7 1) Colorado
2) Agricultural Experiment Station

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Bulletin 297 October, 1925

POTATOES FROM THE HOUSEKEEPER'S STANDPOINT

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ISSUED FROM THE HOME ECONOMICS RESEARCH
LABORATORY OF THE EXPERIMENT STATION
COLORADO AGRICULTURAL COLLEGE
FORT COLLINS, COLORADO
1925

POTATOES FROM THE HOUSEKEEPER'S STANDPOINT

By N. E. Goldthwaite

America is a land in which under pioneer conditions, women always marched abreast with men and carried their full share of burdens. Our pioneer mothers because of their interest often knew as much of the farm, its stock and its crops, as did our pioneer fathers. Always they were thoroughly conversant with their own particular duties. To be otherwise would have been a reflection on their fitness. Household management and all pertaining to it was their concern. Especially did they know food-materials and the principles of cookery; they knew the curing of meats, the drying of vegetables, the drying and preserving of fruits; they understood the care of children and the care of the sick; they were accomplished critics of woolen stuffs and household linens—for had not the fibers for these been raised on the farm? and had not they and their daughters spun the yarns, woven and made up the cloths? Fragments of their sewing yet preserved to us show the honesty and beauty of their everyday stitches. Exquisitely knit socks, stockings, mittens and even gloves attest their skill. Best of all, the honest labor of their minds and hands, wrought characters strong, wholesome, self-reliant.

In this modern age of machinery and factory labor—this age of the machine-made product—the manufacturer has year by year encroached further and further into the household domain. Gradually, he has taken woman's work from her and put it into his factory. When, about a hundred years ago, he began his invasion of this country, he took first our spinning and weaving; next our knitting; by degrees he has got most of our sewing; today he would feed us all out of his tin cans. He would have us feel we can do nothing for ourselves—he wants to do it all. Deprived of our former home tasks, we women have either forgotten how to do, or have never learned, many of the homely household arts of our pioneer mothers. We pride ourselves on "not knowing how." Shades of our blessed pioneer mothers! So have we lost the hard-earned standards of excellence which you bequeathed to us!

In the lightening of our labors which this age of machinery has brought, we women then have lost much; but also we have gained much—much leisure. And how are we using this leisure? Women's clubs throughout the land attest the fact that many of us fain would use it for self-improvement—and thereby the improvement of the race.

Simultaneously with the development of machine-made products, and with woman's loss of her early arts, and thereby many of her standards of excellence, the scientist has been delving in his laboratory. His quest of truth for truth's sake, is the quest of the ages. By his systematic questions, and Nature's unevasive answers, he is reaching depths of understanding, and attaining heights of knowledge hitherto unknown—physics, chemistry, astronomy,

ERRATA IN BULLETIN 297

e 11, line 3, omit "fats."
e 29, under "Vitamines," last line of second paragraph, for "energy," read "enemy."

biology, psychology—all science is slowly yielding its secrets. The scientist is learning the abiding record of the universe, of the sun, of the earth, of humanity. The human mind—that bewildering entity of the ages—and the human body—its matchless vehicle—are under his persistent scrutiny. He is learning the part the human body plays in Nature's unending cycle—the soil and the air, the plant, the animal and the human, again the soil and the air—incessantly the great drama repeats itself.

The scientist today can tell us something of the enigmas of disease—its causes and control; of health—its laws and preservation; of the hidden mysteries of foods—how they function in the body. He can tell us a little of the fascinating story of how a glass of milk becomes a part of the body; of how a slice of bread or a piece of meat yields its elements to the life-cells; of how a helping of potato, or a lump of sugar, energizes the body—enables it to do work.

And we, we women in this new-found leisure of ours, we would not be ignorant of all these thigs. Is not this new knowledge something in which we are vitally interested? Is it not closely akin to our age-long tasks of race preservation, and of feeding our families? With the ever increasing help of the scientist, may we not hope to carry out these tasks more intelligently than ever before?

For women thus interested in enlarging their mental horizon, and hence their usefulness in the world, this bulletin has been written—written as a very small contribution toward popularizing a very small portion of scientific knowledge.

Part I, A Study of Potatoes, attempts to elucidate particularly the structure and composition of the potato. Frequent references throughout the bulletin indicate sources of information for many of the statements made. Some women may be interested to look up these references. The figures on the percentage composition of Colorado potatoes represent the result of several hundred very careful quantitative chemical analyses carried out on various types of potatoes grown in different parts of the State. These analyses were carried out in the Research Laboratory of the Home Economics Department of The State Agricultural College of Colorado. In connection with these analyses and the long series of cooking experiments accompanying them, the author wishes to make grateful acknowledgement for the conscientious help of Miss Vera F. Warren. Also her sincere thanks are due Miss Ena M. Crain and Miss Flora L. Slocum for their careful assistance in many of the cooking experiments.

Part II, Principles of Potato Cookery, will be better understood if Part I is first mastered. No attempt to give receipts or recipes has been made; these may be found in any cook-book. In any case, only the one who understands the fundamental principles involved can follow any receipt intelligently.

Part III, the Appendix, was written primarily to make clear some of the science involved in Parts I and II. Incidentally, it indicates very briefly the relationship between the human body and the earth. Scientists of the present time are making strenuous efforts to tell Nature's stories in everyday language. This is a difficult task; difficult because of inherent difficulties; difficult also because as scientific knowledge has increased, the scientist has been forced to coin new words to typify newly discovered facts. To insure a permanency in meaning otherwise impossible, these new words are usually built up from ancient Greek or Latin words or roots whose meaning is unchanging. Such words are "short cuts" in expression. To the uninitiated, unless he masters them through the dictionary, they present difficulties. To aid in understanding certain such words, the author has taken pains either in the text, or in the glossary (Part IV) to indicate briefly their fundamental or root meanings.

To Summarize—Part I is an attempt to elucidate the structure and composition of the potato; Part II attempts to explain the principles of potato cookery; Part III tries to make clear some of the science involved in Parts I and II, and in so doing it gives a very brief outline of the relationship between the human body and the earth. Part IV gives fundamental meanings of unusual words.

PART I. A STUDY OF POTATOES

Potatoes are originally an American food-product, and they are pre-eminently a Colorado product. Native to the high altitudes of South America, experience has shown that they find a congenial home in the Rocky Mountain regions—the presence of a certain species of wild potatoes[1] on the Western Slope bears witness to this. Colorado's high altitude, her large percentage of sunshiny days and her cool nights combine to furnish an ideal climate[2] in which to grow potatoes of good cooking quality.

STANDARDS OF QUALITY

By potatoes of good cooking quality we mean, in America, well-matured tubers containing a high proportion of starch. The hot, cooked potato, which on mashing separates into a savory, steaming, mealy mass of glistening white particles, meets our highest approbation. When to this steaming mass of glistening particles we add the proper seasonings, such as salt, butter and milk or cream, we have a most appetizing and delicious food.

In Great Britain[3] also, mealiness in potatoes constitutes excellence, but in some other countries, notably France,[4] the approved potato has a slightly yellowish color, and holds together after cooking so that it does not mash easily. The yellow color and the ready preservation of form show a partial lack of starch—that food ingredient for which Americans prize the potato most. The French demand a potato whose cut cooked pieces hold their shape well,

1 Fitch and Bennett, Colo. Ag. Col. Exp. Sta. Bul. 175, p. 8, (1910).
2 Sandsten, Colo. Ag. Col. Exp. Sta. Bul. 243, p. 1, (1918).
3 Langworthy, Farmers' Bul. 244, p. 13, Quotation from Wright.
4 Coudon and Bussard, Am. Sci. Agron. 2 Ser., p. 290, (1897).

both in salads and in "diced" potato dishes; we, a potato which will mash up mealy. So the French have persistantly bred their potatoes for a high nitrogen[5] content; we, for a high starch[6] content —hence, the difference.

However, if desired, our starchy potatoes can be so cooked that their subsequently cut pieces will hold their shape very well, as will be shown further on.

STRUCTURE OF THE POTATO

She who best understands the structure of the potato will best understand its cookery; besides, the woman who covets intelligence concerning her foods will be especially interested to study the structure of this American tuber. It is very easily done. In this study we shall try to discover first the cortex, and second the medullary area of the potato. (It is interesting to know that our word cortex is really the Latin word *cortex* meaning bark or rind: and that our word medullary is derived from the Latin word *medulla* meaning marrow or pith).

The Cortex.—Cut a clean, raw, unpeeled potato in two lengthwise. (Keep these halves and subsequent cuttings in a basin of cold water, as much as practicable while studying them, to avoid the natural blackening of their cut surfaces.) Take one of the halves and notice on the cut surface, just within the brown skin, the dense white ring that seems to form the whole outer portion of the potato flesh. This dense white ring is called the cortex. It varies in thickness from nothing at the "eyes" to one-fourth inch, or even one-half inch sometimes in other places; and it seems to be separated from the main portion of the potato by a very fine line. The cortex, this outer portion of the potato pulp, is the driest[7] part of the tuber and the richest part[8] in starch; hence it is the mealiest part when cooked. Notice how easily you remove it almost entirely if in peeling potatoes for cooking you peel them thick. Hence, a reason for avoiding thick peelings.

The Medullary Area.—The rest of the potato—that is, all of the tuber within the cortex—is called the medullary area. It is made up really of two parts—the inner and outer medullary areas. It is a bit more difficult to distinguish between these two than it is between the cortex and the whole medullary area, but it can be done fairly well.

a. The Inner Medullary Area.—Take one of the halves of the potato you have just examined and shave from its raw surface a very thin slice and try to look through this slice held up to the light. Hold the slice stem downward, and look for the translucent, branched center which seems to start from the stem; this branched center, which you will discover fairly easily, is the inner medullary area, or the so-called core. It is translucent—that is, it lets some

5, 6 See Part III, Appendix.
7, 8 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado State Agricultural College.

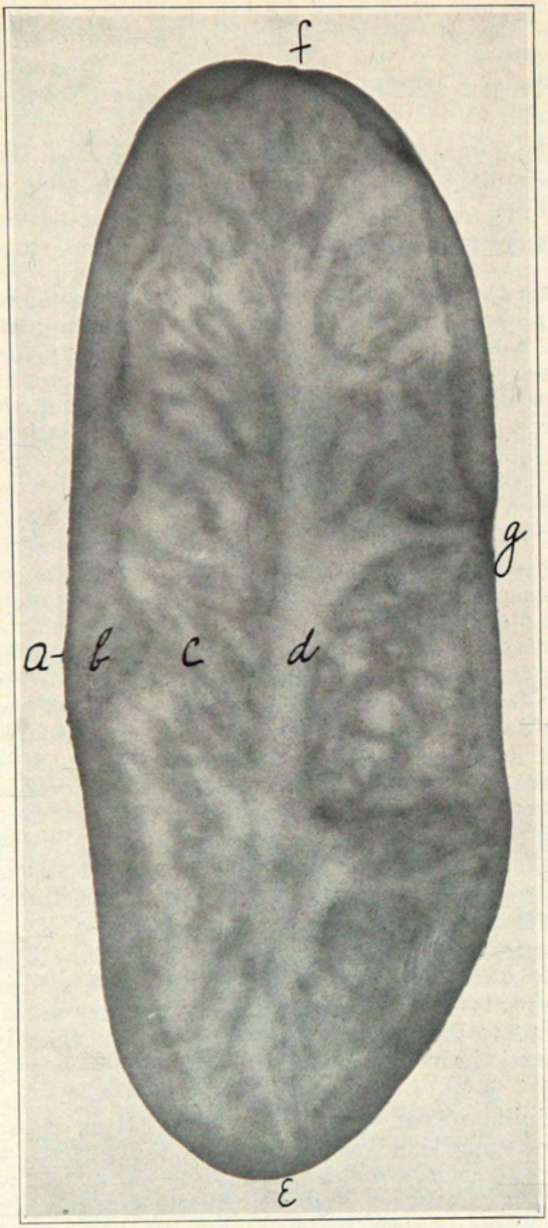

Fig. I. A lengthwise cutting through the center of a potato; a—skin. b—cortex. c—outer medullary area. d—core, or inner medullary area. e—stem end. f—bud end. g—an "eye."

light through — because it contains the largest proportion of water[9] of any part of the potato and the least starch; it is the most watery part of the tuber.

b. The Outer Medullary Area.—Finally, that part of the potato which fills the space between the core and the cortex is the outer medullary area. It is less translucent than the core because it contains a less proportion of water than the latter. We may describe it as semi-translucent, perhaps. It is more translucent than the cortex because it contains more water; the cortex contains so little water, but so much starch, that it is quite opaque; it lets no light through.

Summary. — We find then, passing from the skin of the potato inward, these three parts: Cortex, outer medullary area and inner medullary area or core. See Fig. I.

STUDY OF POTATO CUTTINGS

Lengthwise Cuttings.—Now, if you are interested (otherwise, omit this paragraph and the next) continue shaving off

9 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado State Agricultural College.

very thin lengthwise slices of potato and try to look through each in turn, held up to the light. Try to distinguish in each slice the three parts—cortex, outer medullary area, and core. Anyway you will readily perceive the cortex and the core; the outer medullary area lies between these two. See how the shape of the core in these lengthwise cuttings changes with each successive slice, how it gradually branches from the stem further and further into the outer medullary area, then into the cortex, and finally to the skin of the potato and there ends in an "eye." The more branched the watery core is, the more eyes the potato has; the less branched, the fewer eyes. Notice especially how much more plentiful these core branches are at the bud-end of the potato than at the stem-end. Do not these facts give a clue to the reason why the bud-end of the potato is always more watery than the stem-end? Examination of Fig. II will help you in this little study of potato structure. (Don't waste the potato cuttings. Keep them for comparison with some crosswise cuttings—see next paragraph. Later, all cuttings may be boiled then put through a colander and used for potato soup. See page 18.

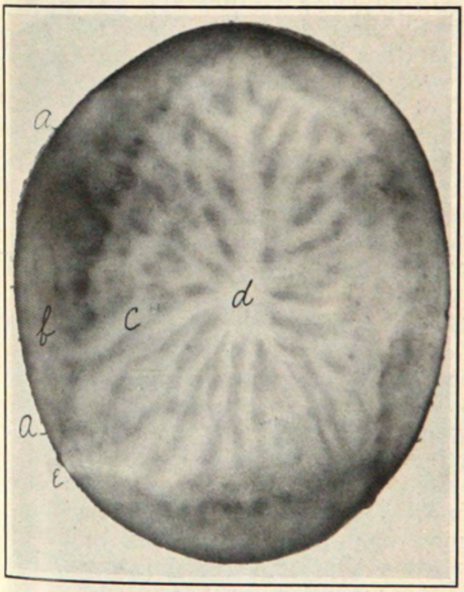

Fig. II. A crosswise cutting through the center of a potato; a—skin. b—cortex. c—outer medullary area. d—core, or inner medullary area. e—an "eye."

Crosswise Cuttings.—Next, let us examine some crosswise cuttings. So clean another potato. Begin at the stem-end this time and shave off very thin slices. Look closely at each of these crosswise cuttings held up in turn to the light. Notice again the dense, opaque cortex, and its apparent separation from the outer medullary area by a very fine line. Trace again the branches of the core in each slice till each ends in a potato "eye." Notice that the number of these branches are arms **increases in going from the stem-end to the bud-end** till the latter seems to be all arms—all core. Try to visualize the fact that the watery core really starts at the stem, and extends itself up through the potato somewhat in the shape of a bush or tree whose branches usually end in the potato skin and are most numerous at the bud-end. Is it not quite evident now why the bud-end with its many watery branches from the watery core, is always less mealy than the stem-end of the potato where these branches are few and the starchy cortex is thick?

THE WATER IN POTATOES

According to the researches[10] in this laboratory the total proportion of water in Colorado potatoes varies from 70 percent to 80 percent and averages about 75 percent to 77 percent, much less than in most fresh vegetables. The proportion of water in the cortex is usually about 4 percent less than in the medullary area. In other words the percentage of water in a potato increases from cortex to core, and the thinner the cortex the greater the proportion of water in the potato.

THE STARCH[11] IN POTATOES

Closely related to the structure of the potato is its food-value; and this depends largely upon the high proportion of starch which it contains. The proportion of starch[12] in Colorado potatoes usually varies from 14 percent to 18 percent or more—depending largely upon the maturity or the ripeness of the tubers—and averages about 16 percent. In general the more mature the potato the greater the percentage of starch throughout it—hence, the more "mealy" it is. The "new" potatoes that we dig for our Fourth-of-July dinners are delicious, waxy little tubers, but they are poor in starch, for the starch has not yet had time to develop. The potato stores the largest amount of its starch during the last few weeks[13] of its growth. The green leaves of the plant world are Nature's starch factories. In the fall, the natural dying of the potato leaves (if the plant is not diseased) shows that Nature is sending their starch down into the tubers to be stored for the growth of next year's plants.[14] And these tubers, rich in starch, we humans use for food.

Starch Decreases from Cortex to Core.—In our study of the structure of the potato we learned that the dense opaque cortex is the driest part of the potato, while the translucent core is the most watery. The dryness of the cortex is due to its very large proportion of starch, and the wateriness of the core is due to its very low proportion of starch. Both in starch and in water content, the outer medullary area is intermediate between the cortex and the core; hence, as we have found, the outer medullary area is less opaque than the cortex, and more opaque than the core. Evidently the potato prefers to store most of its starch in the cortex, just beneath the skin, less in the outer medullary area, and least of all in the core. Thus, **the starch content of the potato decreases from**

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10 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.
11 See Part III, Appendix.
12 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.
13 Abstract in Experiment Station Record, 41, p. 233.
14 Speer, Bul. 12, Iowa Experiment Station (1889).

cortex to core while the water content increases.

The starch content of the cortex[15] of Colorado potatoes usually varies from 18 percent to 20 percent, though it may run higher or lower; of the medullary area it may run even as low as 11 percent. Remember, the thicker the cortex, the higher the percentage of starch in the potato, and consequently the more mealy the potato.

Extractions of Starch from Potatoes.—In colonial days and even later, while each farm was yet an economic unit supplying all, or nearly all, the wants of the dwellers thereon, our thrifty pioneer mothers prepared their starch for household use by washing it out of potatoes. During the Great War this home industry was revived to some extent to help relieve the wheat shortage. It is not a difficult task, and it is very interesting just to see how much starch can be gotten out: Scrub a large potato (or two or three small ones) and grate it fine, or grind fine in a food-chopper, or chop very fine in a wooden bowl. Transfer this finely divided material to a clean, wet piece of cheese-cloth about twelve or fifteen inches square. Leave room enough to work the contents easily, tie up the corners and edges of the cloth securely with a string and transfer it with its contents to a bowl of cold water; then wash and gently squeeze the finely ground potato as long as a milky-looking liquid escapes through the meshes of the cloth. If running water is in the kitchen, this washing and squeezing may be done beneath a very tiny stream of water, while you catch the drippings in a clean bowl or pan. When the drippings are clear, set aside the dish containing the milky-looking liquid till the starch settles. Meanwhile, open the cloth and examine its contents. The solid material left is mainly the brown skin and the white framework (cellulose[16]) of the potato. After some hours, when the starch has settled to the bottom of the bowl, carefully pour the water off; if the starch seems clean, let it dry; if not, add some clean water, stir thoroughly, let the starch settle again, then pour off the water as before; repeat till the starch comes out beautifully white, then let it dry. From a pound of potato you will get from two to three ounces of dry starch, depending upon the richness of your potatoes in starch. See Fig. III.

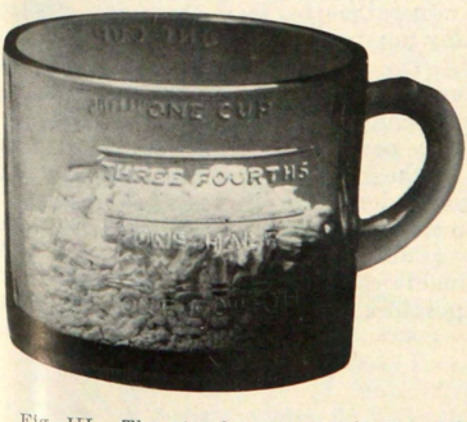

Fig. III. The starch extracted in this laboratory from a 12-ounce potato.

If possible to do so, you will now be much interested to look at some moistened grains of your potato

15 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.
16 See Part III, Appendix.

starch under a good microscope. You may discover some grains with beautiful shell-like markings. Look for them.

USE OF STARCH TO THE BODY

Starch is one of our very important so-called energy[17] foods. Starch is a carbohydrate[18] and is made up of the elements carbon, hydrogen and oxygen—each one of which is absolutely necessary for the daily wear and tear of the body. Whenever you scorch a potato, as sometimes in baking or in frying, the browned or blackened portion proves the presence of carbon in the tuber. About 18 percent of the human body really consists of this element carbon It is a matter of interest to know that the adult human body discards about a half pound of used-up carbon every twenty-four hours, chiefly in the form of carbon di-oxide[19] (a gas) from the lungs. It is necessary of course, that a sufficient amount of carbon to make good this constant loss should be contained in the daily food. Potato is an excellent source of food-carbon; the starch of wheat and corn are other excellent sources.

THE MINERAL[20] MATTER IN POTATOES

The mineral matter of potato is a very important constituent —important to the plant and important in our food—although it forms only about 1 percent of the tuber. Without it potato would not be potato either in taste or in food-value. Should you burn up a potato just as completely as possible, you would finally have left a small amount of grey-white ash, looking much like wood ashes; this is the mineral matter of the potato.

Distribution.—The largest proportion of this mineral matter is found in the cortex[21] of the tuber, and the least in the core. In other words, just as the proportion of starch in the potato decreases from cortex to core, so the proportion of mineral matter decreases. Thick peelings remove much mineral matter from the potato. Hence, a second reason for not peeling potatoes thick.

Elements of Potato-Ash.—The chemist finds that in the grey-white ash of the potato occur the elements[22]—calcium, magnesium, potassium, sodium, phosphorus, chlorine, sulphur and iron.

Use to the Body.—The body needs every one of these elements, not only to help build it up in the first place, but to keep it going —to keep it in proper running order while life lasts. Fortunately, most vegetables contain these elements, but potatoes are richer than most of them in potassium. (Potassium forms nearly 70 per cent of "potash"—one of the valuable constituents of farm fertilizers.) Because of their potassium, potatoes form one of our most efficient

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17 See Part III, Appendix.
18 See Part III, Appendix.
19 See Part III, Appendix.
20 See Part III, Appendix.
21 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.
22 See Part III, Appendix.

"basic"[23] foods, since this element neutralizes so easily certain acids that are formed during the digestion of some of our very important "acidic"[24] foods among which are meats, eggs, [illegible] and cereals. (The latter include, of course, breads, macaroni, rice and all our various breakfast foods made from such grains as wheat, oats, barley, rye, rice and Indian corn.) The body keeps most of its fluids basic, or alkaline, if it has the proper opportunity; hence, the value of potassium as a food element. So don't fail to include in your dinner a good helping of potato—deliciously cooked!

THE NITROGENOUS SUBSTANCES IN POTATOES

The total amount of nitrogenous substances[25] (i. e. substances containing nitrogen) in Colorado potatoes usually varies from 1½ percent to 2½ per cent. Immature potatoes contain a larger proportion of nitrogen than do the mature[26] ones. It should be mentioned that nitrogen also is a very important element of the human body[27]—about 3 percent of the body by weight being made up of it.

Distribution.—In studying the structure of the potato we learned that the percentage of potato-water increases from cortex to core. The percentage of potato-nitrogen does likewise. However, potato-nitrogen is distributed between two classes of nitrogenous substances—potato proteins[28] and potato non-proteins, of which the former is believed to have the greater food-value. Now, the greatest percentage of this potato protein[29] is found in the cortex, and the least, in the core. In other words, the proportion of potato protein decreases from cortex to core, just as starch does and just as mineral matter does. Feeding experiments show that potato protein is a very desirable food.[30] Hence, a third reason for not peeling potatoes thick.

The "Greening" of Potatoes.—If potatoes are exposed to the light for any length of time the flesh just beneath the skin becomes green, and there develops a nitrogenous substance called solanin[31] which is very undesirable in food; it is not only bitter to the taste but it is also poisonous. Any part of a potato that shows that it has turned green indicates that solanin has developed and this portion of the potato should be carefully cut off, or the whole potato peeled before cooking. Solanin sometimes develops in sprouting[32] potatoes; and the bitter taste sometimes discerned in old

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23 See Part III, Appendix.
24 See Part III, Appendix.
25 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.
26 Fitch and Bennett, Colo Ag. Col. Exp. Sta. Bul. 175 (1910).
27 See Part III, Appendix.
28 Osborne and Campbell, Connecticut Station Reports (1895).
Snyder, U. S. Department of Agriculture, Office of Experiment Stations, Bul. 43.
29 Coudon and Bussard Annales de la Societé Agronomique 2 Ser. 1897.
30 Rose and Cooper, Journal of Biological Chemistry, 30, (1917)
31 Experiment Station Record, VII, p. 652;p. 749
32 Experiment Station Record, VIII, p. 332; XL, p. 557
U. S. Department of Agriculture Year- Book, 1900, p. 348

potatoes seems to be due to solanin; peel such potatoes before cooking.

THE VITAMINES[33] IN POTATOES

At the present time when we are learning so much about vitamines—how necessary they are to the growth and health of the body, and even to its life—it is a comfort to know that two of these mysterious but very important substances—vitamine B and vitamine C—are found in moderate amounts in boiled and baked potatoes. Although vitamine B occurs in larger amounts than vitamine C, yet the latter is present in sufficient quantity to render potatoes a valuable antiscorbutic food. "Potatoes while containing the antiscorbutic vitamine in distinctly lower concentration than do oranges, lemons and tomatoes, are yet of great importance as antiscorbutics because of the quantities in which they are consumed."[34] Hence, we have other very cogent reasons for including these tubers in the diet.

CHOICE AND CARE OF POTATOES

General Rules.—

a. Choose, firm, healthy, mature, well-shaped potatoes.
b. Avoid diseased, bruised or cut potatoes.
c. Keep in a cool, dark, dry, airy place.

Mature vs. Immature Potatoes.—Choose firm, mature, well-ripened and well-shaped potatoes, but with eyes few and shallow. "Maturity is essential to high quality in potatoes."[35] Authorities[36] agree that a netted skin, and a firm crisp flesh usually indicate good keeping qualities, mealiness of cooked product and good flavor; while a smooth, shiny skin usually indicates immaturity, incomplete growth—hence, a potato poor in starch and therefore soggy. Immature potatoes sprout much more readily than mature ones; they are not good keepers; as they sprout they shrink in size and the flesh becomes spongy. As we have learned already, there is danger of solanin in sprouted potatoes. Sometimes the skin of the stem-end of potato is netted, while that of the bud-end is smooth and shiny. This condition shows an interrupted growth,[37] not the steady growth that leads to desirable maturity. The more mature stem-end of such a potato may be fairly mealy, but the shiny bud-end with its more recent growth has the texture of an immature potato, and hence its poor keeping qualities. Protuberances[38] or knobs, one or several, on a potato also indicate interrupted growth,

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33 See Part III, Appendix.
34 Sherman, The Vitamines, p. 124.
35 Gilmore, Quality in Potatoes, Bul. 230, (1905), Cornell Univ. Exp. Sta., Ithaca, N. Y.
36 Fitch and Bennett, The Potato Industry of Colorado, Bul. 175, Experiment Station, Colorado Agricultural College.
Gilmore, Quality in Potatoes, Bul. 230, (1905) Cornell University Experiment Station, Ithaca, New York.
37 Girard, Compt. Rend. 116 (1893) Abstract in Exp. Station Record 4, 959; East Illinois Experiment Station Circular 80.
38 Sandsten, Potato Culture in Colorado, Bul. 243, Experiment Station, Colorado Agricultural College.

with consequent deterioration of the inner portion of the potato through the recent development of one or more "eyes" into little new potatoes on the sides of the larger one. These protuberances, each with its well-developed bud-end, mean a much enlarged core with resulting wateriness. Make some cuttings of such a potato and examine the different parts of its core—you will be interested. Avoid such potatoes, both because of impaired food-value, and because of great waste in preparation for cooking.

Deep Eyes.—These seem to indicate a small core, but they are hard to clean properly, and they also lead to much waste in preparation for cooking.

Healthy vs. Diseased or Bruised Potatoes.—It goes without saying that the housewife, if she has a possible choice, always will choose healthy potatoes; she will avoid those which are diseased, or which have been bruised or cut in handling. In any case, diseased, cut, or bruised potatoes must be peeled before cooking, and their peelings will be, necessarily, more or less thick. In this way it is very easy to lose from 25 percent to 50 percent of the potato by weight, and the most valuable food portion of the potato at that, as has been emphasized already. Suppose for such potatoes you pay $2.00 per hundred pounds, and are forced to waste 25 percent

Fig. IV. Potatoes as they were taken from the warehouse. The foot-scale above indicates their comparative sizes. These potatoes are fair samples of the tubers which the housewife usually finds in the market. They clearly show cuts from bad digging and bruises from rough handling. Disease has set in around the cuts and bruises.

to 50 percent by weight in preparing them for cooking; then these potatoes have cost you not $2.00 per hundred but $2.50 to $3.00, besides the extra time needed to prepare them for cooking, and the loss of the best part of the potato.

As every thoughtful housewife knows, diseased potatoes, or those that have been badly handled and then stored in an unsuitable place, quickly acquire a disagreeable odor and taste that **no method of cooking can obliterate.** This was repeatedly found true in the long series of experiments in this laboratory of which this bulletin is an outcome. Often, too, potatoes which had evidently left the hands of the grower as A. No. 1, were found in such poor condition from bad handling and bad storage and ensuing disease, (see Fig. IV.) that not only must a large percentage of each tuber be cut away when prepared for cooking, but by no method of cooking could these potatoes be rendered pleasing to the taste; only strong seasonings, like onions, or cheese could disguise this defect sufficiently to make them palatable.

Potato growers are trying hard to raise undiseased tubers, but not till housewives demand also that potatoes shall be unbruised and uncut as well, will growers, transporters and dealers alike avoid rough handling. Potatoes with their thin skins so easily broken, and their crisp, tender flesh so easily cut—either of which may lead to decay—really need to be handled as carefully as oranges or apples. And the grower who is eventually far-sighted enough to do this will reap, and will be entitled to, correspondingly higher prices. (See Fig. V.)

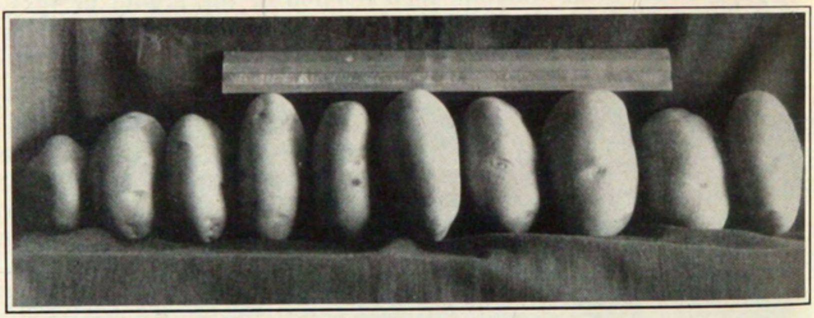

Fig. V. The beauties that potatoes can be and should always be. This is one hill of potatoes dug from a Colorado field; none in the hill were discarded. The smallest weighed about 4 ounces, and the two largest a little more than 9 ounces each—not too large for cooking without cutting in two. Altogether these tubers weighed 4¼ pounds.

Conditions for Keeping Potatoes.—No matter how choice the potatoes they will not remain choice if either the dealer or the housewife allows them to be exposed to the light, or to dampness, or keeps them in too warm a place, or where there is insufficient circulation of air. The potato is a living thing, and if kept under conditions conducive to its growth, it proceeds to take advantage of such conditions with resulting undesirable chemical changes so far as its flavor and food-value are concerned. Keep potatoes then under conditions that will discourage their inclination to grow. Experience and experiments show that they should be kept in a dark, dry, airy, cool place whose temperature is as nearly 40° Fahrenheit[38] as possible, and they should not be kept in bags—air should be allowed to circulate around them.

39 Suitable Storage Conditions for Certain Perishable Food Products, U. S. Dept. of Agriculture Bul. 729, p. 4

PART II. PRINCIPLES OF POTATO COOKERY

WHAT POTATO COOKERY IS

The object in view in cooking a potato is to heat the tuber so hot all through that its own natural water will do the cooking—that is, will swell and burst its starch grains. In other words, the potato is really cooked by stewing in its own internal juice. This is brought about by applying external heat to the potato till the internal water of the tuber is hot enough to accomplish the desired result. It is to this bursting of the starch grains, and the co-incident softening of the celluloss[40] frame—work of the potato, that the "doneness" of the cooked tuber is due. The richer the potato in starch, the more its interior swells in cooking; hence, the mealier the product.

FUNDAMENTAL METHODS OF COOKING POTATOES

Three fundamental methods of cooking potatoes are recognized: boiling, steaming and baking; while a fourth, frying (when raw potatoes are fried) should be added.

Boiling and Steaming.—These methods of cooking are very closely allied, since the external cooking agent—the moist heat of boiling water—is the same in both cases, though used differently: In boiling, the potato is heated through by contact with the boiling water itself, in steaming by contact with the steam only. In both these cases the water should be boiling vigorously before the potatoes are "put on to cook."

Baking and Frying.—Baking and frying (of raw potatoes) are somewhat similarly allied, since in both the external cooking agent is a dry heat: The heat of the oven in the one case, and the heat of smoking fat in the other.

PREPARATION OF POTATOES FOR COOKING

For any given mess choose potatoes of **the same kind,** and of as nearly the same size and ripeness as possible. Scrub them thoroughly. This is done best with a stiff vegetable brush*, and under running water. In the absence of the latter, use plenty of water in some suitable container and rinse the tubers thoroughly. Be particularly careful to scrub out the eyes and bad spots. Always provide a pan of clean cold water to slip the potatoes into as fast as each shall finally be prepared for cooking. Remember the potato is a living thing[41] in which physical and chemical changes are continuously going on; these changes go on more rapidly after the potato has been cut into; hence, the reason for keeping such away from the air under water. But do not soak cut potatoes unneces-

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40 See Part III, Appendix.

*A small stiff brush, kept for the purpose, is a necessity in cleaning vegetables well. A small, sharp, pointed vegetable knife is also needed in preparing vegetables for cooking—pointed in order to avoid waste in cutting out bad spots. A suitable brush may be purchased for five cents, and a vegetable knife for ten or fifteen. Keep the knife sharp. Have your own whetstone.

41 Appleman, Maryland Experiment Station Bulletin 167

sarily, since soaking causes the loss of some of their valuable mineral matter[42] and nitrogenous substances.

Peeling Potatoes.—After scrubbing the potatoes, carefully cut out any bad spots, but without wasteful cutting away of good potato. If any portion of the potato has become "greened," be sure to trim that portion off. If the potato is to be peeled all over before cooking, trim off as thin peelings as the condition of the potato will allow. Don't forget that the cortex is the most nutritious part of the potato; also, that potatoes peeled all over lose more or less of their mineral matter and nitrogenous substances during boiling or steaming. Sometimes instead of peeling potatoes entirely, some housekeepers prefer to remove only a lengthwise band of the skin of each. If potatoes are diseased or have any bad spots, it is quite necessary to peel them entirely before cooking, and such peelings, unfortunately will be unavoidably more or less thick. In any case it is difficult to peel raw potatoes, even the smoothest and best of them, and not lose from 10 to 15 percent by weight; while if the potatoes are diseased, or cut by bad handling, or both, this loss as already indicated, may easily run from 25 to 50 percent. Try it and see. Anyway, if potatoes must be peeled before cooking, don't waste the excellent food materials in their peelings; but if they give evidence of containing solanin, boil them before feeding to the stock. Avoid cutting potatoes in two before cooking. Unfortunately, when potatoes are too large to cook within a reasonable time, this will have to be done, but such cutting necessarily means considerable loss of mineral matter and nitrogenous substances while the potatoes are under water before cooking, and while they are being boiled or steamed. Potatoes to be baked are usually left unpeeled; obviously these should be chosen without blemish if possible, and should be scrubbed immaculately clean—the eyes especially.

"**New**" **Potatoes.**—Small new potatoes whose skins are very tender are readily "scraped" by the scrubbing process. Finish scraping the skin from the eyes by gentle use of the point of the vegetable knife.

"**Old**" **Potatoes.**—Shriveled old potatoes or potatoes which have sprouted, should be peeled before cooking (see p. 11). Such shrunken potatoes may often be much freshened by scrubbing, cutting off the stem (or cutting out the stem-end) to expose a fresh stem surface, and then soaking them several hours in cold water **before** peeling. If the potatoes seem likely to have a bitter taste when cooked, they should also be soaked **after** peeling, regardless of any loss of food material, since their bitter taste may be due to solanin (see p. 12.) Thorough soaking of old or shrunken potatoes seems to result in freshening the tubers by restoring internal water to the potato, and this internal water, as already pointed out, is necessary to cook the starch well.

42 Snyder, Minnesota Experiment Station Bulletin 42.

TO BOIL POTATOES

General Rules.—

a. Always put potatoes into boiling water, never into cold.
b. Slow boiling tends to make potatoes soggy, rapid boiling to make them mealy.
c. Have a coarse knitting needle, kept for the purpose, to test the "doneness" of potatoes.
d. If potatoes have been peeled before boiling, save the cooking water to use in soups, gravies, etc.

Mealy vs. Soggy Potatoes.—Potatoes when "put on to boil" should be dropped into rapidly boiling water, that any raw surfaces may be sealed over as quickly as possible to prevent undue loss of mineral salts, etc. Cover tightly. The water should be salted beforehand (about one teaspoonful of salt to one quart of water) and should be sufficient to considerably more than cover the potatoes, especially in high altitudes. The cold potatoes will stop the boiling for a few moments, so keep the fire going well that the boiling may be resumed quickly. If the water boils away too much, add boiling water, never cold. If "mealy" potatoes are desired, then keep them boiling rather vigorously, how vigorously depends upon their natural mealiness; if the potatoes are well ripened, and so inclined to be very mealy, too rapid boiling may "cook them to pieces," so in this case the boiling should be done more slowly; but if the potatoes are not well ripened, or very old, and hence inclined to be soggy, vigorous boiling will produce a mealier, more palatable product than too slow boiling. In other words, rapid boiling of potatoes tends to cook them to pieces, simmering tends to make them soggy. If, for some special purpose a cooked product that will hold its shape is desired, then boil the potatoes slowly, even simmer them, but in this case, steaming is better than boiling, (see p. 19).

As soon as the potatoes are just "done," as shown by testing with the knitting-needle, remove them from the fire, push the cover aside slightly, then while holding on the cover securely, drain off the water into some cooking receptacle (see rule d, above). Return the vessel containing the potatoes to the hot stove, remove the vessel-cover entirely, then while shaking the vessel gently for a few moments, allow the steam to escape. If the potatoes must be kept hot for any time, cover them with several thicknesses of a clean, dry, cheese-cloth, not with the cover used while boiling them. This is because a dry cloth will absorb the constantly rising steam, while the cover will merely condense it and allow the water so formed to drop back upon the potatoes and so tend to make them soggy. If the tubers have been peeled before cooking and are to be served as plain boiled potatoes, then, with a hot cooking-spoon, remove them at once from the cooking-vessel, and serve in a hot open vegetable dish covered with a clean dry folded napkin, not with a cover, for reasons already given. If the potatoes have not been peeled, or only partially peeled, before cooking, then with the tip of the vegetable knife, rapidly remove the skins, and serve as indicated above.

Gravy for Potatoes.—Boiled or steamed potatoes are served preferably with some sort of gravy, either poured over them or in a separate dish. A thickened, well-boiled brown gravy, not too fat, made following a roast or a pot roast, is very good. A thickened, well-cooked, "milk gravy" made in the iron skillet directly following the frying of salt pork, or the pan-broiling of a steak or chops or bacon or a piece of ham, is most delicious if properly seasoned. None of these gravies should be too rich with fat. If too much fat remains in the pan or skillet after cooking the meat, discard some of it for future uses before making the gravy. For milk gravy, since the meat-fat present should make it sufficiently rich, sweet skimmilk or separated milk may well be used, the cream being reserved for other purposes.

Mashed Potatoes.—If well mashed, well seasoned, well beaten, and served piping hot, one of the most delicate potato dishes is mashed potatoes. Mash the potatoes thoroughly in the hot vessel in which they were boiled. Quickly estimate the number of cups or pints (1 pint=2 cups) of potato, but do not measure lest the mass become chilled. Add seasoning about in the following proportions: To each pint of potato, 1 to 1½ level teaspoonfuls of salt, 1 to 1½ tablespoonfuls of butter, and one cup or more of scalding hot milk—the mealier the potatoes the more milk will be necessary. Beat the mixture vigorously with an egg-whip, to incorporate air into it, to lighten its color, and to make it very fluffy. Pile the mass lightly on a hot vegetable dish, dot it with butter and serve immediately. Too often mashed potatoes are insufficiently mashed, insufficiently beaten with insufficient hot milk, and are chilled or nearly cold when served—a poor apology for the deliciously delicate dish possible.

Uses of Potato Water.—If the potatoes were peeled before boiling, the cooking water should not be wasted; but if they were not peeled before boiling, be sure to discard the water. The cooking water[43] from peeled boiled potatoes is rich in potato mineral matter, in nitrogenous substances, and also in starch worn off the outside of the tubers during the boiling process. Use this water in soups, in gravies, or for setting the bread to rise—it is especially rich in food that the yeast plant thrives on. In making a thickened brown gravy after cooking meat (see above), the water from boiled peeled potatoes may well be used instead of the usual clear water, and the food-value of the gravy so increased.

Potato Soup.—An excellent potato soup for supper or luncheon may be made as follows: (1) Boil down the potato water to about half, unless already quite concentrated; (2) add an equal volume of milk, some meat dripping fat or butter, and salt (if necessary); (3) bring the mixture to a boil; (4) then, while stirring constantly, slowly add a thickening of flour mixed smooth with cold milk or

43 Snyder. Minnesota Station Bulletin 43

water; continue stirring till the soup boils up thoroughly, then serve at once. This thorough boiling after adding the thickening is to burst the wheat starch grains of the flour. Any left over bits of cooked potatoes or other vegetables such as peas, beans, greens or sweet corn, may be put through a colander and then added to the potato water, in which case boiling down the water before adding the thickening may be necessary.

Effect of Altitude on Time Necessary to Boil Potatoes.—The Colorado woman knows very well that the higher the altitude the longer it takes to boil a mess of potatoes. This is because the higher the altitude the rarer the air, and hence the lower the temperature at which water boils, or passes off as steam. In other words, boiling water is not nearly as hot on the mountains as at sea-level, on the Great Divide as at San Francisco. Water boils at sea-level at 212° Fahrenheit, but at the altitude of Fort Collins (5000 feet—nearly one mile) it boils at about 201° Fahrenheit; that is, boiling water is about eleven degrees cooler at Fort Collins than at New York City, for example. Now as we have learned, in either boiling or steaming potatoes, to get them hot enough throughout to cook the starch, we depend upon the external heat of boiling water. But if at 5000 feet altitude boiling water will not heat them within eleven degrees of the temperature to which it will heat them at sea-level, then the potatoes must be kept proportionately longer at the temperature to which the boiling water will heat them. The greater the height above sea-level, the longer it will take potatoes, or any other vegetable, to boil or to steam. Obviously, the same reasoning applies to the temperature of steam as to that of boiling water.

TO STEAM POTATOES

Potatoes may be cooked by the action of live steam,—that is, by being kept long enough in contact with steam from boiling water to heat them throughout sufficiently to burst their starch grains. To steam potatoes a kettle supplied with a tight-fitting steamer, and that in turn with a tight-fitting cover, is needed.

The Process.—Fill the kettle about half full of water, close securely with steamer and cover, and bring to vigorous boiling. Carefully drain or wipe the cold water from the previously prepared potatoes and transfer them to the hot steamer. Close the cover tight, and keep the water boiling vigorously till the potatoes are "done." Since the temperature of the steam cannot be higher than that of the boiling water producing it, but under ordinary conditions is a little less, the time necessary to steam potatoes is slightly more than for boiling them. When just done, with a hot spoon promptly remove the potatoes from the steamer to a hot vegetable dish; if they are already peeled, cover them with a clean, dry, folded napkin, and serve at once. If unpeeled, then as in the case of boiled potatoes, peel them promptly, cover them as directed above and serve. Steamed potatoes when done, if to be served as such, should always be removed at once from the steamer, since this vessel usually retains considerable water in the bottom despite its holes; hence, any cooked potatoes left in it are quite likely to become soggy.

Advantages and Disadvantages of Steaming Potatoes.—It is probably unnecessary to point out that the steaming method of cooking potatoes often can be utilized to advantage when some other food is being boiled vigorously in the kettle beneath. In this way, cooking utensils and stove space both, may be economized. However, since the steaming of potatoes produces a less[44] loss of mineral salts and other materials in the cooking water, than boiling them, it is not usually economy to try to use the cooking water for soup, unless some other vegetable is being boiled in it while the potatoes are being steamed. Steamed potatoes usually "keep their shape" better than boiled ones, but seem less mealy. Consequently they are very desirable for some purposes, but less so for others. They are especially desirable for cutting up cold for salads, and for "diced" potato dishes. Potatoes so mealy that it is difficult to boil them without "cooking them to pieces" usually can be cooked more satisfactorily by steaming. Obviously, steamed potatoes are usually less desirable for mashed potatoes than vigorously boiled ones. It is worth while to know that cold cooked potatoes either boiled or steamed, may often be "warmed over" very satisfactorily by steaming; the process in this case takes less than half the time necessary to steam raw potatoes.

TO BAKE POTATOES

As we have already seen, both in boiling and steaming potatoes we depend upon the moist heat from boiling water to heat the tubers hot enough throughout to cook their starch, while in baking and frying (raw potatoes) we depend upon dry heat to accomplish this purpose. When potatoes are ready to bake, remove the tubers from the cold water, wipe each as dry as possible, and transfer them to the oven, which at the beginning may be either hot or cold. The time necessary for baking will be less if the oven is hot when the potatoes are put into it, but fuel will be saved if it is heated thereafter, since the latter method allows the potatoes to become heated through at the same time that the oven is heating up. Also potatoes so baked are less likely to have their skins burned to the delicious cortex, than are those plunged into a hot oven at first. In either case, don't allow the oven to get too hot. It is desirable to turn potatoes over while they are baking—sometimes more than once.

To Avoid Sogginess in Baked Potatoes.—As soon as the potatoes are done, before the skins have had a chance to burn to the cortex, take each in a dry, clean cloth, then with the point of the vegetable knife, quickly and carefully slit the skin lengthwise, and then

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44 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.

gently squeeze the tuber just enough to help the imprisoned steam to escape; this is to prevent the potato from becoming soggy; immediately replace each potato in the oven, but leave the door open. Now take each one in turn in the cloth and with the vegetable knife, rapidly peel off the thin brown skin, being careful not to peel off the cortex. This thin brown skin is quite easily removed if the potatoes have been carefully baked. The cortex should be only slightly browned beneath the skin. Transfer the hot, nicely peeled, slightly browned potatoes to a hot vegetable dish, cover them with a folded napkin and serve at once.

The Flavor of Baked Potatoes.—The slight browning of the cortex spoken of above, is due to some dextrinization[45] of some of the starch by dry heat; starch so dextrinized has a distinctly sweetish taste, hence the reason why baked potatoes are sweeter to the taste than boiled or steamed ones, and also one of the reasons why baked potatoes should be peeled so carefully. This delicately sweet taste is very easily hidden if baked potatoes are served with a gravy, no matter how well it is made. Better serve baked potatoes with just salt and butter and cream since these seasonings will not mask their delicious flavor, but rather will emphasize it. If potatoes are baked so hard that the skin and cortex form a tough shell that cannot be separated, then much of the most tasty portion is lost, unless one eats the outer brown skin also; and this often is not advisable, especially for one whose stomach digestion is not over strong.

Baked Potatoes in the Half-Shell.—However, if baked potatoes are to be served in the half-shell, then it is necessary to bake the tubers down so that the skin and cortex will form the required shell. Cut such baked potatoes in halves lengthwise. Being careful not to break the shells, scoop out the potato pulps into a hot basin; mash, season, and beat as mashed potatoes. Refill the shells, piling the potato lightly. Dot each half with butter, return to a hot oven till delicately browned, then serve at once. Needless to say, such potatoes mean the loss of the delicious cortex as human food.

Dryness of Baked Potatoes.—It is a matter of common observation that potatoes properly baked are not only sweeter but also drier than are boiled or steamed ones. Many careful chemical analyses made in this laboratory prove that whereas potatoes properly boiled or properly steamed contain about the same proportion of water as the corresponding raw ones, that is, on the average, about 75 percent to 77 percent, well-baked potatoes contain considerably less water, that is, about 67 percent to 69 percent. The dry heat of the oven and the treatment of the potatoes after baking are responsible for this loss of water and the resulting more nutritious product; the proportion of starch[47] in baked potatoes

45 See Part III, Appendix.
46 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.
47 Variations in Composition of Colorado Potatoes, Department of Home Economics, Colorado Agricultural College.

runs from 20 to 24 percent against 14 to 18 percent in the raw potato.

TO FRY POTATOES

Obviously the frying of raw potatoes is a fundamental method of cooking the tubers, but the frying of previously cooked ones is not. In the former case the problem is to burst the starch grains of raw potatoes by the heat of piping-hot fat; in the latter case, to re-heat previously cooked potatoes, by the same means.

French Fried Potatoes and Saratoga Chips.—In the preparation of either French fried potatoes or of Saratoga chips, the problem is that of frying raw potato in deep fat. In both these cases the pieces of raw potato should be as dry as possible, and it cannot be too strongly emphasized that the fat must be smoking hot. In frying potatoes, either raw or previously cooked, some dextrinization[48] occurs on the surface of the pieces. The resulting sweetish taste combined with that of the slightly adhering fat accounts for the pleasing flavor, especially of French fried potatoes and Saratoga chips.

LEFTOVER POTATOES

Principle of Re-cooking Such Potatoes.—The thrifty housewife always has a number of ways to utilize leftover potatoes for supper or luncheon. The well-founded objection of most persons to "warmed-up" potatoes will disappear entirely if the housewife insists that the process shall be properly carried out. The potatoes not only must be cut into pieces of correct size, and must be well seasoned, but they must be **thoroughly heated through**—heated till they are as hot throughout as when they were cooked first! Failure to do this is adequate reason for objection to warmed-over potatoes. Properly prepared, such potatoes may be even more delicious than when first cooked.

Fried Potatoes (Previously Cooked).—Especially are fried "warmed-up" potatoes an abomination to many, and rightly so because of an over-sufficiency of fat and a great insufficiency of heat. Try this method: Into an iron skillet put enough meat-dripping fat to fill it about one-fourth inch deep when melted. Cut cold cooked potato into slices one-fourth inch thick. When the fat is **smoking hot** (not before) lay these potato slices in it one at a time, till the bottom of the skillet is covered. Keep the fat piping hot and fry till each slice is hot throughout and the under surface of each is delicately but thoroughly browned; then, as rapidly as this occurs, with a knife and fork turn each slice separately, and continue frying till the other side is similarly browned. As rapidly as each slice of potato is "done," with a knife and fork, or a slit spoon, remove it from the skillet, shake an instant to remove any excess of fat, drop into a hot, open vegetable dish and salt lightly;

48 See Part III, Appendix.

keep such slices hot (but do not cover) till the whole mess has been fried similarly, then serve at once. (If preferred, the potato slices when removed from the skillet may be transferred for a moment to a piece of clean, hot, brown paper to absorb any superfluous fat, before putting them into the hot vegetable dish.) If properly done, very little fat will cling to the well-browned slices of potato, and the well-heated-through and well-dextrinized product, if chewed fine, should not remind one of the usual dish of "fried potatoes."

Creamed Potatoes.—An excellent dish of creamed potatoes from leftovers (baked, boiled or steamed) may be prepared as follows: If not previously peeled, carefully remove the thin brown skins—but not the cortex!—and slice the potatoes rather fine on a cutting-board, or chop them fine in a chopping-bowl. Put enough meat-dripping fat into an iron skillet to cover the inside surface; to be sure that the fat does this, turn the hot skillet in various directions to allow the melted fat to run over the bottom and sides. Transfer the finely cut potatoes to the hot skillet, add salt, then enough boiling water to cover the potatoes about half. Cover tightly and heat slowly till the water boils. While the potatoes are heating take a thin-bladed knife, or better a kitchen spatula, and occasionally loosen the potatoes from the bottom and sides of the skillet and gently turn them over. Keep the skillet covered, and continue heating till the potatoes are hot throughout and the water has boiled nearly away. Again loosen the potatoes from the skillet, add hot milk to replace the water that has evaporated, and continue heating, but without cover, till the milk boils up thoroughly. If too much liquid seems to be present, cook down till the product is sufficiently thickened to serve easily, but do not let it burn—keep it loosened from the skillet. Transfer these "warmed-up" potatoes to a hot vegetable dish, dot with bits of butter, and serve at once.

Baked Creamed Potatoes.—A delicious dish of baked creamed potatoes may be prepared from leftover potatoes (baked preferably, though boiled or steamed may be used): Carefully remove the thin brown skin, being careful not to waste any of the dextrinized cortex, slice the potatoes layer upon layer into a casserole or earthen baking dish, adding to each layer salt, butter or meat-dripping fat, and some left-over gravy or a freshly made white sauce; finally fill up the dish with hot milk, and bake uncovered till the surface is delicately browned. Serve at once. If potatoes that had been previously properly baked are used for this dish, a most satisfactory product should be the result.

PART III. APPENDIX*

THE RELATIONSHIP OF THE BODY TO THE EARTH

COMPOSITION OF THE EARTH[49]

Elements.—This earth of ours is made up of elements, so called, such as iron, tin, aluminum, copper, silver, sulphur,—simple forms of matter which cannot by any ordinary means be decomposed into anything simpler. The chemist has reason to believe that there are ninety-two of these elements—eighty-seven of which have been discovered already. Most of these elements are solids like those mentioned above; some are gases—as for example, oxygen, nitrogen, hydrogen, helium, chlorine; two are liquids—bromine and mercury. Mercury or quicksilver we are familiar with in our thermometers—that heavy, silvery liquid that tells us how hot or how cold it is.

Mixtures.—The air we breathe is a mixture of colorless, odorless, invisible gases; nearly 99 percent of it consists of the elements nitrogen and oxygen—about four parts of the former by volume to one of the latter. The substances forming a mixture have neither lost their individuality nor identity; so in air its nitrogen is yet the gas nitrogen, and its oxygen is yet the gas oxygen.

Compounds.—The water we drink, when pure, consists of just oxygen and hydrogen—however, not a mixture of these two elemental gases, but a chemical combination of the two. In fact, most elements of which this earth is made up do not exist ordinarily as such but each exists in chemical combination with one or more others—compounds, the chemist calls them. So water is a compound of hydrogen and oxygen. In water the identity of the two combining elements, oxygen and hydrogen, is completely lost. This is true of any compound or chemical combination of elements. For example, sugar is a compound of the three elements, oxygen, hydrogen and carbon (a solid), no one of which would you ever suspect of being present in sugar till you take it apart chemically: this you do partially when the pie runs over in the oven and the juice burns down to the black, brittle mass, that you have a hard time to clean off. That black mass is mostly carbon. Whenever you burn any food, or brown it as in baking bread or cake; or whenever you scorch your clothes in ironing them, you thereby prove the presence of carbon. This carbon is a very important element of our foods, our clothes, our bodies—18 percent of the latter being made up of carbon.

COMPOSITION OF THE HUMAN BODY BY ELEMENTS[50]

Of the eighty-seven known elements, thirteen of them at least enter into the make-up of the normal human body. Several other elements have been found in very small amounts in the body, but whether or not they are essentially a part of it, we do not know yet.

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*For derivation of scientific terms not defined in the text, see the Glossary.
49 See any good General Chemistry.
50 Sherman, Food and Nutrition.

so we shall not consider them in this appendix. The thirteen absolutely essential elements, with their approximate percentages in the adult human body are as follows:

Oxygen	about	65.00%
Carbon	"	18.00%
Hydrogen	"	10.00%
Nitrogen	"	3.00%
Calcium	"	2.00%
Phosphorus	"	1.00%
Potassium	"	0.35%
Sulphur	"	0.25%
Sodium	"	0.15%
Chlorine	"	0.15%
Magnesium	"	0.05%
Iron	"	0.004%
Iodine	a very small quantity	

Relative Importance of the Body Elements.—You will be much interested to discover that of this list the first six elements—oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus—make up about 99 percent of the body-weight. Quite naturally you may suppose that these six must be much more important than the remaining seven—potassium, sulphur, sodium, chlorine, magnesium, iron, and iodine—which together constitute only about 1 per cent of the body weight. But not so; there is a certain "law of minimum" in nature that demands that the human body, to be properly constituted, must be made up of **all** its necessary elements. A rather startling illustration of this is the fact that less than 1/500 of an ounce of the element iodine stands between any one of us and feeblemindedness. Much has been written just on the need to the human body of that infinitismal amount of iodine.

Weight of Each Element in Your Body.—If you would like to know about how many pounds of each of the body elements are compounded in your own body, just find out how much you weigh, then take 65 percent of that weight for oxygen, 18 percent for carbon, and so on through the list. For example, suppose you weight 125 pounds; now 65 percent of 125 is 71¼—the number of pounds of oxygen that you have imprisoned in your own body. Similarly you will find that you have about 22½ pounds of carbon, about 12½ pounds of hydrogen, and so on.

Acidic and Basic Elements.—There is another very interesting way of looking at these elements which make up the human body. Some of the elements of which the earth is composed are **acidic** by nature—that is, they have acid-forming properties—their compounds tend to taste sharp like vinegar; other elements are **basic**, or **alkaline**, by nature—that is, they are just the opposite of acidic. Curiously enough, such acidic and basic (or alkaline) elements, when united chemically in proper proportions, neutralize each other—that is, they form a compound which is neither acidic nor

51 See any good General Chemistry.

basic, but is neutral. You know very well how a little vinegar added to your soapy dish-water, quickly spoils your nice suds—this is because the acid vinegar neutralizes the basic or alkaline properties of the soap. If you have never observed this you will be interested to make a little strong soap-suds in a small bowl, then add a few drops of vinegar and see how quickly the suds vanish.

The Body Fluids Are Mainly Basic.—Now let us return to the human body. Seven of its elements—oxygen, carbon, nitrogen, phosphorus, sulphur, chlorine and iodine—are acidic by nature; while the rest—hydrogen, calcium, potassium, sodium, magnesium and iron—are basic. And although the total weight of the acidic elements of the body is much more than that of the basic ones therein, yet in the body fluids these two classes of elements neutralize each other beautifully; so well, in fact, that, in health, their combinations keep most of the body fluids, like the blood and lymph, slightly basic (or alkaline)—just as the body wishes them to be.

Composition of The Human Body by Compounds.[52]—It is a curious fact that of the thirteen necessary body elements, the gaseous ones—oxygen, hydrogen, nitrogen and chlorine—constitute about 78 percent of it by weight. The other nine elements are solids. Of the whole thirteen not one ever exists as such—that is, "free" or uncombined—as a part of the human body; instead, they are present in the body in various chemical combinations—compounds as we have learned. In general, these body compounds and their constituent elements are as follows:

a. **Water,** (oxygen and hydrogen).
b. **Carbohydrates,** (oxygen, hydrogen and carbon).
c. **Fats,** (same elements as in carbohydrates but in different proportions and differently combined).
d. **Proteins,** (oxygen, hydrogen, nitrogen, carbon, sulphur; and, in some proteins, phosphorus, also).
e. **Mineral Matter,** (various combinations of calcium, potassium, sodium, magnesium, iron, oxygen, phosphorus, sulphur and chlorine).

HUMAN FOOD[53]

The body being composed of thirteen essential elements, it follows that its daily food must contain more or less of these elements, if the body is to function properly, and be kept in health and strength. This is true of all animal and plant bodies; hence, the care the farmer takes to provide the right food for his stock, just the right fertilizers for his crops. It is most interesting that human food—both animal and plant—is made up of the thirteen elements which constitute the human body, but chemically combined with each other. Moreover, in general, these elements are combined into the same classes of compounds as those which constitute the human body: **water, carbohydrates, fats, proteins,** and **mineral matter.** Let us, now, consider each of these classes of foods in a little detail.

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52 Jordan, Principles of Human Nutrition.
53 Sherman, Food and Nutrition; Jordan, Principles of Human Nutrition.

Water.—Next to the dire necessity of air to the human body we all recognize the extreme necessity of water. Normally the human body is about two-thirds water;[54] its blood is about 79 percent water, its muscles 75 percent, its bones 22 percent. Every twenty-four hours the body of average weight (154 pounds) loses, through the urine, the perspiration and the lungs, about six pints of water. These daily losses must be made good. This we do in the water and beverages which we drink, and in the water which we unconsciously take otherwise in our food; for example, bread is from 30 to 35 percent water, potatoes about 75 percent, fresh garden vegetables 75 to 95 percent.

Carbohydrates.—That name sounds rather formidable, but when you learn that sugar and starch are very important carbohydrates, you will feel better acquainted with the word. Long ago it was thought that carbohydrates were compounded of just carbon and water, and so they got their name which means "hydrated carbon." Chemists have discovered long since that they are not hydrated or watered carbon, but the name, carbohydrate, yet clings. Our carbohydrate foods are plant products and are composed of carbon, hydrogen and oxygen, chemically combined. Because of certain differences which exist among them, carbohydrates are sub-divided into three main groups: **sugars, starches, and cellulose.** Let us consider each of these groups in turn.

a. Sugars.—Ordinary, pure white sugar is 100 percent carbohydrate. Milk contains another sugar—**lactose**, or sugar of milk, as it is often called. Corn syrup contains a yet different sugar—**glucose**, not so sweet to the taste as granulated sugar, but a very good food, nevertheless.

b. Starches.—Of course we are all very familiar with cornstarch—the starch obtained from Indian corn. One of the principal food ingredients of each of our cereal grains is some form of starch, each form being characteristic of the particular grain in question: As, wheat-starch from wheat; rye-starch from rye; oat-starch from oats. In fact, all of our edible seeds, as beans and peas, are particularly rich in starch, stored in each by nature for the use of the future plant. Among vegetables, potatoes are especially rich in starch, and hence, are one of our very important starchy foods. It is very interesting to wash the starch out of a potato (see p. 9) just to discover how much can be obtained, and what a beautiful, white product it is. By a similar process, starch is also readily washed out of flour, or corn-meal, or any other ground cereal grain. Try it.

Dry starch is readily dextrinized at oven temperature. For example, this occurs somewhat in the crust of bread, and in the cortex of baked potatoes. Dextrin is sweeter than ordinary starch. Hence, the sweetish taste of bread crust and of baked potato cortex.

Sugars and starches are exceedingly important "energy" foods. By an energy food is meant any substance which the body uses up

54 Huxley, Lessons in Elementary Physiology.

(burns) when it does work—somewhat as your automobile engine uses up (burns) gasoline when in use. Whenever the body works, it actually does burn up its food, or itself; and the harder the body works, the more food, or the more of itself it burns up in a given length of time.

c. Cellulose.—To the third group of carbohydrates belong the wood of trees, the stems and frame-work of plants, the bran coverings of seeds—all of which consist mainly of cellulose. Pure white cotton and linen are nearly pure cellulose. As most of us know, the human body does not digest cellulose; and yet the softer forms, which occur in cooked or raw vegetables, in whole-wheat products or in other whole-grain products are valuable aids in avoiding or in overcoming constipation; consequently these softer forms of cellulose are wisely included in our foods.

Fats.—Nature forms fats out of the same elements that she uses in making carbohydrates (oxygen, hydrogen, and carbon), but she puts these elements together very differently in the two classes of compounds. Animal fats and vegetable fats are substantially the same chemically, and both forms are valuable foods. Nuts and seeds are especially rich in fats, but fruits and garden vegetables are poor in them.

Fats, like sugars and starches, are very important "energy" foods, although the body does not appear to burn them as readily as it burns the sugars and starches. When we eat more sugars or starches (or proteins, see next paragraph) than the body needs immediately, the body proceeds at once to transform the surplus into fat and store it as such for future use. Sometimes, the body never gets a chance to burn up this surplus!—and so that body continues to grow fat. Only more work or eating less will rid the body of the superfluous fat so acquired.

Proteins.—When Nature forms proteins she uses not only the elements oxygen, hydrogen and carbon, but also nitrogen and sulphur; and sometimes she adds phosphorus, too. The white of egg is very pure protein—mostly albumin. The curd of milk (casein) is another very pure protein. Lean meats are rich in proteins. The unusual dough-making property of wheat flour is due to gluten—a mixture of proteins. All cereal grains, indeed, carry a high percentage of proteins, but in each grain the proteins present are characteristic of that particular grain. Dried beans and peas are rich in proteins, but the fresh garden vegetables are not.

Proteins are of supreme importance to the human body. This is because the body, whether feasting or fasting, is constantly discarding, through the urine, protein waste products. These never-ending protein waste products show that under all conditions of life, the body is always using up its proteins. This daily loss of protein must be made good, else the body slowly starves; the "law of minimum" insists on a daily replenishment of the nitrogen and sulphur losses. And the only way this can be done is by protein foods. The term **protein** is derived from the Greek word *proteios* meaning pre-eminence, of first importance.

Mineral Matter.—Of no less importance to the body than the proteins is mineral matter. Just as the body is constantly discarding protein waste products through the urine, so it is constantly discarding mineral waste products through the same channel. To replenish these losses mineral matter must be supplied in the food. The best sources of food mineral matter are fruits and garden vegetables, including potatoes. On no account should these be omitted from the diet. Milk, eggs, meat and whole-wheat products are also excellent sources of food mineral matter.

As we have already learned, the body normally keeps most of its fluids basic. To do this, it relies upon the basic elements in its food mineral matter to neutralize the acidic elements in its necessary protein foods. Hence, the emphatic need of fruits and vegetables in the diet.

VITAMINES[55]

Even this very short discussion of foods would be incomplete without a word about vitamines. Though we do not yet know much about what vitamines are, nor what they are composed of, yet we do know how necessary they are to keep the human body in good running order. We know something about what foods they are found in, and we know, too, that there are at least three types of them: Fat-Soluble A, Water-Soluble B, and Water-Soluble C. Present researches seem to show that there are others also.

Fat-Soluble A.—This is found especially in milk, cream and butter; in egg yolks; in tomatoes, sweet potatoes and carrots; in green vegetables—especially spinach, green cabbage, chard, dandelion greens, lettuce, string beans and green peas. It is also known as the **anti-xerothalmic** vitamine, which means that it is an enemy to the serious eye diseases that often attack poorly nourished children. One fat-soluble form is very plentiful in cod-liver oil which explains partly why this oil is so valuable in rickets. This form is known as the **anti-rachitic** vitamine, which means, of course, that it is an ~~energy~~ enemy to rickets.

Water-Soluble B.—This is by far the most widely distributed of these three types of vitamines. It is present in all of our whole-grain foods; but not in polished rice, nor is it very plentiful in patent wheat flour. It is present in practically all of our garden vegetables, including white potatoes, and is especially plentiful in spinach and tomatoes. It is found in several fruits, particularly lemons, oranges and grapefruit. Likewise it occurs in most nuts. The form of water-soluble B best known so far, is called the **anti-neuritic** vitamine, because it is a foe to neuritis (inflammation of a nerve).

Water-Soluble C.—This is the anti-scorbutic vitamine, that is it prevents or cures scurvy. For fully two centuries the great value of lemons, and oranges, and fresh vegetables, in curing scurvy, has been known, but it is less than twenty years since we have

55 Sherman and Smith, The Vitamines.

begun to get any definite knowledge regarding the reason why. This vitamine is found especially in lemons, oranges, tomatoes, cloud-berries, raspberries, cabbage (raw and green), raw carrots, lettuce, onions, rutabagas and white potatoes.

Need of Vegetables and Fruits in the Diet.—The foregoing facts concerning the vitamines and their sources, serve well to re-emphasize what has been said about the need of fresh vegetables and fresh fruits in the diet. The further need of these foods, as sources of food mineral matter, has already been pointed out. Doubtless many of our "deficiency" diseases are due to a lack of vitamines and mineral matter in the diet.

THE AIR

Attention has already been drawn to the fact that the air we breathe is a mixture of gases—mainly nitrogen and oxygen. The absolute necessity of air to the life of the human body is due to the dire need of the body for "free" or uncombined oxygen. Without free oxygen the body "fires" will not burn. Life ceases. The body is a sort of internal combustion engine, whose fuel is its food; or, lacking that, the body itself. This fuel is constantly being burned (oxidized) to a variety of compounds, most of which, except carbon dioxide, are washed out of the body by the urine.

Carbon Dioxide.—Carbon dioxide is a colorless, odorless, invisible gas, produced by the burning (oxidation) of the carbon taken into the body in our foods—you remember that carbohydrates, fats, and proteins all contain carbon. The body gets rid of this carbon dioxide gas by breathing it out, mostly through the lungs. Some moisture (water) is breathed out with the carbon dioxide. You know how on a cold winter morning you can "see" your breath. That is the moisture you are breathing out from your lungs. Just as soon as this moisture reaches the frosty air it condenses to tiny drops and so forms a little cloud. You can't "see" the carbon dioxide gas that your lungs throw off, but if you wish, you can easily prove that you do breathe it out: Into a glass pour a little clear lime-water, and breathe hard and long into it through a clean straw thrust below its surface. Try to expel all the air in your lungs through the lime-water. As you do so, you will see forming in the lime-water a heavy white cloud. That cloud (calcium carbonate) proves that you are constantly breathing carbon dioxide out of your lungs. Later, the green leaves of plants, under the influence of the sunshine, will use that carbon dioxide gas and some water to build up more starches and sugars. Similarly has every excretion from the body been used, and will be used, over and over again. So has the wondrous cycle repeated itself, and will repeat itself, times without number.

Oh, this earth of ours is a marvelous place, and these human bodies of ours are marvelous mechanisms! May the very little bit of information given in this appendix but whet our interest to know more of the fascinating story!

PART IV. GLOSSARY

GLOSSARY

Many women like to know the derivation of scientific terms, since such knowledge often helps to fix them in mind. Some words not explained in the text may be found here.

Acid.—Derived from the Latin word *acer* meaning sharp.

Alkali.—Derived from the Arabic word *al* meaning the, and *qaliy* (kali) meaning ashes of saltwort (a sea plant). These ashes are rich in soda, and their solution is alkaline (the opposite of acidic).

Aluminum or Aluminium.—Derived from the Latin word *alumen* meaning alum. Aluminum is a constituent of alum.

Anti-rachitic.—Derived from the Greek word *rachis* meaning spine. The prefix *anti* is a Greek (and Latin) word meaning against or opposed to.

Anti-scorbutic.—Derived from the middle Latin word *scorbutus* meaning scurvy. The prefix *anti* is a Greek (and Latin) word meaning against or opposed to.

Anti-xerothalmic.—Derived from the Greek words *xeros* meaning dry, and *ophthalmos* meaning eye. The prefix *anti* is a Greek (and Latin) word and means against or opposed to.

Astronomy.—Derived from the Greek word *astron* meaning star, and the Greek word *nemo* meaning I arrange.

Bromine.—Derived from the Greek word *bromos* meaning a stench. Bromine is a heavy reddish-brown liquid which gives off a vile-smelling heavy vapor of the same color.

Calcium.—Derived from the Latin word *calx* meaning lime. Calcium is one of the constituents of limestone.

Carbon.—Derived from the Latin word *carbo* meaning a coal (either glowing or dead).

Casein.—Derived from the Latin word *caseus* meaning cheese. Casein is the chief nitrogenous constituent of milk and of cheese. It is the substance that coagulates when milk sours.

Cellulose.—Derived from the Latin word *cellula* meaning a cell.

Chemistry.—Derived from the Greek word *Chemia* meaning Egypt (black earth); or possibly from the Greek word *chymeia* meaning a mingling, an infusion (of juice of plants.)

Chlorine.—Derived from the Greek word *chloros* meaning greenish-yellow. Chlorine is a greenish-yellow gas.

Biology.—Derived from the Greek word *bios* meaning life, and the Greek word *lego* meaning I speak.

Helium.—Derived from the Greek word *helios* meaning the sun. Helium was first discovered in the sun's corona.

Hydrogen.—Derived from the Greek word *hydor* meaning water, and the Greek root *gen* meaning produce (*gennao* = I produce).

Iodine.—Derived from the Greek word *iodes* meaning like a violet; this refers to the beautiful color of iodine vapor.

Lactose.—Derived from the Latin word *lac* meaning milk.

Magnesium.—Derived from *Magnesia*, a district in Thessaly.

Neuritis.—Derived from the Greek word *neuron* meaning a nerve; the termination *itis* signifes inflammation.

Nitrogen.—*Nitro* signifies that the element nitrogen is an essential constituent of niter (Latin, *nitrum*) or saltpeter; *gen* is the Greek root meaning produce (*gennao* = I produce).

Oxygen.—Derived from the Greek word *oxys* meaning acid, and the Greek root *gen* meaning produce (*gennao* = I produce).

Phosphorus.—Derived from the Greek word *phos* meaning light, and the Greek word *phero* meaning I carry.

Physics.—Derived from the Greek word *physis* meaning nature.

Potassium.—Derived from the new Latin word *potassa* meaning potash.

Psychology.—Derived from the Greek word *psyche* meaning soul, and the Greek word *lego* meaning I speak.

Science.—Derived from the Latin word *scire* meaning to know.

Sodium.—Derived from the new Latin word *soda* meaning soda.

Vitamine.—Derived from the Latin word *vita* meaning life, and amine, a chemical term meaning an ammonia derivative. Vitamine is one of the very few scientific terms concerning which there is a doubt regarding its applicability. Other terms such as *accessory food factors* and *dietary essentials* are often used. This word is spelled either with, or without, the final "e"—vitamine or vitamin.