In sufficient quantity any of these substances, like food itself, may be deleterious. Whether they are essentially injurious or whether such action is dependent on the quantitative relation is, from what precedes, to be determined according to whether they may be injurious in such quantities as are useful. If in these quantities they may be injurious or if such quantities are not widely separated from the amount that becomes injurious from the quantitative relation, then safety requires that they be considered as essentially deleterious and that they come under the designation of "added poisonous or other added deleterious ingredient." If the reverse is true, that is, if in the quantities added to food for a useful purpose the substances in question do not render such article of food injurious to health but are only capable of doing so when added in quantity widely separated from the amount made use of, then such possible deleterious action is not an essential quality of the substance, but a quality dependent on the quantitative relation, and the added ingredient is not an essentially deleterious substance and does not and may not render the article of food injurious to health according to the meaning and intent of the law. This is true whether or not the substance is capable of a deleterious action by its abuse in being used in the increased amount widely separated from the quantity which subserves the purpose of its use. In this discussion, no new position is taken in regard to these matters; there is merely an attempt to present clearly distinctions which have long been established in practical life. As an example of such practise, consider the use of cream of tartar. As a result of its use rochelle salt becomes an added ingredient to the food. When ingested in relatively large quantity this substance acts as a saline purgative, abstracting fluid from the blood and in such quantity is, in health, a deleterious substance. However, such action is not exhibited in any degree by the very much smaller quantities present because of its use in food. Hence, rochelle salt because of its laxative effect in quantity is not an added poisonous or deleterious substance according to the meaning and intent of the law, notwithstanding that it may become deleterious by its abuse. Its addition to food is justified by its usefulness and by the fact that it is not essentially injurious, even though it may become injurious in the quantitative relation.

To summarize, we conclude that substances added to food are essentially injurious when incapable of serving a useful purpose in amount widely separated from the quantity that may produce deleterious effects; and that they are not essentially injurious when capable of serving a useful purpose in amount widely separated from the quantity that may produce deleterious effect, even though, in this latter instance, they may become deleterious by abuse of the quantitative relation.

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SPECIAL ARTICLES

A NEW FORM OF LIGHT FILTER FOR USE IN EXAMINING FLAME COLORATIONS

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