Busey (S.C)

THE

GATHERING, PACKING, TRANSPORTATION, AND SALE

OF

FRESH VEGETABLES AND FRUITS:

THEIR CHEMICAL CONSTITUTION AND NUTRITIVE VALUE, COMPETENT INSPECTION, AND FREE MARKETS FOR PRODUCERS.

BY

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THE GATHERING, PACKING, TRANSPORTATION, AND SALE OF FRESH VEGETABLES AND FRUITS; THEIR CHEMICAL CONSTITUTION AND NUTRITIVE VALUE; COMPETENT INSPECTION AND FREE MARKETS FOR PRODUCERS.

By SAMUEL C. BUSEY, M. D., *Washington, D. C.*

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It is not my purpose, at present, to discuss this question in all its important relations to the health of cities and of communities of consumers, but briefly to invite the attention of this Association to a few suggestive inquiries, with the view of securing, through a competent committee, a thorough consideration of the effects upon public health of the deterioration of fresh vegetables and fruits, as offered for sale in the markets of the principal cities of this country, and how far this deterioration is attributable to the manner of gathering, mode of packing, and transportation from the farm or garden to the city markets.

No one will maintain that masses of consumers can be supplied with vegetables and fruits in the same state of freshness and perfection as the rural population, for all must admit that under the most favorable conditions, with every requisite care, many vegetables and fruits rapidly lose freshness, flavor, and nutrient qualities. The state of perfect maturity speedily passes, and deterioration and decay begin. So, likewise, must it be conceded that, as a rule, fresh and mature vegetables, in their proper seasons, contribute to enjoyment and health, and in the country rarely provoke disease; and, furthermore, I need hardly remind you that, in our American cities, the summer intestinal diseases and digestive troubles usually begin with the introduction of certain fresh vegetables. Here I shall be met with the objection that the intestinal diseases mostly prevail among very young children, who are consumers of vegetables and fruits to a very limited extent, and that the rising temperature, so necessary to the growth and maturity of vegetables, together with the foul exhalations and improper hygienic conditions, contribute chiefly to the production of the wide-spread epidemics of intestinal diseases which annually decimate the infantile population. The influence of these agencies I concede, but I am impressed with the conviction that intestinal diseases as frequently find their cause in that which is ingested as in that which is smelled or inhaled. The cause is often something more tangible and gustatory than the fœtid and subtle emanations which hygienists have striven so long to define and to circumscribe. I am disposed to shield Providence from the alleged agency in the causation of many of the "ills which flesh is heir to," and to ascribe them to the indulgence of our own insatiate thirst and fondness for the "good things of this world." Even among very young children, the intestinal diseases are frequently directly traceable to the ingestion of unwholesome fruits and vegetables; nor is the nursling

exempt from the danger, even though the deleterious influence may only reach it through the defective milk supply of the mother feeding upon immature or deteriorated vegetables and fruits.[1] In this connection I will briefly invite attention to a few admitted facts. Not that I wish to use them to maintain any exclusive doctrine of causation, or to construct any new theory, but rather to extend the field of inquiry, and to direct your studies away from a too exclusive consideration of the very prevalently received opinions and theories in regard to the ever fermenting and wide spreading agency of bad smelling, impure, and foul exhalations, as the chief and segregate cause of summer intestinal diseases.

Intestinal diseases, both among adults and children, are comparatively rare in the farming regions, and both classes of the rural population, adult and infantile, are more generally consumers of fruits and vegetables, and suffer less detriment therefrom, than like classes of the population of cities. Far the larger proportion of infantile intestinal diseases occurs among those beyond the age of six months, that is, subsequent to the period at which the natural aliment is usually considered by the laity adequate to the demands of growth and development; and far the larger percentage of mortality occurs among the children of the poor and squalid residents of cities, — the class necessarily the most indiscreet consumers of cheap and deteriorated vegetables and fruits. Statistics establish the greater prevalence of these diseases

[1] The influence of lactation, both natural and artificial, in the causation of infantile intestinal diseases, is far too frequently overlooked. Milk is the natural aliment of young animals, but the nursling is very frequently fed exclusively upon milk wholly deficient in the necessary nutrient and healthy constituents, and, indeed, often upon it when it is diseased. The unwholesome and sometimes pernicious changes produced in the mother's milk by sudden bursts of passion, by a nervous temperament, by menstruation and pregnancy, by excessive sexual indulgence, by irregular habits of life, and by certain articles of diet, are too well established by clinical observation, if not by chemical analysis, to be considered as mere coincidences unworthy of the attention and careful scrutiny of the scientific physician. Decaisne (*London Lancet*, Sept. 1872) has shown that insufficient food may occasion very serious and varied disturbances of the quality of the milk. In his report to the Academie des Sciences of the results of his observations of forty-three women who nursed their infants during the siege of Paris, he deduced the conclusions that some women may, upon insufficient diet, produce abundant and rich milk, and their children will thrive, while they themselves will emaciate. Another class will produce but little milk, and that very poor, and their children will suffer for want of nutriment, and sicken with choleraic diarrhœa, and a third class will produce scarcely any, and their children will die. In syphilitic mothers the proportion of sugar is diminished and water increased in the milk; fever lessens, and may suppress the secretion; emotion, mental anxiety, and sorrow may diminish it or render it poisonous; puerperal fever seriously disturbs its healthy qualities; insufficient air, sedentary habits, and want of cleanliness not unfrequently impart to it conditions injurious to the health of the nursling. Certain drugs administered to the mother may affect the infant. Iodine can be detected in the milk; mercury given to syphilitic mothers will be conveyed to the suckling; opiates and some purgatives will demonstrate their physiological effects upon the infant. Lettuce imparts its qualities to the milk, yielding "when inspissated, (Redwood) lettuce opium, or lactucarium." Garlic, the onion, cabbage, turnips, and even green clover will impart a distinctive aroma to the milk of cows feeding upon them. But more important are the facts that the quality and quantity of the milk are dependent upon the character of the food and the vigor and healthfulness of the digestion. A meagre diet affects almost exclusively the quantity of butter and casein; a bad diet imparts deleterious qualities.

between the ages of six and thirty months, and among the artificially fed, and greater proportionate mortality in the densely populated districts, and among the children of the poorer classes. Can it be that those under six months, those advanced beyond thirty months, and those nursed at the breast, are less exposed to and less impressible by atmospheric influences? Undoubtedly the intercurrent affections and developmental peculiarities of the period exercise very considerable influence in predisposing to intestinal disease; but, assuredly, improper alimentation must constitute the chief among the many factors concerned in the etiology.[1] It is then manifest that intestinal diseases are most prevalent during the warmer months of the year — June, July, August, and September, when vegetables and fruits are most abundant and deterioration most rapid,— are proportionately far more frequent among communities of consumers who can only obtain supplies by purchase, and are most fatal among the poor, who from necessity become the purchasers of the cheapest and most deteriorated.

These are significant facts, not adduced to disprove the manifold ill effects of a bad atmosphere, and of fœtid exhalations, but to invite your attention to the consideration of another, and perhaps as frequent and direct an agency in the causation of intestinal diseases; and to illustrate, as well, the comparative innocuousness of fresh, mature, and properly gathered fruits and vegetables, as to demonstrate their pernicious and disease-producing qualities as supplied to and consumed by the inhabitants of cities.

To further elaborate the distinct question here at issue — the agency of immature and deteriorated fruits and vegetables in producing intestinal diseases, and the more strikingly to exhibit the qualitative changes which they speedily undergo after preparation for market — I will select a few of those most generally consumed, and describe the mode of gathering, packing, and conveying, and their condition when exposed for sale.

The Irish potato, *Solanum tuberosum*, perhaps the most popular aliment supplied from the "truck farm," when mature and properly cooked, is a wholesome and nutritious article of diet, carries well, and preserves its flavor and nutrient qualities, even in very warm weather, for a reasonable time. It has a stage of ripeness, marked by a thick and firmly adherent skin, and when cooked breaks, upon very gentle pressure, into a semi-dry mealy mass. In this condition the producer supplies them to his own family. Young children consume them with comparative impunity. In the early spring, we are usually supplied from Bermuda with a variety which, as a rule, is in a fair state of preservation, but the general demand and high price soon draw a supply in succession from Savannah, Charleston, Norfolk, and the

[1] Starchy aliments are indigestible in consequence of the feebleness of the digestive properties of the salivary, pancreatic, and intestinal juices of young children. They are also deficient in "materials for the re-integration of the principal tissues, which is so necessary to the growing infant." Sonsino established the condition of "physiological dyspepsia in infants for starchy aliments." Korowin has deduced the conclusion from a series of experiments that the property of the pancreatic juice to transform starch into sugar is only manifest after the third month of life, but that the parotidean saliva possesses this power from birth. In regard to both secretions, this power becomes more active with the development of the child.

farms in the immediate vicinity. The tubers are gathered, not because they are ripe, but because they are merchantable, that is, have attained sufficient size, perhaps washed, better not, packed in barrels and transported to the place of sale. In this tender, succulent, and growing state they are easily bruised, have a smooth, thin, delicate, and slightly adherent surface covering, and we find them in the market with partially peeled and ragged surfaces, the loosened parts of the cuticle partially attached to the remaining adhering pieces. These are the unavoidable results of gathering before maturity, rough handling, improper packing, and of the heating process — preliminary to other deteriorating changes, through which they wholly or partially pass before they are exposed for sale. The extent of these degenerative changes is proportionate to the lapse of time and closeness of packing, and perhaps also to the mode of transportation. The heating, or rather steaming, process favors the detachment of the partially developed cuticle, as it does of the matured skin. I need hardly inform you that the destruction or removal of the surface covering which nature provides for protection and preservation, favors and hastens the decay of all perishable fruits and vegetables. Such tubers cook waxy, cut cheese-like, bite doughy, and taste greenish and weedy. They are served upon our tables with savory dressings, and eaten with relish, but they are only partially digestible, and, in the main, pass from the bowels in white, doughy, unaffected lumps. Of the consumers, some escape unhurt, some suffer a pang or two, others, fortunately, purge freely, but the less fortunate suffer more seriously. To many young children, whose digestive powers are inadequate to the complete digestion of any starchy aliment, these tubers, mashed and commingled with savory gravies, are fed as choice and nutrient morsels, and when sickness and suffering come, the temperature — not above 70° at mid-day — or some distant slaughter-house or bone-boiling establishment is charged with the dire calamity. The potato probably ripens from exterior to centre; hence, after cooking, it may frequently be observed that immediately under the apparently ripened skin, a layer of greater or less thickness, according as the stage of ripeness has advanced, of a semi-dry, farinaceous mass, will scale from a firm and waxy central portion, so that one may be deceived by the manifest external evidences of ripeness. The potato deteriorates by growing out or germinating. If left in the ground long after maturity, during a growing season, from one or more of the buds or eyes will grow appendages resembling in every respect the mother tuber — they are, in fact, homologous outgrowths. The presence of such a tumor is the evidence of a second growth, and if broken off, as is usually the case when offered for sale, the surface is denuded at the point of attachment. When improperly stored, and especially during the later spring months, the tubers germinate, and from each eye, rootlets shoot forth, which are likewise broken off before being exposed for sale, but the surface exhibits no denudation, and the condition can only be detected by a very careful inspection of the buds, and, perhaps, a softer feel. The density may have diminished because of the commencement of germination. Freezing destroys the organization of the potato, and with thawing the putrefactive changes begin. Notwithstanding, it is a very common occurrence for dealers to offer, and for

consumers to purchase frozen potatoes. "The potato," says Pavy, "is made up of cells, penetrated and surrounded by a watery albuminous juice, and filled with a number of starch granules." Cooking coagulates the albumen, and the starch granules absorb the watery part; hence the cells are distended, and their cohesion being destroyed, the potato breaks down into a "loose farinaceous mass." "Young potatoes" (Chambers' "Manual of Diet," p. 43), "from not so easily breaking up, require long mastication to render them soluble, and are not then very digestible. But old waxy potatoes are worse, for they seem to unite again into a sticky mass, after being swallowed, and remain for hours undissolved." The worst of all are potatoes affected with disease.

The potato contains[1] per ounce (437.5 grains), in its natural state, 324 grains of water, 1 of nitrogen, 49 of carbon, and 4.4 of salts. These elements vary much (Smith) with the season, variety, ripeness, and soil. The nutrient value of the potato is determined by its specific gravity;[2] the heavier any given tuber is according to its size, the greater amount of starch it contains. The relative proportion of solid constituents can be ascertained (Parkes, p. 237) by multiplying the specific gravity by a factor taken from the table,[3] and if it be desirable to ascertain the percentage of starch, multiply the specific gravity by the factor less 7. If the specific gravity of the potato is below 1068, the quality is bad (Parkes).

[1] Percentage amount of ash 1 to 1.5. Mineral constituents in 100 of ash: —

	Way.	Fromberg.
Potash	46.60	50.23
Soda	—	3.7
Magnesia	8.70	4.4
Lime	4.54	0.83
Phosphoric acid	13.30	10.10
Sulphuric acid	4.66	14.67
Chloride of Potassium	—	17.76
Chloride of Sodium	3.43	
Carbonic acid (from the incineration of the organic acids)	13.30	
Oxide of iron	—	
Silicate of Alumina	1.95	

Parkes, *Prac. Hygiene*, 4th ed. p. 236.

[2] This may be ascertained by throwing several potatoes into a strong solution of salt, and then adding water until some of them sink, and others swim. The specific gravity of the solution will represent that of the potatoes as a whole. Smith, *Foods*, p. 199.

[3] Specific gravity between	Factor.	Specific gravity between	Factor.
1061–1068	16	1105–1109	24
1069–1074	18	1110–1114	26
1075–1082	20	1115–1119	27
1083–1104	22	1120–1129	28

Between 1068–1082, the quality is inferior.
Between 1082–1105, the quality is rather poor.
Above 1105, the quality is good.
Above 1110, the quality is best.

The potato should be cooked with the skins on, and well boiled or thoroughly steamed, otherwise the starch is not easily digested ; and if the cooking process is rapid, the cellulose and albuminates become hard. For the sick Chambers (*loc. cit.*, p. 244) prescribes the following method : —

"Boil one pound of potatoes with their jackets on till they are tender or brittle. Peel them, and rub them through a fine sieve ; when cool, add a small teacupful of fresh cream and a little salt, beating the *purée* up lightly as you go on, till it is quite smooth, and warming it up gently for use."

With a knowledge of the structure and composition of the tuber, it is easily understood why bruising, peeling, germination, and freezing should promote degenerative change. Any change which increases its very large proportion of water diminishes its relative nutritive quality and hastens the destructive process. The tuber should be firm and cut with crispness. The chief value of the potato lies in its anti-scorbutic properties. "Ten grains (Smith) of potato consumed in the body produce heat sufficient to raise 26 lbs. of water 1° F., or to lift 1,977 lbs. one foot."

The pea (*Pisum sativum*), as a fresh vegetable, is eaten unripe, but should have reached the stage of maturity when the seed husk is filled. It, like the potato, comes first from the far South, and successively from nearer regions. As a fresh vegetable they bear transportation badly, soon wilt, heat, wither, shrink, fade, and deteriorate after having been gathered and packed. It is a tedious crop to gather and a bulky product to transport. The producer gathers his table supply during the forenoon, perhaps before the morning sun has evaporated the dew from the leaves and seed-pods. Upon his table the pea is a delicious, inviting, and richly flavored vegetable, seeming to dissolve during the process of mastication, and digests without inconvenience. For the market the crop is more frequently gathered when too far advanced toward ripeness, than before the fitted stage of development, — and for the obvious reason that transportation is better borne and the loss is less from shrinkage. Usually the gathering is done during the heat of the day, because of less injury to the vine while wilting under a blazing sun ; but the prudent farmer never enters his pea patch until the gathering is ready for his "pickers" — that is, when the hand can pluck a number of pods at a single grasp, for he wisely estimates the cost of time lost in clutching at single pods, and knows too well that the loss in price by a few days' delay will be abundantly made up by the increased measurement from the too far advanced and ripened seed-pods. Thus gathered, they are immediately packed in barrels and transported to market. Very speedily the heating process begins, and in a few hours the temperature in the centre of such a bulk will rise considerably above blood-heat, and when emptied upon the salesman's stand, the subsequent morning, the loosened bulk will emit an amazing volume of smoke — condensing steam ; or perhaps more time has elapsed, and the heating process has been completed, succeeded by other

destructive changes. The seed pods have lost their fresh and pea-green color, their crispness and resiliency, — have faded and withered, flattened as the salesman will tell you, by pressure, but in fact by the loss of natural moisture expelled by *the* steaming process. The contained seeds, the only edible portion, have lost entirely their peculiar luscious flavor, acquired toughness, and, to a greater or less degree, hardness, and the seed husk no longer submits to ordinary digestion. Each seed must be crushed between the molars, or else may roll through the alimentary canal, except for the preliminary cooking, conditioned for a vigorous vegetation. The seed pulp contains all the nutrient qualities, but cannot be separated from the husk in the green state. The husk acquires firmness as the seed pulp progresses to complete development, and loses color through the ripening process. It is better to select for the table undeveloped rather than past developed peas, and small, immature pea-green pods rather than the faded and ripening ones. The peculiar greenish hue is an essential characteristic of freshness.

"They should (Chambers) be young, and their skins tender enough to crack in boiling." In such condition they are sweet, easily digested, but less nutritious than when fully matured. "When old (Chambers, Pavy), no amount of boiling will soften them; indeed, the longer they are boiled the harder they become."

When dried they are deprived of their husks before cooking, and when thoroughly boiled constitute a good article of diet for those blessed with vigorous digestion.

Composition of the Dried Pea (Payen).

Nitrogenous matter	23.8
Starch, etc.	58.7
Cellulose	3.5
Fatty matter	2.1
Mineral matter	2.1
Water	8.3

Beans. — Beans are even more perishable than peas. As a fresh vegetable, both pods and seed are edible, and in their highest perfection for the table they must be young, fleshy, brittle, and tender. The succulence and fleshiness of the pods invite destructive changes, and in bulk, closely packed, rot soon begins. Hence it becomes the interest of the distant grower to delay the gathering beyond the stage of dietary perfection; and, consequently, of the city consumer to purchase his supplies from the growers of his vicinage. They should be packed loosely in small bulk and in crates. A coarse vegetable at best, but nutritious and harmless when in proper condition. They are cheap, and therefore popular among the poorer classes. As the pod ripens color fades, dryness increases, they become tough and tasteless. Cattle will not eat them. Even when gathered in proper condition and properly packed, deterioration soon begins, and though not actually rotten, the loss of succulence and brittleness denotes changes which unfit them for table use.

Beans are sometimes, improperly, eaten as salad, in the preparation of which vinegar should never be used, for it renders the legumin insoluble, and thus prevents digestion.

Composition of Dried Beans (Payen).

	Horse Bean.	Windsor Bean.
Nitrogenous matter.	30.8	29.05
Starch	48.3	55.85
Cellulose	3.0	1.05
Fatty matter	1.9	2.00
Saline matter	3.5	3.65
Water	12.5	8.40
	100.0	100.00

The leguminosæ are rich in nitrogenous matter, and approximate in nutritive value the products of the animal kingdom. They possess the special advantage of combining sulphur and phosphorus with the vegetable casein, but in consequence of the indigestibility of the legumin about 6.5 per cent. is lost, and escapes with the excrementitious matter, and much flatus (Parkes) is also produced by the formation of sulphureted hydrogen. In combination with other starchy or fatty aliments they constitute valuable articles of diet. Bacon and beans in this country, as in England, has been a favorite dish, especially among the laboring classes, who are accustomed to much exercise and continuous labor.

Tomatoes. — The tomato (*Solanum lycopersicum*), so universally and deservedly popular among all classes of consumers of vegetables, when ripe and gathered and packed with ordinary care, bears carriage well, and is usually supplied to city consumers in great perfection. Those brought, in early spring, from the remote South have been gathered green, are packed with very great care, each wrapped in a separate piece of paper, and are thus ripened on their journey. Those supplied from the near vicinity, after a killing frost has bared the earth of all summer vegetation, have been ripened under glass. When the chilling wind and falling thermometer threaten frost, the grower hastens to save the green fruit upon the vines. They are hastily gathered and put under glass and then colored red, not in fact matured. Such fruit possesses but little of the attractive flavor and nutrient qualities which belong to the matured and naturally ripened fruit, but they find ready sale, and are offered to the consumer in the best condition attainable. It is the business of the producer to supply the demand, and it is no fault of his if the luxurious palates of city consumers are only to be satisfied with green fruit colored red. I regard the tomato as a healthy, agreeable, and nutritious vegetable, but have no confidence in its cholagogue or blood-purifying qualities, as very many of the laity believe and some physicians claim. In the flesh reside all the nutritive and gustatory qualities, hence they should always be peeled preparatory to being eaten. The preliminary degenerative change is fermentive, which rapidly progresses to the complete destruction of all the fleshy part, leaving nothing but the seed and thin but tough skin. Neither seed nor skin are digestible. Feed hogs

upon tomatoes, and scatter the manure from the sty upon a barren field, and tomato plants will flourish like noxious weeds. Commingle the refuse skins with the slop and the hog will carefully avoid them, leaving them in the vessel from which he feeds. Rot will very slowly destroy tomato skins. Throw them into the cess-pool and they will offer an obstinate resistance to the putrefactive process. They disappear through disintegration by dryness. Notwithstanding all this, some foolish people will insist that the choicest part of this popular vegetable is the skin, and not unfrequently I have known young children to be fed upon the sliced fruit without previous peeling or ordinary care to avoid the ingestion of the seed.

The following analysis[1] is by Dr. B. F. Craig of this city: —

"A can of tomatoes was found to contain 2.04 pounds avoirdupois, of which, however, only 0.05 pounds (22.75 grains) were solid matter, dried at 212° Fahrenheit. There was, therefore, 97.6 per cent. of water present.

"The acid of the tomato I found to be malic, with a trace of citric, the amount of the free malic acid being equivalent to 315 parts in 100,000, or a little over three tenths of one per cent. (Lemon juice contains about twenty-five times as much free acid.) In tomatoes there is about as much more malic acid in combination with bases.

"The amount of vegetable acid — its proportion to the total solid matter — is of itself enough to make tomatoes valuable as an antiscorbutic, but it certainly seems desirable, in canning them, to get rid of some of the great excess of water."

Chambers regards the tomato as a healthy but not a substantive article of diet, and Pavy regards it more as a relish than a nutritive aliment. Surgeon Swift would regard it as an addition to the army ration of great value, if the excess of water could be dispensed with.

They may be eaten cooked, or sliced raw as a salad with oil and vinegar; and are easily digested when ripe, but when green are flatulent. Their only medicinal property is exclusively derived from the very limited quantity of malic acid, and it may be defined as mildly antiscorbutic.

Cucumber (*Cucumis sativus*). — Perhaps no one member of the family of kitchen garden vegetables has so many greedy devourers as the cucumber. There is something so refreshing and exhilarating about the appearance of a dish of sliced cucumbers prepared for the table, and something so attractive to the palate in its peculiarly inviting and mouth-watering aroma, that one's self-denial oftentimes fails to protect the stomach from the indigestible mass, and consumers fail to appreciate the fact that they are vigorously masticating an aroma, deriving but little if any sustenance. Why preferred for the table before maturity I do not know. Swine, I believe, select the full-grown and matured fruit, ripened into a golden yellow color, as the choicest, and certainly the aroma is more decided and the juicy constituent is most abundant at maturity. For home consumption, it is gathered in early morning, while chilled by the morning temperature, and either immersed in cold water or kept in a cool place until prepared for the table. Not easily digested at best, yet those who eat them with such avidity are very unwilling to

[1] Circular No. 8, Report on Hygiene, p. xxxix.

acknowledge any after ill effects, and it is assuredly true that country consumers usually escape merited suffering. The cucumber carries well, resists decay, withers slightly, loses some in crispness and brittleness, and acquires toughness, but retains flavor for some days, and is usually offered for sale in a fair condition of preservation. Without presenting the manifest evidences of destructive change, it speedily undergoes some alteration which renders it exceedingly hurtful to healthy digestion, and provocative of intestinal trouble. It would seem that these evil effects were proportionate to the loss of the watery constituent, and thus gathering during the heat of the day, exposure, and the elapse of time, promote those changes which so seriously injure its dietary qualities.

Cucumbers, like celery, says Chambers (*loc. cit.* p. 49), are not suitable for eating raw after a full meal. The quantity of woody fibre in them cannot be digested. "With bread and cheese, as a light lunch, they give an agreeable zest, and seem to stimulate the secretion of gastric juice." "Stewed, they form (Pavy) a light and wholesome vegetable." "When made acid with vinegar and eaten in a large quantity (Smith), they cause pain at the stomach." Some have supposed that the unwholesome property resided in the skin, others located it in the juice. It usually repeats its flavor in the mouth some time after having been eaten.

The brassica tribe, which includes all the varieties of the cabbage, Brussel sprouts, cauliflower, brocoli, and kale, are very highly esteemed as vegetable aliments by very many persons, and especially by the laboring classes, who rank them as highly nutritious, usually styling the cabbage as "strong food." In this respect, however, the popular estimate is far above their true value as food. There may be very wide differences in the chemical composition of the several species of this family of vegetables, but for all practical purposes cabbage may be assumed to represent the type of the class. It contains in 100 parts —

Water	91.
Albuminates	.2
Fats	.5
Carbo-Hydrates	5.8
Salts	.7

"10 grains of cabbage (Smith) when consumed in the body produce heat sufficient to raise 1.12 lbs. 1° F., which is equal to lifting 834 lbs. one foot high," thus representing less than one half the power of an equal amount of potato. Even this very feeble nutritive property varies according to the stage of growth and maturity of the plant. Anderson has determined these variations as follows: —

	Young Plant.	Ripe Outer Leaves.	Ripe Heart Leaves.
Water	91.8	91.1	94.4
Nitrogenous	2.1	1.6	0.9
Woody fibre, gum, and sugar	4.5	5.00	4.1
Ash or salts	1.6	2.2	0.6

It thus becomes manifest that as the plant advances to maturity its nutritive property diminishes, and that the matured and blanched heart leaves, usually selected as the choicest parts, and largely consumed as a salad in the form of "cold slaw," possess but little else than water and woody fibre. The very large proportion of these two constituents not only diminish its value as an alimentary product, but render it very difficult of digestion, and hence inadmissible as an article of diet when the digestion is enfeebled by disease or other conditions. Life could not be sustained but for a brief period upon this class of substances, for the digestion and capacity of the stomach would prove inadequate to the wants of the system. The tribe as a whole may be very properly styled the hay of the human race, but in fact they are less valuable as alimentary substances, containing less oily and nitrogenous material. "Their proportion of sulphur (Pavy) is large, and they thus are apt to give rise to flatulence of an unpleasant nature." For the table they should be young, fresh, and green (brocoli should be white); blanching is the evidence of loss of nutritive qualities.

"If the cabbage has begun to heat from fermentation (Chambers) it is most noxious, and generates in the intestinal canal an enormous amount of flatus, consisting not only of the usual carbonic acid, but of sulphureted hydrogen." Fermentation destroys the antiscorbutic qualities, for which the cabbage is so highly prized, and in which consists its chief value as an aliment. This property diminishes with loss of freshness and crispness.

It is the common belief that cabbage deteriorates very slowly, and this prevalent opinion enhances the cupidity of the tradesman. The purchaser buys the largest head for the smallest amount of money, and distributes his mess of bacon and cabbage through as many meals as his daily subdivisions will admit, and hopes to restore freshness and crispness by continuous immersion in water, forgetting that he is thus diluting his five per cent. solution of woody fibre, and feeding himself on bad water and noxious gases. If one will have cabbage to season his bacon and pork, purchase the heads fresh, unstripped of the green and most nutritious leaves, and buy it daily from the producer, and not from the huckster when old and blanched, with 94 per cent. of water, and but nine tenths of one per cent. of nitrogenous material. On such substances nursing women feed to make rich milk, and puny babies are fed to promote vigor and growth. The disagreeable, penetrating, and tenacious odor of boiling cabbage ought to banish it from the kitchen.

The turnip (*Brassica napus*) belongs to the cabbage tribe. It is less nutritious than the young, fresh, green cabbage, but more so than the matured and blanched heads.

Composition of the Turnip (*Letheby*).

Nitrogenous matter	1.2
Starch, etc.	5.1
Sugar	2.1
Salts	0.6
Water	91.0

One pound of turnips (Smith) contains —

	Swede.	White.
Carbon	30.4 grains	17.3 grains.
Nitrogen	15.3 grains	11.2 grains.

Dr. H. C. Bastian, in his experiments on spontaneous generation, made much use of a solution of turnip, as being an especially favorable medium for the growth of bacteria and other microzymes; and my friend, Dr. J. S. Billings, U. S. A., in repeating Dr. Bastian's experiments, found that bacteria developed more rapidly in a solution of the turnip than in any other medium employed by him. This fact may be of but little value as a proof of the speedy deterioration of the turnip, but in view of other researches, as yet, perhaps, not determinative of any practical conclusion, the interesting inquiry presents itself — what relation does the development of bacteria bear to the degenerative change which vegetables and fruits undergo, and how far such microzymes may be concerned in the causation of disease? Accepting the researches of M. Pasteur, that "putrefaction is a fermentation determined by infusoria of the family of vibrios and by bacteria," and the further conclusion, deducible from the researches of M. Davaine, that septic matter owes its toxic properties to the development of bacteria, it requires but little stretch of the imagination to conceive how purulent infection might follow the introduction into the system of bacteria generated during the process of vegetable decomposition, unless it be maintained that such infusoria differ in their virulence from those of septic matter. This is but a passing suggestion.

Like cabbage, the turnip is not easily digested. Age and germination diminish its nutritive quality and lessen its digestibility. As an aliment it is less valuable than either the carrot or the parsnip.

Composition of the Carrot (Letheby).

Nitrogenous matter	1.3
Starch, etc.	8.4
Sugar	6.1
Fat	0.2
Mineral matter	1.0
Water	83.0

"Ten grains of carrot (Smith), when consumed in the body, produce heat sufficient to raise 1.36 lbs. of water 1° F., which is equal to lifting 1,031 lbs. one foot high," exceeding the power of an equal amount of cabbage 197 lbs., and 946 lbs. less than an equal amount of potato.

Composition of the Parsnip (Letheby).

Nitrogenous matter	1.1
Starch, etc.	9.6
Sugar	5.8
Fat	0.5
Salts	1.00
Water	82.0

The parsnip and carrot (Smith) require from two and a half to three and a half hours to digest.

Contrary to the popular belief, the turnip, carrot, and parsnip are more easily digested and more valuable as aliments than the cabbage; and it is remarkable that the parsnip and carrot are not more generally used. Both are productive crops, carry well, are easily preserved, and do not deteriorate rapidly. When tough and fibrous they should be rejected. When overgrown, they are apt to be hard in the centre. The carrot is more nutritious in proportion to thickness of the "soft, outer, red, than the central, yellow, core-like part."

The cantaloupe is especially illustrative of the rapidity of deterioration, and of the marked and sudden transitions from the stage of perfect maturity to one of decay, and these changes progress more rapidly if left, after maturity, attached to the vine and exposed to the air and sunlight than when gathered and properly sheltered. The experienced grower knows precisely at what stage of ripening to gather to suit his mode and the distance of transportation. If distant a night's journey in a wagon or a few hours by rail or water, they can be offered for sale in the city in perfection. But there is art in growing as well as tact in gathering the cantaloupe. It should be regular in shape; have a well netted and deeply furrowed surface, and thick rind; possess the well recognized, penetrating, and tenacious fragrance; and be thick and firm fleshed, juicy and high flavored. Deformed and irregularly shaped melons are wanting in flavor; past ripened lose flavor and firmness; insipidity is in proportion to softness and pultaceousness. A deep yellow colored cantaloupe should not be permitted to be sold in any market. In its highest state of perfection, it is delicious, nutritious, and healthy fruit; in its past ripened, decaying condition, very unwholesome. No cantaloupe in a state of perfection to-day can be kept in a proper condition until to-morrow, by any process known to me. The flattened and blanched under surface is always defective in flavor and other essential qualities.

It may be permissible, though not strictly relevant, to refer to the quality especially illustrated by this melon, which, as expressed in ordinary parlance, some fruits and vegetables possess of imparting their peculiar and characteristic flavor, and odor also, to certain oleaginous articles of diet, when packed together in partially or wholly air-tight compartments. It is, perhaps, more properly the absorption by such substances of the volatile oils which give to vegetables and fruits their aroma; and hence the impregnation of milk, butter, and other oleaginous substances, with the flavor of certain fruits and vegetables, is due to the facility and extent of such absorption of the volatile oils. How far this may affect the nutritive and digestible qualities of such articles, I do not know. It may also be added that certain vegetables grown in near proximity reciprocally impoverish the flavor of each — for instance, the squash, pumpkin, or gourd, grown sufficiently near the cantaloupe, will destroy the flavor of the latter.

Fruits. — There are a few general observations applicable to fruits, which I may be permitted to epitomize from the recent work of Professor Pavy,

on "Food and Dietetics." Fruit is a modification of the leaf, and in the green state exhibits much of its chemical composition. As maturity advances, special characteristics develop. At first, like other green parts of the plant, the fruit absorbs and decomposes the carbonic acid of the atmosphere, liberating oxygen and assimilating the carbon. As the ripening progresses, oxygen is absorbed and carbonic acid given out, and some of the proximate principles contained in the unripe fruit, particularly the acids and the tannin, in part disappear, apparently by oxidation. At the same time, the starch undergoes transformation into sugar, and the insoluble pectose into pectin and other soluble substances. In this manner the fruit arrives at a state of perfection. But oxidation advances, the sugar and remaining acid become destroyed, flavor diminishes, and deterioration sets in; and if these changes are allowed to pursue their ordinary course, the pericarp undergoes decay, and the seed is set free. It is thus manifest that the stage of complete ripeness is quickly followed by degenerative changes, which rapidly progress to the entire destruction of the sarcocarp, unless, by some method of preservation, the oxidation can be arrested at the stage of ripeness.

Composition of Fruits (Fresenius).

	SOLUBLE MATTER.					INSOLUBLE MATTER.					
	Sugar.	Free Acid (reduced to equivalent in Malic Acids.	Albuminous Substances.	Pectose * Substances, etc.	Ash.	Seeds.	Skins, etc.	Pectose.	Ash from insol. matter included in weights given.	Water.	Variety.
Apples . .	7.58	1.04	0.22	2.72	0.44	0.38	1 42	1.16	0.03	85.04	White dessert.
Pear . . .	7.94	trace	0.23	4.40	0.28	0.39	3.42	0.60	0.49	83.00	Sweet, red.
Plums . .	3.58	0.58	0.19	5.77	0.57	5.78	0.17	1.08	0.08	82.25	Com. Yellow.
Cherries . .	13.11	0.35	0.90	2.28	0.60	5.48	0.45	1.45	0.90	75.37	Sweet, red.
Apricot . .	1.14	0.89	0.83	5.92	0.82	4.30	0.96	0.14	0.07	84.96	
Grapes . .	13.78	1.02	0.83	0.49	0.36	–	2.592†	0.94	0.11	79.99	White Austrian.
Gooseberries	8.06	1.35	0.44	0.96	0.31	2.48	0.51	0.29	0.14	85.56	Large red.
Currants . .	5.64	1.69	0.35	–	0.62	–	3.940†	2.38	0.18	85.35	Large red.
Strawberries	7.57	1.13	0.35	0.11	0.48	–	1.96†	0.90	0.15	87.47	Large red.
Raspberries .	4.70	1.35	0.54	1.74	0.48	–	4.106†	0.50	0 29	86.55	Red, cultivated.
Blackberries	4.44	1.18	0.50	1.44	0 41	–	5.210†	0.38	0.07	86.40	Very ripe.
Mulberries .	9.19	1.86	0.39	2.03	0.56	–	0.905†	0.34	0.08	84.707	Black.
Bilberries .	5.78	1.34	0.79	0.55	0.85	–	12.864†	0.25	0.55	77.55	
Peach . . .	1.58	061	0.46	6.31	0.42	4.62	99‡	–	0.04	84.99	Large Dutch.

Composition of the Pulp of Ripe Bananas.

Nitrogenous matter	4.820
Sugar, pectose, organic acid, with traces of starch	19.657
Fatty matter	0.632
Cellulose	0.200
Saline matter	0.791
Water	73.900

* Of, or belonging to pectin, or vegetable jelly.

† Aggregate of seeds and skins.

‡ Aggregate of pectose and skins.

These analyses show that fruit, in consequence of the small quantity of nitrogenous matter and the very large proportion of water which it contains, is not entitled to very high rank as a nutritive aliment. "Whilst advantageous (Pavy) when consumed in moderate quantity, fruit, on the other hand, proves injurious if eaten in excess, of highly succulent nature, and containing free acids and principles prone to undergo change, it is apt, when ingested out of due proportion to other food, to act as a disturbing element, and excite derangement of the alimentary canal. This is particularly likely to occur if eaten either in the unripe or overripe state: in the former case, from the quantity of acid present; in the latter, from its strong tendency to ferment and decompose within the digestive tract."

The cultivated fruits are more nutritious than the wild, the quantity of sugar being considerably augmented, and the amount of insoluble matter, skins and seeds being greatly lessened by careful cultivation. To the succulence is due the rapidity of degenerative changes. Berries and cherries soon ferment; the latter even when fresh are apt to disorder the bowels.

The strawberry season does not properly, in any particular locality, extend beyond thirty, but in our northern cities it not unfrequently runs through sixty, and perhaps even ninety, days. Since the introduction of improved varieties and more intelligent culture, with careful gathering, and packing in small open baskets in crates, favored by the rapidity of transportation, the berries can be supplied to consumers at great distances from the localities where grown, in a condition quite equal to the demand of a prudent and healthy consumption. Good strawberries should be plump and firm, with a dry and unbroken surface, and should not be separated from the cap until prepared for use. Rough and unnecessary handling, bruising, moisture, and bulk promote fermentation and speedy decay. Capped berries will not long resist destructive change, and neither bulking on the salesman's stand, nor sale by any fixed measure, should be permitted in any market.

Strawberries, like all very small seeded fruits, not excepting the blackberry, so much valued by many for its alleged astringent properties, are laxative in their tendency. The seeds are absolutely indigestible, and pass through the bowels uninjured by the digestive fluids. To this quality, to their locally irritating influence upon the mucous membrane of the alimentary tract, and to their liability to cling to the folds of, and find lodgment in the innumerable crypts of the membrane, add the deleterious influence of the fleshy part in a state of fermentation and decay, and surely nothing more is needed to admonish you of the danger of ingesting such deteriorated fruit. Especially objectionable are these small seeded fruits to young children, to whom they are frequently fed during the period when the follicular apparatus of the digestive tract is undergoing rapid evolution, and perhaps disturbed in its normal progress by some one or more of the coincident developmental operations. Strawberries contain much less insoluble matter (seeds and skins), and much more sugar, than either the blackberry or raspberry; carry better than the latter, and equally as well as the blackberry. The raspberry when fully ripe degenerates very soon and rapidly after being gathered and packed for market, and is very rarely

offered for sale before deterioration has commenced. This is due to the delicacy of the skin and the absence of the caps, which render it easily compressed by light pressure and careless packing. It bears transportation badly, and only when packed in very small bulk.

The tendency of the berry family[1] to speedy fermentation, when packed for transportation, is due to the large proportion of free acid, structure, and delicacy of skin which does not afford protection against injury from even very light pressure and very careful handling. This tendency is specially manifest in the raspberry and mulberry.

These analyses do not sustain the popular estimate of the relative nutritive value of several varieties of fruits. The peach and apricot, so universally esteemed because of their luscious flavor and comparative easy digestion, are in fact less valuable than others less attractive and palatable. Like the plum and the pear, they are rich in pectous substances, which mask the free acid, but do not add much to their alimentary value. Wholesomeness is not necessarily in proportion to the nutritive value, but to the digestibility and adaptation to the condition and wants of the animal economy.

In the table below, the proportions of soluble and insoluble constituents, and of the seeds and skins, have been arranged so as to exhibit with approximate accuracy the relative value as aliments of the several kinds of fruits. The table is based upon the assumption that in the soluble elements reside, for the most part, if not entirely, the nutritious properties. The seeds and skins are insoluble, and but partially, if at all, digestible. As aliments, each kind must be considered not only in reference to the relative proportion of soluble and insoluble constituents, but in regard also to the proportion of

Proportions of Soluble and Insoluble Constituents.

	Apples.	Pear.	Plum.	Cherry.	Apricot.	Peach.	Grape.	Gooseberry.	Currant.	Strawberry.	Raspberry.	Blackberry.	Mulberry.	Billberry.
Soluble .	12.	12.85	8.69	17.24	9.60	9.38	22.37	11.12	8.30	9.64	8.81	7.98	14.03	9.31
Insoluble .	88.	87.15	91.31	82.76	90.40	90.62	77.63	88.88	91.70	90.36	91.19	92.02	85.97	90.69
Seeds & Skins	1.80	3.81	5.95	5.93	5.26	5.61	2.59	2.99	3.94	1.96	4.10	5.21	0.90	12.86

seeds and skins which is necessarily ingested with the soluble and nutritive elements. The peach contains 9.38 per cent. of soluble constituents, and 5.61 per cent. of seed and skin, but the latter are usually removed from the edible portion, whereas the gooseberry contains 11.12 per cent. of soluble material, and 2.99 per cent. of skin and seed, which, as a rule, are never removed, but ingested with the pulp, and consequently, while richer than the peach in nutritive properties, it is less wholesome, because of these indigestible constituents. The strawberry contains 9.64 per cent. of soluble elements, but 1.96 per cent. of seeds and skin, and 1.13 per cent. of free acid, and must be accepted as the healthiest of the berry family, notwith-

[1] Strawberries, raspberries, mulberries, and blackberries are not properly berries, though classed as such here.

standing the mulberry is richer in soluble constituents, and contains but .90 of seeds and skin. The large proportion of free acid in the mulberry (1.86), though masked by 2.03 per cent. of pectous substances, promotes speedy fermentation, and even when eaten freshly gathered from the tree, this action is set up, usually speedily followed by some derangement of the bowels.

If the nutritive value of the several varieties of fruits is estimated according to the amount of nitrogenous matter (albuminates) each contains, it is very little, and would vary between .90 per cent. found in the cherry and .19 per cent. found in the plum. The cherry and the grape are richest in nutritive properties, in soluble constituents, and contain less water, yet there is a great difference in their wholesomeness as aliments. The grape contains but .49 per cent. of pectous substances, but is ingested without the skin ; the cherry contains 2.28 per cent. of pectous substances, and is eaten with the skin ; but the skin and seed of the grape does not aggregate more than half of the percentage of the skin and seed of the cherry. Whether the difference in digestibility is due to the difference of chemical constitution or to the parts ingested, has not been determined, but it suggests more care in avoiding the ingestion of the seeds and skins of fruits.

Grapes bear transportation well in unbroken bunches, cherries badly at best, but should never be detached from the stems until being eaten.

These examples are believed to be sufficient to satisfy you of the necessity of the inquiry to which I invite you ; but, as yet, the picture is far from complete. Before proceeding to describe the process of *freshening* stale vegetables and fruits, now so generally practiced by the market dealers, I must briefly refer to the market system in operation in many American cities, which I hold is not only wrong in itself, but productive of greater wrong upon the communities.

Market Systems. — In many of the large cities of this country there is a class of dealers, generally known as "hucksters," who stand between the producer and consumer. They purchase from the producers fresh vegetables and fruits in large quantities, at prices far below the rates paid by consumers, always overstock themselves in quantity and variety, preferring to carry over to another market day the surplus rather than lose the opportunity of accommodating a customer. Having, by a system of market regulations established by municipalities in their generous zeal to promote business and to foster trading, secured, through the payment of a bonus, the right of occupancy, upon the payment of an annual rental, all the stalls in the regular market places allotted to the sale of fresh vegetables, they establish a monopoly so exclusive that the husbandman cannot penetrate any nearer than the nearest curb line or foot-walk, and there, if at all, offer his products for sale, otherwise he must compete with the monopolist at public auction, in bonus bidding, for a suitable stand under shelter. The huckster's capital consists in his right of occupancy thus secured, perhaps a horse and wagon and a very small amount of money. He purchases to sell and promises payment after sale. Competition is consequently not between the dealers to secure the choicest and freshest products, but between

the growers to secure a purchaser. Far from his garden with his wagon and team, he wisely submits to a sacrifice rather than return with his perishable commodities. This bidding for a purchaser does not enure to the benefit of consumers; it simply enhances the profits of the dealers. Hucksters have little or nothing at risk, and deal exclusively for the profit, and if supplied from the surplus of the previous day buy only to freshen their wilted and decaying stock. In brief the system, —

1st. Regulates the supply by separating the producer from the consumer.

2d. Enhances prices to the consumer, without benefiting the producer.

3d. Compels consumers to purchase stale if not deteriorated vegetables, because the supply is controlled by middlemen, and not by amount produced.

4th. Supply and demand do not bear their proper trade relationship, because supply can only reach consumers through middlemen who control the only channels of trade.

5th. Consumers cannot make quality a basis of value, for the good and bad are mixed. The fresh is made to sell the stale.

"*Freshening*" *Fruits.* — The system of freshening green vegetables is extensively employed by many dealers in perishable vegetables and fruits, and is so cunningly devised and adroitly executed that it will escape any but the most careful and cultivated observation. It can be most practically exposed by individual and descriptive illustrations. Cabbage and lettuce are freshened by stripping off the external layer of leaves and clipping the end of the foot stalk, and this process is repeated from time to time until the head is either sold or is so reduced in size as to become unmerchantable. The process of stripping brings to the exterior the blanched and whitened leaves, and it oftentimes happens that the blanched head most eagerly sought has been stripped sundry times, and while its surface is apparently fresh and crisp the centre is in a state of decay. Cabbage at certain seasons of the year will bear this process without rapid deterioration, but lettuce is much more perishable. Beets, radishes, and other roots which are offered for sale bunched, speedily deteriorate in moderately warm weather. This begins first at the circumference of the leaves, and actual decay at that part of the leaves and midribs compressed by tying, hence freshening is performed by clipping or tearing off the faded parts, and this process is repeated until the midrib is cut short to the crown, and then they are either bunched by the extremities of the roots or sold by measure, so that not unfrequently the fresh beets upon our tables in May and June have been hauled from market to market for a week or more. Peas and beans are offered for sale bulked upon the market stand, and the salesman always measures from the bottom. The surplus from previous sale days is heaped upon the stand, and the entire surface neatly and adroitly covered with a sufficient quantity of the more recently gathered. Great taste is displayed in making the stale surplus look attractive, and much tact is acquired in measuring so as to disturb the surface but little and secure for the purchaser the full measure of the underlying deteriorated legumen. Spinach and kale, after the first rush of the season is over, are generally so cheap as to render

the freshening process unremunerative, but when dear the latter is freshened by clipping or tearing off the faded parts of the leaves, reclipping the foot stalks and sprinkling. Spinach in cold weather can be preserved in a fair condition for some days. But did it never occur to you that a crop which is left standing in the open ground during winter could not be gathered in such quantities as is sometimes offered in the markets during hard weather, when the surface of the ground is covered with a foot of snow for weeks and sometimes months? The salesman will tell you the crop was protected with a layer of straw or thick brush, and by removing this it was easily gathered. And so far he tells the truth, but if you undertake to remove straw loosely spread upon the earth and covered by six or twelve inches of frozen snow, you will soon learn it is far from an easy task. The truth is, the crop is gathered before the snow falls, kept in a cool, secure place, and retained frequently until the price rules high.

"Unfortunately dead plants (Chambers) do not stink early enough to disgust the nose; but yet, every minute they are kept after their actual death, — that is, after they have ceased to be capable of growth, — renders them in some degree less digestible. Sometimes they are kept too long out of mere carelessness, sometimes from lack of sale, but sometimes also intentionally, to make them look better at table. For a long time I could not make out why London asparagus so often disagreed with people, till at last I caught a gardener cutting it twenty-four hours before it was wanted, and putting it in a damp warm frame, 'to swell,' as he said. Cucumbers and brocoli are often spoiled in the same way. The vast wagons of cabbage that one sees coming into London at midnight are often the bearers of two or three days' cutting in small gardens, kept till a full load is accumulated for a single journey. Sprinkled with water they look well, but never regain their fresh character. They ferment in the stomach and produce flatulence."

Strawberries, raspberries, and blackberries are offered for sale either in bulk or in pint or quart measures as transported. If in bulk, the freshening process is executed in the same manner as other products offered for sale in like manner, by carefully concealing the stale and deteriorated surplus from previous days by a neatly arranged surface covering with fresh fruit from the near gardens. And great care is exercised in properly placing each berry so as to thoroughly hide the underlying fermenting mass. If in baskets, the top is dressed with fresh fruit and without loss of measure. A dealer can purchase a crate containing fifty quart baskets of strawberries from a producer, empty them upon his stand, refill each basket by placing every berry, undersell the producer standing alongside, and make money. His baskets will be "heaping full," and each berry will present a bright glossy fresh surface to the purchaser, while the producer's lot will have sunken below the margin of his baskets, and the surface of the topmost layer of berries will have lost glossiness. Thus the baskets are freshened.

I may be mistaken, but my casual observations lead me to the conjecture that illy formed and defective fruit is frequently the result of imperfect and

deficient fecundation, and I have sometimes thought we might apply certain phenomena, which are constantly occurring in the vegetable kingdom, to the study and elucidation of the cause of monstrosities in the animal.

Certain conditions are essential to secure complete fecundations of fruit and grain bearing plants — sunlight, a certain amount of warmth and humidity of the atmosphere, requisite moisture and fertility of the earth, and adaptation of the soil to the vegetable growth. Cold, dashing rains falling at inopportune times, by washing to the ground, and continuous blasts of wind, by blowing away the pollen granules, seriously interfere with perfect fecundation. For instance, I have seen two fields of wheat, each on opposite sides of the same road, or adjoining, with like exposure, and growing upon soil presenting no obvious differences, one yielding abundantly, the other but a scanty crop. The latter had been caught just at the stage of full bloom by a rain and wind storm ; the other escaped because it was either in advance or behind its neighboring field in growth and development ; and, again, when I have seen one field yielding heads of wheat with a full plump grain for each ovum, and an adjoining, or other stalks in the same field, and springing with other spears from the same root, yielding heads with light and shriveled and absent grains, I have inferred that in the first fecundation was complete, in some incomplete, and in other germ cells it failed entirely. In this suggestion I antagonize the accepted views of agriculturists, who so generally attribute these defects and failures alone to atmospheric and climatic influences operating during the stages of development and ripening.

Impregnation of the seed-bearing flowers, or its equivalent organ, is absolutely necessary in all grain-bearing plants, or else the product will be a failure. When single spears of corn stand alone, the ears never fill, because the pollen from the top-gallant fails to reach every germ cell through the silk ; and if two rows of corn, each of a distinct variety, be planted alongside, every ear will contain grains of both varieties more or less distinctly marked ; but if from any cause any part of the silk of any incipient ear be destroyed previous to fecundation, no grains will be developed in the cells connecting with such injured silk ; and imperfect impregnation will find many illustrations in the illy formed and defectively developed grains.

All flowers are sexual, being furnished with the fertilizing or fertile organs, or bisexual, possessing both stamens and pistils, varying in number from a single stamen and pistil to an indefinite number of each. In all fruit-bearing plants complete fecundation is essential to the perfection of the seed, and, as it is a rule with but few exceptions, that the full development of the sarcocarp is concurrent with complete maturity of the seed, it is manifest that the perfection of the latter, like the perfection of the seed, must depend upon proper fecundation. The first dropping of young fruit, which even after an abundant show of blossoms, sometimes extends to the whole orchard crop, is, says Watson, mainly due to the imperfection or total failure of the fertilization, whether this arises from drought and glaring sunshine, from unseasonable cold, an inopportune storm, or from other less manifest causes ; all such dropped fruit is seedless or germless. Again, as

it will occasionally happen, a fruit grown among a number upon the same tree, will be seedless, and invariably such a fruit will be deficient in development — if not illy formed, certainly diminutive in size. Neither the cucumber nor the cantaloupe will fructify under glass, except by the actual and artificial contact of the staminate with the pistillate flower, even though the requisite conditions of humidity, temperature, sunlight, adaptation of the soil, and vigorous growth may all be present. The plants are monœcious, and the sexually distinct blossoms grow in near proximity, yet the crop will prove a signal failure unless artificial impregnation is carefully executed; and this is true of all fruit-bearing plants unless the fruit-bearing blossom is bisexual. Hence, it is evident that some condition, which pertains exclusively to the open air, is essential to complete fecundation in the monœcious and diœcious plants.

The strawberry plant presents itself in distinct staminate and pistillate varieties, and with bisexual flowers. If you destroy in irregular patches the pistils projecting in great numbers from the exterior surface of the ovum of a pistillate variety, or in like manner occlude the stile tubes, each one of which communicates with a germ cell, and leave the undisturbed pistils and stile tubes in near proximity to a staminate flower, those parts of the fruit will fecundate and develop to maturity, whereas the parts connecting with the destroyed pistils or occluded stile tubes will remain undeveloped, and the fruit as a whole will be illy shapen and deformed. Most of our fruit-bearing trees have perfect bisexual blossoms, with more than one stamen and a number of pistils; hence, reasoning from analogy, I have reached the conclusion that knotty, irregularly shapen, and defectively developed apples, pears, peaches, and other fruits, result from defective and imperfect fecundation.

If these suggestions and observations are entitled to consideration, and worthy of being classed as facts, surely I have established the proposition that defective development in fruits is in a measure due to imperfect fecundation. I shall not, at present, undertake to estimate their value in determining the nature and causes of the degenerative changes which speedily take place in fresh fruits, nor the effect of such imperfectly developed fruits when consumed as food.

The final considerations relate exclusively to the remedy for the imposition practiced in the sale of fresh vegetables and fruits. A system of competent inspection will undoubtedly accomplish much, and correct many of the alleged abuses, and not only must the plan be wisely regulated, but the officials must be persons skilled in the art of gathering and packing, and in the transportation of perishable fruits and vegetables. No mere novice who has passed a lounging life in a city, absolutely ignorant of the essential qualities of fresh fruits and vegetables, too weak to resist temptation, and too timid to fearlessly discharge a disagreeable duty, would accomplish any good. To this must be added the right of confiscation. The enormity of the crime must be brought directly home to the practical and pecuniary necessities of the offender. The business of huckstering can be conducted in a proper manner with profit, and I would

rather not believe that every man engaged in the business resorts to the tricks of the trade.

But the most effectual means for the accomplishment of satisfactory results will be the establishment of free market places for the accommodation of the producers. Afford ample opportunities for the utilization of the products of his labor, and cease compelling him to sink his scanty earnings in the enormous profits of middlemen. The perishable products of the farm are introduced into cities for immediate consumption, and every obstacle which obstructs the ready access of the consumer to the producer should be removed, and municipalities should abandon such sources of revenue. Thus may value be enhanced to the producer and diminished to the consumer. Quality will be improved and health promoted.