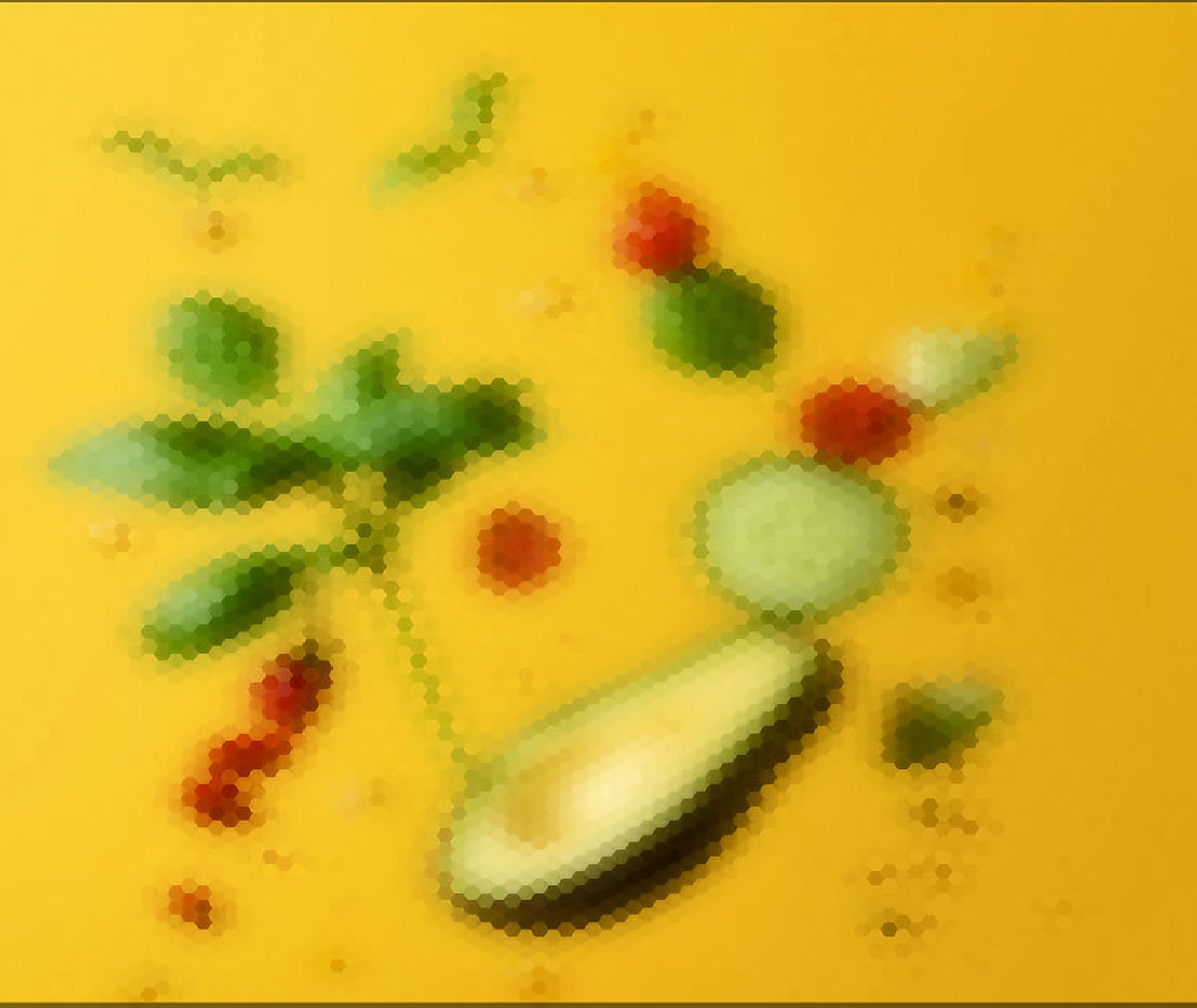
EUGENE CHRISTIAN



ENCYCLOPEDIA OF DIET

Eugene Christian

Encyclopedia of Diet

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Volume 1

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PREFACE

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Countless centuries have come and gone and have left on the earth myriad forms of life; but just what life is, from whence it came, whether or not there is purpose or design behind it, whether or not all the sacred books are mere conceptions of the infant mind, of the whence and whither, we do not know; but when we put life beneath the searchlight of science, we do know that it is a mere assembling of ionic matter into organic forms, and that this strange work is done in accordance with certain well-defined laws.

We know that these laws are a part of the great cosmic scheme. In harmony with them works evolution, which tends to lift to higher and higher degrees of perfection all forms of both animate and inanimate life. We believe that if all the natural laws governing life could be ascertained and obeyed, the number of disorders or interferences with Nature's scheme would be very greatly decreased.

Man's system of co-operating with his fellow-creatures, which we call civilization, has imposed certain restrictions, duties and limitations upon him, which make it impossible for him to live in strict accordance with these laws; therefore if he would have his birthright, which is health, he must employ science to fit him into his artificial environment.

Man has been brought to his present state of physical development on the rural, outdoor, close-to-nature plan, and since he must live in houses and pursue occupations foreign to those through which he was developed, he must make corresponding changes in the material from which his body is constantly being repaired and made; therefore, as the selections, combinations, and proportions of the various things he needs for nourishment are determined by his age, activity, and exposure to the open air, if he accurately or even approximately ascertains and observes these things, life will continually ascend in the scale of power and grandeur, and his endurance and period of longevity will be increased.

Nearly all forms of life on this globe, except man, live approximately eight times their period of maturity. Man matures at twenty-four; measured by this scale he should live about two hundred years. But the average life of civilized man, reckoning from the age of six, is only about forty years, while if we include the infant class, and reckon the average age from his birth, he scarcely gets his growth before his hair and teeth are disappearing, and his eyesight is being propped up by the lens of the oculist, and he quietly drops into his grave. One hundred and sixty years of life, then, is about what civilization has cost him up to date. This is very expensive, but of course he has something to show for it. He has aeroplanes, wireless communication, the mile-a-minute train, politics, several kinds of religion, rum and cocain, the tramp, the billionaire, and the bread line.

We cannot consistently leap over ten thousand years of heredity and habit, but we can recover some part of the one hundred and sixty years of life civilization has cost us. This can be done by feeding our bodies according to their requirements determined by age, temperature of environment, and work or activity; by cultivating mental tranquillity; by loving some one besides ourselves, and proving it; by breathing an abundance of fresh air, and by doing useful work. Of all these things food is the most important because it is the raw material that builds the temple wherein all other things dwell.

Civilization and science are doing but little real good for man if they cannot select for him the material necessary to develop his body and all its faculties to their highest degree, or at least free him from much of his disease and materially increase his "ease"; they have brought him but little, I say, if they cannot show him a way to live more than forty years. Science would have nothing of which to boast if it only pointed out a way by which man could exist for two hundred years, as this is his birthright. It can only boast when it has given him more than his natural heritage.

That man's general health and period of longevity have decreased, while all other branches of science have so vastly increased, is evidence sufficient to justify the assertion that he has not employed scientific methods to the art of living, or at least to those fundamental principles, such as nutrition, motion, and oxidation, which really govern his health and his life.

The difference between youth and age, between virility and senility, is in reality a chemical difference only. The difference between the flexible cartilage of youth, and the stiff cartilage of age is one of chemistry.

If, by the process of metabolism, the muscles, bones, tissues, and brain-cells can be made to multiply and to reproduce themselves at eighteen, it seems only logical that science should give us the secret by which this same thing could be done at eighty, and if at eighty, why not at a hundred and eighty? It is by no means extravagant to say that if science can teach us the actual demands of the body under the varied conditions of age, climate, and activity, and the means of supplying these demands with only such food elements as are needed, life can be prolonged to what seems to be our natural period of years.

Consider the human body as a machine that possesses the power of converting fuel or food into energy, using or expending that energy at will, reproducing itself piece by piece from the same fuel, and casting out the debris and ashes—if all this is done by the body automatically, and its power to act or to do these things depends so completely upon the fuel or the material with which the body has to work, then the question of the *kind* of fuel, the quantity, how to select it, how to combine it, how to proportion it, becomes at once the most important problem within the scope of human learning.

THE PURPOSE OF THIS WORK

When we compare man's longevity with other forms of life, and consider that he breathes the same air, drinks the same water, lives under the same sunshine, and that he differs from them chiefly in his habits of eating, the conviction is forced upon us that in his food is found the secret, or the causes of most of his physical ills and his shortened life. All elements composing the human body are well known. Its daily needs are matters of common knowledge. Science has separated the human body into all its various chemical elements or parts, and weighed and named them; it has also analyzed and separated his food or fuel into its various chemical elements or parts, and named these. It would seem, therefore, a most logical step to unite these two branches of science, and to give to the world the dual science of Physio-food Chemistry, or, what I have named Applied Food Chemistry.

The sciences of physiological chemistry and of food chemistry can be made useful only by uniting them—putting them together—fitting one into the other for the betterment of the human species. These two branches of science can be of use in no other possible way except by ascertaining the demands of the human body through physiological chemistry, and by learning how to supply these demands through the science of food chemistry. In the union of these hitherto separate branches of science I can see the most useful, the most important, and the most powerful department of human knowledge. It is this union that these volumes are designed to make.

THE AUTHOR.

NEW YORK, *August, 1914*.

A chest of miracles,
Close-packed and all secure, the unstable mass
Supported from a ruinous collapse
Or helpless flexion, by a spinous pile
Rigid as oak, yet flexile as the stem of the nodding flower.
Within, a nest of wonders, separate tasks
Each organ faithfully performing, still
From day to day harmoniously smooth
And uncomplaining, but for hindrances
Or ruinous urgence. Thou hast wisely said,
Melodious singer of old Israel,
"I am fearfully and wonderfully made."

E. C.

LESSON I

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THE INTERRELATION OF FOOD CHEMISTRY AND PHYSIOLOGICAL CHEMISTRY

FOOD CHEMISTRY AND PHYSIOLOGICAL CHEMISTRY UNITED

The human body is composed of fifteen well-defined chemical elements. A normal body weighing 150 pounds contains these elements in about the following proportions:

	POUNDS	OUNCES	GRAINS
Oxygen	97	12	—
Carbon	30	—	—
Hydrogen	14	10	—
Nitrogen	2	14	—
Calcium	2	—	—
Phosphorus	1	12	190
Sulfur	—	3	270
Sodium	—	2	196
Chlorin	—	2	250
Fluorin	—	2	215
Potassium	—	—	290
Magnesium	—	—	340
Iron	—	—	180
Silicon	—	—	116
Manganese	—	—	90

There are a number of other body-elements, but they are so remote that they have not been clearly defined by physiological chemists. All these body-elements are nourished separately, or, as it were, individually. They must be replenished in the body as rapidly as they are consumed by the vital processes, and this can be accomplished only through the action of the elements, in the forms of food, air, and water, received into the body and assimilated by it.

Where 91 per cent of human ills originate

From my professional experience I have estimated that about 91 per cent of all human ills have their origin in the stomach and the intestines, and are caused directly by incorrect habits in eating and drinking. If this is true, or even approximately true, it shows that, in its relation to health and the pursuit of happiness, food is the most important matter with which we have to deal; yet the average person devotes far less consideration to it than he does to the gossip of the neighborhood, or to the accumulating of a few surplus dollars.

Eminent writers agree as to importance of diet

Profs. Pavloff, Metchnikoff and Chittenden; Hon. R. Russell; Drs. Rabagliati, and Wiley, Ex-Chief of our Federal Bureau of Chemistry, and many other profound thinkers and writers have given in their various books an array of facts which prove beyond doubt that food is the controlling factor in life, strength, and health; yet they have given us but few practical suggestions as to how it should be selected, combined, and proportioned, so as to produce normal health, and especially how to make it remedial and curative, or to make it counteract the appalling increase in disease.

I have endeavored to begin where the great theorists left off—

1 By becoming familiar with the chemistry of food

2 By becoming familiar with the chemistry of the body

Food chemistry useless without body chemistry

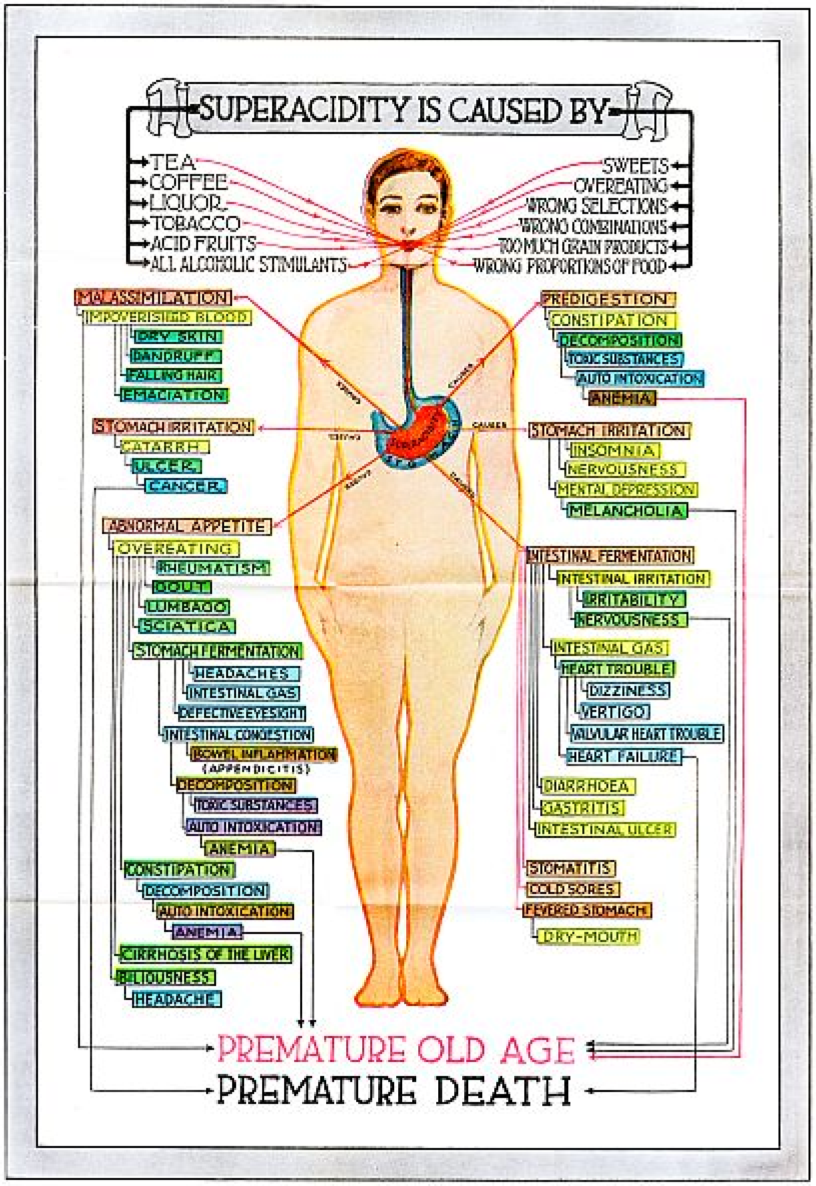
Until my work began these two great sciences had been taught as distinct and separate branches of learning, while in reality *physiological chemistry* is but half of a science, and *food chemistry* is, in fact, the other half of the same science. The energy in food cannot be developed without the body—the body cannot develop energy without food. Each branch is worthless, therefore, without the other. In this work I have endeavored to unite them and to make of the two one practical, provable, and usable science.

RELATION OF SUPERACIDITY TO OTHER DISEASES

Superacidity a primary cause

Nearly all stomach and intestinal troubles begin with superacidity. This is caused by the wrong combinations of food, or overeating. Food passing from the stomach, thus supercharged with acid, causes irritation of the mucous lining of the alimentary tract. This results in nervousness, insomnia, intestinal congestion (constipation), fermentation, and intestinal gas, while the excess of acid in the stomach causes irritation of the mucous surface of that much-abused organ, which develops first into catarrh, then ulceration, and sometimes into cancer. The accumulation of gas from the fermenting mass in the intestines causes irregular heart action, and sometimes heart failure. The great number of sudden deaths from this cause is pronounced by physicians "heart failure." In this the doctors and the writer agree—I know of no other way to die except for the heart to fail. The primary purpose of this work, however, is to ascertain *why* the heart fails, and, if possible, to remove the causes. From the fermenting food toxic (poisonous) substances, such as carbon dioxid, are generated, which, when taken into the circulation, become a most prolific source of autointoxication (self-poisoning).

From long experience gained by scientific feeding, in treating stomach and intestinal trouble, it became apparent that a great many disorders, very remote from the stomach, completely disappear when perfect digestion and assimilation of food, and thorough elimination of waste are effected. This has led to a very searching investigation of causes, and to the preparation of the following chart, which is designed to show how a great many so-called diseases can be traced back to one original cause—superacidity.



CHART, SHOWING THE NUMBER OF SO CALLED DISEASES CAUSED BY SUPERACIDITY

Power to resist disease depends upon correct feeding

Aside from emotional storms, great nervous shocks, inoculation (vaccination), and violent exposure, nearly all diseases can be traced back to the stomach, or errors in eating. Even in cases of exposure, vaccination, or contagion, if the digestion and the assimilation of food, and the elimination of waste are perfect, the body will have the power to resist nearly all these causes of disease. Curing disease, therefore, by scientific feeding, is merely a method of removing causes and *giving Nature a chance* to restore normality.

Foods that ferment make inferior flesh

Food that sours, ferments, or that does not digest within Nature's time-limit, cannot make good bone and brain. A defective digestion that converts food into poisonous gases in the intestinal canal will make inferior flesh and blood, just as any other defective machine will turn out inferior work. This is the natural law governing all animal life.

Nature's protest against unsuitable building material

Millions of learned people admit that good specimens of men and women can be constructed only out of good building material. They admit that the quality of a man, like that of a house, or a machine, depends upon the kind of material used in his construction; and yet they allow this important material to be selected and prepared by the most ignorant and unlearned, and they take it into their bodies with a childish thoughtlessness that is amazing; and when Nature imposes her penalty for violating her laws, they seek a remedy in drugs and medicines, and these are applied only to the symptoms which are merely the protest Nature is uttering. Thus a powerful drug silences or kills the friendly messenger who brought the timely warning, but the cause still remains. Suppose houses, ships, and machinery were constructed and repaired after this plan!

NATURAL LAWS DEMAND OBEDIENCE

Recompense for obedience to natural law, and punishment for its violation, are the invariable order of the universe, and are nowhere so effectively and emphatically demonstrated as in the cause and cure of the condition called disease.

There are certain laws which, if obeyed, will build the human body to its highest efficiency of energy, vitality and strength; but in order to obey these laws, one must know them, and in order to know them one must pass through the long and arduous mill of experience, or else learn from one who has done so.

Pain is a warning that something is wrong with the human mechanism, and he who tries to silence this signal with medicine will be punished for two wrongs instead of one. Nature tolerates no trifling, no deception; her laws are inexorable, her penalties inevitable.

Treating symptoms instead of causes

Multitudes of people are convinced that there is *something wrong* with their eating. Instead of food giving them the highest degree of mental and physical strength, which it should do, it actually produces ills and bodily disorders; moreover, not knowing the cause, people have no conception of a remedy other than drugs. It is amazing when one thinks how man, for two thousand years, has treated disease. Instead of studying causes and endeavoring to remove them, he has treated symptoms and symptoms only. It is generally known that the practise of medicine consists in treating symptoms rather than causes. For example, nearly all headaches—one of our common afflictions—are caused indirectly by impaired digestion, faulty secretion and excretion, yet the drug stores and Materia Medica (the Bible of the profession), are laden with "headache cures," all of which act only upon the symptoms. The whole system of drugging people when they are sick is merely a method of quieting the signals—of killing or paralyzing the messengers. Most drugs, taken into the human body, are merely diminutive explosives, the effect of which is destructive. They are like a lash cruelly applied to a willing servant who lags from sheer exhaustion.

"Ease" and "Dis-ease"

Since symptoms are really the language of Nature, if we learn to interpret them, we need never err in diagnosis, and consequently never err in getting directly at the causes, as we must do in order to "cure." A drug that could *cure* a disorder caused by wrong feeding would perform a miracle. *It would reverse one of the fixed laws of the universe. It would produce an effect without a cause.* Nature works along the lines of least resistance, and points out with unerring certainty the best, the cheapest, and the easiest way to live. Health was originally called "ease." People who did not have health were in disgrace or "dis-eased."

HOW TO MAKE HUMAN NUTRITION A SCIENCE

Human nutrition cannot be made a science under the conventional methods of omnivorous eating—eating anything and everything without thought or reason. Nutrition can only be made a science by limiting the articles of food to such things as will reproduce all the chemical elements of the human body, mentioned at the beginning of this lesson.

The further we remove foods from their natural state, the more difficult becomes their analysis, their reliability, and a knowledge of their chemistry, therefore the menus that appear in this work include only the foods that will give to the body the best elements of nutrition.

Prepared foods unscientific

There is but little difficulty in ascertaining the chemistry of natural foods, but when they have been preserved, pickled, canned, smoked, evaporated, milled, roasted, toasted, oiled, boiled, baked, mixed, flavored, sweetened, salted, soured and put into the popular commercial forms, it becomes very difficult, if not impossible, to know what we are eating, or to estimate the results.

Man is the net product of what he eats and drinks. Food bears very much the same relation to him that soil does to vegetation. The following questions, therefore, should be solved by every one who believes that success and happiness depend upon health and vitality:

1 How to select and how to combine foods which will give to the body a natural result, which is *health*

2 How to select and how to combine foods so that they will counteract and remove the causes of disease

3 How to select foods which contain all the chemical elements of the body, and how to combine and proportion them at each meal so that they will chemically harmonize

4 How to determine the quantity of food to be taken each day, or at each meal, that will give to the body all the nourishment it is capable of assimilating

> *Note*: Too much food, even of the right kind, defeats this purpose and produces just the opposite result.

Upon this knowledge hinges the building of a natural body, the cure of a vast majority of dis-eases, our ability to reach the highest state of physical and mental vitality, the prolongation of youth and longevity.

OUR FOOD MUST FIT INTO OUR CIVILIZATION

We must make our diet fit into our civilized requirements. Civilization has imposed many customs, habits, and duties upon us that have not been properly met by nutrition or diet. This is why nearly 91 per cent of our ills are caused by errors in eating.

Effect of sedative occupations upon nutrition

Under continued physical exertion, the body will thrive for a time on an unbalanced diet. It will cast off surplus nutrition, and convert one element into another, a problem unknown to modern science, but under sedative or modern business habits and occupations, it will not continue to cast off a surplus, or to reconvert nutritive elements. As a result of an unbalanced bill of fare, the nutrients taken in excess of the daily needs undergo a form of decomposition, producing what is called autointoxication, and become a most prolific source of dis-ease.

WHY THE SCIENCE OF HUMAN NUTRITION IS IN ITS INFANCY

The reader may inquire why it is that all other branches of science have advanced so rapidly, and the science of human nutrition has just begun. The reasons are:

> 1 Our ancestors, for many thousand years, were taught that dis-ease was a visitation of Divine Providence, therefore to combat it was to tempt the Almighty.
>
> 2 Doctors of medicine who have been custodians of the people's health for many centuries have seldom been food scientists. Most of them attempt to combat disease with drugs.

Now we are beginning to learn the truth about the origin of disease and in considering the body as a human engine, to take into consideration the all-important question of fuel.

Tendency of the modern physician toward food science

That the most learned physicians are drifting more and more toward scientific feeding and natural remedies is a matter of common knowledge. This splendid army of laborers in the great field of human suffering is made up largely of what is termed the *Modern Doctor*—the man who is brave enough to think and to act according to his better judgment.

Just to the extent that we understand the origin of drugs, and the drugging system of treating dis-ease, we turn instinctively *from them*, and instinctively *toward* food, for in drugs we find an ancient system of guesswork, while in food we find fundamental principles and primary causes. The majority of causes are removed when the diet is made to fit our physical condition and environment, and we then become normal by the process of animal evolution, Nature merely bestowing upon us our birthright because we have obeyed her laws.

> 3 The true science of human nutrition can be evolved only from an accurate knowledge of both food chemistry and of physiological chemistry.

Why food chemistry and physiological chemistry have not been united

The science of physiological chemistry has been known and taught for more than one hundred years, while the science of food chemistry is of recent origin. These two branches have been kept separate because they grew up at different periods of time. United they constitute the greatest science known to mankind, because they affect his health, his happiness, his life, and above all they measure the period of time he will live.

Physiological chemistry tells what the body is and its needs—food chemistry tells how to supply these needs. Recognizing these facts, I have merely united these hitherto unapplied branches of science, and have made of the union the science of Applied Food Chemistry, which makes practical that which has heretofore been confined mainly to theory.

LESSON II

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SIMPLE PRINCIPLES OF GENERAL CHEMISTRY

Relation of chemistry to food science

If the student is versed in chemistry, this lesson will serve merely as a review; if not, somewhat close attention must be given to facts which at first may seem uninteresting. Patience should be exercised, for, while all the information herein given does not, taken as a whole, bear directly upon the subjects of health and dis-ease, yet with this knowledge it will be much less difficult to understand the principles which are applied later when we take up the chemistry of the body and the chemistry of food.

Chemistry is not, as popularly supposed, a science far removed from everyday life. Everyone has some knowledge of chemistry, but the chemist has observed things more minutely and therefore more accurately understands the composition of substances and the changes that are everywhere taking place. For illustration:

> A cook starts a fire in a stove. She knows that the fire must have "air" or it will not burn; that when the fire is first lighted, it "smokes" heavily, but as it burns more, it smokes less; further, that if the damper in the pipe is closed the "gas" will escape in to the room.

Fire, gas, and smoke the result of chemical changes

The chemist also knows this, but because he has compared his observations with similar events elsewhere, he is enabled to express his knowledge in the language of science. To the chemist, fire is the process of combustion—the union of the oxygen of the air with the carbon and hydrogen compounds of the wood or of the coal. The heat of the fire is generated by this chemical union. To the chemist, the smoke is a natural phenomenon occasioned by particles of carbon which fail to unite with the oxygen gas. The gas, which to the woman suggests suffocation if enough of it escapes into the room, to the chemist suggests a compound resulting from combination of the oxygen with the carbon.

CHEMICAL ELEMENTS

To the chemist, all forms of matter are mere combinations of elements. Chemical analysis is a process of separating, dividing, and subdividing matter. When the chemist separates or analyzes compounds, until he can no longer simplify or subdivide them, he calls these simple products "chemical elements."

Common elements

Many of the chemical elements are well known, such as copper, iron, and gold. Other elements that are still more common are unknown in their elementary form, because they combine with other elements so readily that they exist in nature only as compounds. For example: Hydrogen, united with oxygen, forms water; the elements chlorin and sodium, combined or united, form common salt.

Number of elements

Altogether chemists have discovered about eighty-four elements, many of which are rare, and do not occur in common substances.

All substances of the earth, whether dead or living, are formed of chemical elements. These elements may be found in the pure or elementary state, or they may be mixed with other substances, or they may be combined chemically. Copper, iron, and gold are elements in the pure state. If we should take iron and copper filings and mix them together, we would still have copper and iron. Were we to take copper and gold and melt them together, we would have a metal that would be neither copper nor gold. It would be harder than one and softer than the other. But this substance would still be a mixture, and its properties half way between copper and gold.

Examples of chemical changes

If a piece of iron be exposed to dampness it will soon become covered with a reddish powder called "rust." The rusting of iron is a process of chemical changes in which the original substance was wholly changed by chemically uniting with the oxygen and the moisture of the atmosphere, which is really a process of combustion. The burning of wood, the rusting of iron, the souring of milk, and the digestion of food are, in a way, all mere examples of chemical changes.

Difference between chemical compounds and simple mixtures

Care should be exercised to distinguish chemical compounds from simple mixtures. Air is not a compound, but a mixture of oxygen, hydrogen and nitrogen gases. Water, however, is a compound of oxygen and hydrogen. Both salt and sugar are compounds, but if we grind them together, we do not have a new compound, but a mixture of two compounds. Most of the common things around us are mixtures of different compounds or substances. Rocks are mixtures of many different compounds. Wood is, likewise, formed of many different substances. Wheat contains water, starch, cellulose, and many other compounds. Grinding the wheat into flour does not change it chemically, but if we heat the flour in an oven, some of the starch is changed into dextrin. The starch has disappeared, and dextrin, a new substance, appears in its place. Whenever elements are combined into compounds, or compounds broken up into elements, or changed into other compounds, we have true chemical action.

The names of the elements are formed in many different ways. The name chlorin is derived from a Greek word meaning *greenish-yellow*, as this is the color of chlorin. Bromin comes from a Greek word meaning *a stench*, a prominent characteristic of bromin being its bad odor. Hydrogen is formed from two Greek words, one of which means *water* and the other to *produce*, signifying that it enters into the composition of water. Potassium is an element found in potash, and sodium in soda, etc.

Names of elements—how derived

For convenience, abbreviations are used for the names of elements and compounds. Thus, instead of oxygen, we may write simply "O"; for hydrogen, "H"; for nitrogen, "N," etc. Very frequently the first letter of the name of the element is used as the symbol. If the names of two or more elements begin with the same letter, some other letter of the name is added. In some cases the symbols are derived from the Latin names of the elements. Thus, the symbol of iron is Fe, from *ferrum*; of copper, Cu, from *cuprum*.

Symbols of elements—how derived

The following table gives the names of the elements which it will be necessary to understand in pursuing this work.

Aluminum	Al	Gold	Au;	Phosphorus	P
Arsenic	As	Hydrogen	H	Platinum	Pt
Boron	B	Iodin	I	Potassium	K
Bromin	Br	Iron	Fe	Silicon	Si
Calcium	Ca	Lead	Pb	Silver	Ag

Carbon	C	Magnesium	Mg	Sodium	Na
Chlorin	Cl	Mercury	Hg	Sulfur	S
Chromium	Cr	Nickel	Ni	Tin	Sn
Copper	Cu	Nitrogen	N	Zinc	Zn
Fluorin	F	Oxygen	O		

AIR AND OXYGEN

Composition of air

AIR—The air consists chiefly of two substances, only one of which can keep up the process of burning. This substance is known as oxygen. The other, in which nothing can burn, is known as nitrogen. Besides these the air contains smaller quantities of other substances, particularly water vapor, carbonic acid (carbon dioxid), ammonia, and carburetted hydrogen.

Distribution of oxygen

OXYGEN—Oxygen is the most common element in nature. It forms between forty and fifty per cent of the solid crust of the earth, eight-ninths of all the water on the globe, and one-fifth of all the air around the globe.

We have oxygen around us in great abundance, but it is mixed with nitrogen, and it is difficult to separate the two so as to secure the oxygen for any practical or commercial use.

MANUFACTURE OF OXYGEN

There are three methods of obtaining oxygen:

1 From *potassium chlorate*, or, as it is commonly called, chlorate of potash.

When potassium chlorate ($KCLO_3$) is heated in a closed vessel (closed vessel means "closed at one end"), it breaks up into potassium chlorid and oxygen; that is, $KCLO_3$ + heat = KCL + O_3.

Potassium chlorate is used in fireworks because it gives up its oxygen readily. Potassium nitrate serves the same purpose in gunpowder, which is a mixture of sulfur (S), charcoal (C), and salt-peter or potassium nitrate (KNO_3). The explosion of gunpowder, after a certain temperature has been reached, is due to the formation of oxygen, which, combined with the potassium nitrate, is set free by the very rapid burning of the charcoal and the sulfur. Other gases formed by the explosion are nitrogen, and probably sulfur dioxid (SO_2), and oxids of nitrogen, N_2O, NO_2, etc. Carbon monoxid and carbon dioxid are sometimes formed. Potassium nitrate, however, is the most active agent in gunpowder.

2 By the *electrolysis of water*.

By this method the oxygen and the hydrogen are separated by electricity.

3 By the *liquefaction of air*, which is a very recent and a very scientific method.

By this method the air is cooled down until it liquefies. At normal atmospheric pressure it liquefies at a temperature of—312.6°F., but under pressure of about 585 pounds it liquefies at a