The therapeutic value of phosphorus in this case is unquestioned. While it has not removed the underlying cause, osteogenesis has been markedly stimulated, both in the fibrous and enchondral processes of bone formation. This has led to transverse growth of the shafts, which process is chiefly affected in the disorder, as well as to longitudinal growth and growth of the epiphyses.

These findings show that phosphorus affects the normal bones of children in much the same way as described by Wegner for experimental animals. The effects on enchondral bone growth is especially well marked. No definite increased transverse growth could be made out, but if slight it would easily escape detection by means of the roentgen ray, especially as the technic varied with each set of plates. Also for some time after the phosphorus is stopped there is a continued but less marked overproduction of bone in the juxta-epiphyseal region of the shaft which is probably due either to the cumulative effect of phosphorus or to the stimulating influence of the excessive stores of calcium salts in the neighboring bone.

Fig. 19 (Case 3).—Effects in the pelvis and thighs.

COMMENT

The diseased bones showed certain variations. In osteogenesis imperfecta, the transverse growth was as strikingly affected as the longitudinal. All fractures occurring during the period of observation healed except one at the middle of the left humerus, which occurred during the period of interruption of the phosphorus, an inactive stage of nonunion being established before renewal of the drug. Judging from the general effect it produces, phosphorus if given early in fractures during the active period of repair should stimulate callus formation and ossification. In nonunion, however, when the natural reparative impulses have been exhausted, little should be expected from its use.

Roentgen-ray studies of the bones during the administration of phosphorus alone and with other substances in rickets should be of interest. These obser-

vations show clearly that phosphorus when given alone has a marked stimulating effect on bone production and consequently of calcium accumulation in the normal zones of growth, and speak against the assertions of Schabad relative to calcium metabolism in healthy children.

During the florid stage of rickets, the bony tissues have lost the power of depositing lime salts; and as phosphorus is presumably unable to restore this power, no appreciable effect from its administration would be detectable by means of the roentgen ray, although it may increase the amount of osteoid tissue formed. During the healing stage, when the power of laying down lime salts begins to return, the phosphorus would stimulate the formation of osteoid tissue and consequently increase the amount of bony tissue formed. It must be remembered that during the healing stage of rickets, from the rapid ossification of osteoid tissue piled up in the metaphysis during the florid stage, a condition forms which roentgenologically resembles very much the phosphorus changes in normal bones.⁷ Phosphorus administration would intensify this condition.

122 South Michigan Avenue.

A CONSIDERATION OF SOME DRIED VEGETABLES

WITH SPECIAL REFERENCE TO THEIR NITROGEN AND CALCIUM CONTENT *

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From an economic standpoint it is highly desirable, particularly at this time when the transportation of foods occasions unusual difficulties, to eliminate as much water as possible from them and thus reduce their weight and bulk. This furnishes the justification for the attempt to use desiccated foods. Any propaganda for the widespread use of foods prepared in novel ways ought to be supported by scientific evidence of its importance from a physiologic standpoint.

For arctic explorations a supply of vegetables is considered desirable. In some expeditions this has been obtained by the use of desiccated green foods. During the Civil War such dried vegetables as were available were used. At present the various governments are using desiccated foods. The United States Food Administration has directed much effort during the past year in impressing on the minds of the people the value of drying foods. Farmers in this country years ago started drying such products as string beans. A successful community drying plant is no longer an experiment but an institution.¹ The drying of fruit likewise received attention from the Department of Agriculture years ago.² The possibilities of conservation by desiccation are obvious.

In considering the value of a food today, its inorganic constituents should receive attention as well as its protein, fat, carbohydrate and vitamin content. Years ago, Bunge³ and other physiologists emphasized

7. Lovett, R. W.: The Roentgenographic Appearances in Rickets, *THE JOURNAL A. M. A.*, Dec. 11, 1915, p. 2062.

* From the Sheffield Laboratory of Physiological Chemistry, Yale University.

1. Farmer's Bulletin 916, U. S. Dept. Agr., 1917.

2. Yearbook U. S. Dept. Agr., 1912, p. 505.

3. Bunge, G.: *Lehrbuch der physiologischen Chemie*, Leipzig, 1897.

especially the physiologic importance of the mineral content of foods. The significant rôle which the inorganic constituents of foods may play has of late been demonstrated experimentally in more than one way, notably through the study of synthetic dietaries in which one or more inorganic elements were lacking or present in unsuitable proportions.*

Sherman's⁵ determinations of the inorganic constituents of a great many foods and also his compilations of recorded analyses are of unusual value to all students of nutrition. He in particular and later Blatherwick⁶ have called attention to the significance of the acid and base forming constituents of foods. Forbes⁷ has analyzed the ash of a great many foods, but most of his data relate to animal feeds.

Recently Courtney, Fales and Bartlett⁸ reported statistics of the inorganic constituents of a number of vegetables subjected to definite conditions of cooking. These authors were particularly interested in determining to what extent cooking by different methods removed the available inorganic components of the foods, bearing in mind the use of green vegetables for their iron and calcium content in infant nutrition.

The student of dietetics recognizes that were it not for the use of milk, eggs and a few green vegetables, our food intake would ordinarily be very deficient in available lime. The present study was planned to supplement our somewhat meager knowledge regarding the composition of desiccated vegetables.

METHODS OF DRYING

Carrots and potatoes were peeled, care being taken not to contaminate the freshly cut surfaces with dirt; they were then weighed, sliced thin, and dried. All other vegetables were handled in an edible form; that is, inedible portions were removed, and the remainder washed thoroughly in cold running water to remove all traces of adherent soil. All vegetables were either dried on a piece of cheesecloth or in a small sieve on an ordinary steam-heated radiator at from 65 to 70 C. (149 to 158 F.).

At the temperature here used in drying, it is wise not to keep those vegetables containing much starch and sugar on the radiators longer than from two to three days, because they then begin to darken. The loss of water in producing these air-dried products was estimated as given in the table.

ANALYTIC PROCEDURES

The moisture still remaining in the air-dried products was determined by drying for from four to five hours in an oven at from 96 to 97 C. (204.8 to 206.6 F.). This temperature in some instances caused a slight darkening; but after many trials at different temperatures, it seemed the best to adopt as a working basis for this analytic procedure.

Ash was determined in the ordinary way on the air-dried material; nitrogen by Kjeldahl's method likewise, and calcium by McCrudden's⁹ method. Before the calcium was determined, the ash was always taken down to dryness on the water bath from three to five

times with hydrochloric acid to cause the traces of silica to flock out for removal.

THE LOSS OF WATER IN DRYING

The water content of vegetables is so variable that we only report figures on the basis of the solids found after drying as described. Values for raw edible portions mean nothing when the possibilities for a plant to lose water are so many. For example, variations in water content of a green vegetable may be due to the soil, weather at the time of harvesting, manner of shipment, manner of "handling" by the various dealers, period of time from harvest to consumption, and many other conditions.

NITROGEN

The nitrogen content of the dried vegetables is at best only a rough index of their content of protein. The increase in the concentration of protein as the result of drying is most striking; for example, the nitrogen content estimated on the basis of raw sweet potato is 0.3 per cent.; on the dried product it is 1.06 per cent.; in raw spinach it is 0.45 per cent.; in the dried, 4.58 per cent.

PERCENTAGE COMPOSITION OF VEGETABLES, ARRANGED ACCORDING TO DECREASING NITROGEN CONTENT

Name	Materials as Purchased		Air-Dried Material				
	Water	Solids	Moisture	Ash	N	Ca	Ca in % of Ash
Swiss chard*.....			4.8	15.2	5.42	1.26	8.3
Beans of String							
Beans III.....	80.0	20.0	1.14	5.37	4.98	0.30	5.6
Spinach II.....	90.2	9.8	3.7	15.9	4.58	0.56	3.5
Beet tops.....	94.2	5.8	2.3	18.1	4.35	1.66	9.2
Lettuce.....	96.4	3.6	4.22	10.5	4.01	0.77	7.3
String Beans II.....	92.8	7.2	6.3	6.8	3.90	0.60	8.8
Spinach I.....	82.0	18.0	4.7	10.1	3.53	0.60	6.0
String Beans I.....	90.4	9.6	5.8	6.9	3.47	0.53	7.7
Pods of String							
Beans III.....	93.0	7.0	3.56	5.8	3.09	0.87	15.0
Cabbage II.....	85.0	15.0	6.2	6.0	3.01	0.38	6.3
Celery.....	97.3	2.1	2.27	16.5	2.99	1.13	6.8
Cabbage I.....	89.4	10.6	4.5	4.75	2.86	0.55	11.6
Cabbage III.....	87.3	12.7	6.3	5.5	2.85	0.36	6.6
Potato.....	79.4	20.6	1.89	3.7	2.13	0.03	0.8
Carrot tops.....	74.9	25.1	4.1	10.3	1.95	2.14	20.8
"Riced" potato**			6.43	2.7	1.58	0.01	0.4
Carrots II.....	82.2	17.8	7.6	4.2	1.39	0.22	5.2
Carrots I.....	83.5	16.5	5.3	3.7	1.19	0.19	5.2
Carrots III.....	84.2	15.8	5.9	3.95	1.16	0.20	5.1
Sweet potato.....	71.7	28.3	0.9	3.1	1.06	0.12	3.9

* Product of the Mrs. O. H. Harriman Laboratory, New York.

** Prepared by Dr. H. C. Gore, Bureau of Chemistry, U. S. Department of Agriculture.

The variation in nitrogen according to the plant or parts of the plant is striking. The starch plants, as potatoes and carrots, notwithstanding a high solid content on drying, have a low protein content. Spinach, Swiss chard, lettuce, celery and cabbage serving as vehicles of roughage and flavor, with a high water content, contain a relatively high percentage of nitrogen in the dried material. Intermediate between these two groups stands the string bean, in which the protein is concentrated ten times or more by drying.

In addition to the variation in nitrogen content according to the plant, there is a noticeable difference in the amount of nitrogen in the different parts of the same plant. Dried Carrots I had a nitrogen content of 1.19 per cent., while the tops from these carrots contained 1.95 per cent. According to a calculation from the tables of Atwater and Bryant,¹⁰ the solids of

10. Atwater, W. O., and Bryant, A. P.: Bull. 28, O. E. S., U. S. Dept. Agr., 1906.

4. Osborne, T. B., and Mendel, L. B.: Publication 156, Carnegie Institution of Washington, 1911; Jour. Biol. Chem., 1918, **34**, 131.

5. Sherman, H. C.: Chemistry of Food and Nutrition, Ed. 2, New York, the Macmillan Company, 1918.

6. Blatherwick, N. R.: The Specific Rôle of Foods in Relation to the Composition of the Urine, Arch. Int. Med., September, 1914, p. 409.

7. Forbes, E. B.; Beegle, F. M., and Mensching, J. E.: Bull. 255, Ohio Agr. Exper. Station, 1913.

8. Courtney, Angella M.; Fales, Helen L., and Bartlett, Frederic H.: Some Analyses of Vegetables Showing the Effect of the Method of Cooking, Am. Jour. Dis. Child., July, 1917, p. 34.

9. McCrudden, F. H.: Jour. Biol. Chem., 1911-1912, **10**, 187.

beets contain 2.04 per cent. of nitrogen, whereas the sample of dried beet tops here analyzed contained 4.35 per cent. In the case of String Beans III, the nitrogen value of the beans was 4.98 per cent., while of the pods it was 3.09 per cent. In other words, the dietetically unimportant or waste parts of some vegetables contain almost as much nitrogen as, and in some cases more than, the important part of the vegetable, that is, for human consumption.

Notwithstanding these apparently high nitrogen values of some dried foods, it is doubtful whether they are significant from the standpoint of protein intake. Unless we alter our mode of cooking or resort to the use of dried material, it is hardly probable that an individual on his ordinary mixed diet would consume at one meal, in addition to other food, more than from 100 to 200 gm. of the cooked edible portion of any of the vegetables. However, it is not beyond the realm of possibility to dry and comminute the vegetable so finely that one could easily cook the dried material in half of its original water content. In fact, we have cooked our dried carrots in an amount of water equivalent to that driven off from them during the drying process, and have subsequently concentrated the mixture to a palatable consistency. This would have been impossible if the same vegetables had been cooked in their original form.

INORGANIC CONSTITUENTS

A glance at the table shows that a high percentage of inorganic constituents is characteristic of the green vegetables. This statement applies likewise to the calcium content. This alone, if there were no other reasons, would warrant a consideration of these materials as adjuvants to the dietary of the growing individual. We noted by comparative qualitative tests that the green foods had a preponderance of iron over the other vegetables. Their value as a source of iron cannot be overlooked when it is remembered that a quart of milk, one of the most valuable foods, contains only 1 or 2 mg. of this element. The last column of the table shows the calcium in percentage of the total inorganic content of the vegetables.

LOSSES BY COOKING AND DRYING

Attention is called to the possible loss of inorganic elements in the method of cooking vegetables. Snyder¹¹ studied the loss in cooking potatoes, carrots and cabbage under various conditions. Using ordinary methods of cooking, he showed that there was a decided loss in the inorganic constituents, as well as other components, in some instances as much as 50 per cent. Wardall¹² has estimated the loss in carbohydrates in preparing "thrice washed" vegetables for diabetics. Most recently Courtney, Fales and Bartlett called attention to the loss in minerals, by boiling, in preparing vegetables for children. They recommend the steaming of foods.

As is shown in the table, the "riced" potato contained a smaller amount of inorganic components, particularly calcium, than the other potato. This may be due either to the soil in which they were grown or to

the method of preparation for drying. These "riced" tubers were steamed before drying to destroy the enzymes which cause the raw potato to darken when exposed to the air. The calcium content of the potato is very low, and to remove any of it in the preparation for drying is a serious objection. This fact must be borne in mind if potatoes are to be dried extensively in this country. With our material there was only a slight darkening when the time between slicing and exposure to radiator heat was reduced to a minimum. In fact, the darkening was so slight that it could not be detected after the dried product was ground.

The physiologic importance of calcium in the feeding of growing organisms is now universally recognized. No other food supplies as much lime as milk. Some of the vegetables here analyzed, if fed in conjunction with milk or other foods, as the cereals, which are decidedly lacking in lime, will increase the available lime in the diet. There is a paucity of studies on the physiologic value of calcium in vegetables. From investigations conducted in this laboratory during the

Calcium and nitrogen content of fresh and of dried vegetables: heavy lines, percentage content of calcium or nitrogen in the fresh vegetable; light lines, concentration of these elements in the same products dried.

past year, the indications are that for at least two vegetables, spinach and carrots, the available lime is not as well utilized as that from milk or lime salts. Courtney, Fales and Bartlett indicate that in their experience one child, somewhat rachitic, showed an improved mineral balance on the addition of spinach to its dietary. The analyses here reported indicate the amount of lime present in some vegetables, which might become desirable as supplementary sources of calcium.

SUMMARY

The quantity of water lost by the foods dried in this series is in accord with the values reported in Atwater and Bryant's analyses. The vegetables here studied contained from 71 to 97 per cent. of water.

In the case of some of the vegetables, the nitrogen content in terms of the dried product is in striking contrast with that of the original material, owing to the large losses of water.

Some of the materials are possible, valuable and hitherto unappreciated sources of lime. The calcium

11. Snyder, H.: Bull. 43, O. E. S., U. S. Dept. Agr., 1897.

12. Wardall, Ruth A.: Vegetable Foods for the Diabetic, THE JOURNAL A. M. A., Dec. 1, 1917, p. 1859.

statistics here reported are in accord with the comparable figures for such of these materials as Sherman and Forbes have analyzed.

The high calcium content of the green vegetables in contrast with that of the tubers and roots is very striking.

There may be a loss of inorganic constituents, particularly calcium, in the cooking of foods and in the preparation of some of them for drying.

INTRATRACHEAL ANESTHETIC MACHINE *

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In neurologic surgery it frequently becomes necessary to employ an intratracheal anesthetic, particularly in work on the cerebellum and the brain stem, when a patient may have respiratory difficulty that may be relieved by the administration of plenty of pure air under slight pressure. There are many intratracheal anesthetic machines in use, some of which are used very successfully, but the general tendency has been to make them too complicated. In view of this fact, it seemed permissible to construct a machine that would be efficient yet simple and easy to manipulate.

Fig. 1.—Intratracheal anesthetizing machine.

The one herein described has been constructed to conform to three principles, as follows:

1. *Constant Flow of Air.*—A constant flow of air maintained and controlled so that pure air alone, or any degree of ether saturation, may be given (Fig. 2). This is accom-

plished by diverting the air current through valve *C* from *E* to *F*. If pure air is desired, the valve is thrown open to send the air direct from *E* to *F* without entering the ether chamber. If ether is desired, part of the air current is forced through tube *N* on the ether surface, where it becomes saturated with ether and escapes through tube *B* to tubes *C* and *F*.

2. *Ether Tension.*—Ether tension is kept constant by the lowering or raising of tubes *B* and *N*.

3. *Constant Air Pressure.*—A safety valve prevents too great pressure within the lungs. This is accomplished by connecting the air current with a mercury manometer, *L*, *G* and *H*.

THE APPARATUS

The apparatus consists of a motor directly connected to a small rotary blower mounted on a suitable base; a coil of flexible metal tubing to convey the air to the controlling valve, and a three-point foot piece with a column supporting a base plate, to which is secured a 24 ounce glass bottle by means of a yoke-clamp gripping the two side rods that are threaded into the base plate and secured at the top by the hand bar (Fig. 1). In Figure 2 the upper end of the etherizing stand is shown enlarged, and the working parts are numbered as follows:

The 24 ounce bottle, *A*, is supplied with a metal cap cemented to its top and having two openings. The opening in front has a knurled screw collar, *K*, designed to clamp and hold tube *B* at any desired vertical position. The other opening has a knurled screw stopper which shows above *K* and to the right of *B*, and which is used for filling the bottle with ether.

The lower end of the tube *B* may be seen just below the neck of the bottle, and the upper end supports valve *C* and the mercury column *H*. The valve is controlled by the knurled knob *C*, to which the indicator point is secured, while dial *D* is fastened to the valve body, and has a point at the left marked "All Air," a point at the top marked "Half A and E" (half air and half ether), and a point at the right marked "All Ether." Tube *E* at the left of the valve conducts the air into the valve, where it is directed downward into the bottle or straight out through the tube *F* at the right of the valve. Tube *G* is a glass extension of the metal tube, *L*, and directs the flow of air against the pressure of the mercury, *H*, which is in a glass retainer held in a metal protecting case. The intratracheal pressure is increased as the column of mercury is raised about the glass tube, *G*.

A flat metal arm extends out to the right from the top of tube *B*, and supports a rod to which is secured a pinion having a knurled knob, *J*. The pinion engages a toothed rack, secured to the upper and lower sleeves around the rod, the sleeves being part of the protecting case of the mercury column. At *I* a millimeter scale is seen and reads, beginning at the bottom, 0, 5, 11, 15, and 20 mm. A small quantity of cotton is packed loosely around tube *G* at the top of the glass retainer to prevent the

Fig. 2.—Upper end of etherizing stand.

* From the Mayo Clinic.