

contractile pull of the mylohyoid upon the mandible. A large tongue will, on the other hand, the more deeply bulge into and fill the oral floor-space, partly overcoming the resistance of the mylohyoid sheet and causing its pull upon the mandible to be more downward and less inward. In regard to the inward traction the following observation may be significant.

During the routine examination of many thousands of occluded plaster casts, I observed that in a proportion of those in which the occlusion of molars might be reckoned as good mesio-distally the occlusion bucco-lingually would have been better or more normal if the mandibular molars were moved buccally or wider apart—that is to say, the mandibular arch was a little too narrow at the first molars for the normal occlusion of these teeth with their maxillary opponents. This in itself suggests the possibility that in some cases the *lower jaw leads the way* in the contraction of both arches.

In conclusion, it is urged that what I have called (in short phrase) “perverted activity of the tongue” is harmfully frequent among children, and is incited chiefly in the oral manipulation of foods a *preponderant* amount of which is of a sweet, soft, or glutinous nature; and also less frequently by the crippling or (from whatever reason) insufficient use of the cheek teeth.

At the same time it is possible to go to the other extreme by encouraging young children to masticate well an unduly large proportion of tough food, so that the anterior teeth are to an undue extent called upon to relieve the overworked cheek teeth in the extra labour of fine reduction; the forward-thrusting and holding action of the tongue is thus brought into too frequent use, and the mandible is subjected to an upward and backward traction. In several reported cases (including children of dentists) where the precepts of vigorous mastication were faithfully and conscientiously put into practice, the deciduous arches were seen to be broad and fine, and the teeth individually were in every way satisfactory; nevertheless, the puzzling excessive overlap was there, as well as some degree of post-normal occlusion.

That the forward thrust of the tongue during its perverted activity must, in some cases, induce protrusion of the *upper* teeth is so evident a proposition that I omitted any explicit statement on the point, and detailed discussion is here barred out from want of space. But what I regard as remarkable and important in my discovery (about five years ago) of the tongue's abnormal activity, is its unsuspected yet inevitable reaction on the mandible. The tongue exerts a *centrifugal pressure on the maxilla* anteriorly, and the main resistance and reaction to the tongue's thrust takes effect as a *centripetal traction on the mandible*, the one being in effect the reciprocal of the other.

The great majority of superior protrusion cases are associated with inferior retrusion, as stated by Mr. Norman G. Bennett when reporting (March, 1912) to the British Society for the Study of Orthodontics, for the Committee on Orthodontic Classification. The degree of superior protrusion actually produced during functional activity must depend upon the greater or less amount of counteracting restraint and inward pressure from the upper lip, which effective centripetal pressure varies, I think, not so much or so entirely with the length, thickness, or “poise” of the lip as with the “temperamental” and muscular *motility* in the particular individual. This line of investigation may seem too obscure to bring out anything helpful, but in point of fact striking differences in the functional labial movements of different individuals are made evident merely by visual observation. More important, however, and more directly bearing upon my present thesis concerning the identification of primary causes and the actions they evoke, is the marked influence of *reflex* movement and pressure, here just touched upon as follows:—

#### *Gustatory Reflexes.*

Among the oral *reflexes* incited by sweetened food and sweet substances, as well as substances with an acid or a “sharp” taste, there are certain labial and buccal muscular actions which very probably play a part in the contraction of the upper arch. Discussion of this would be quite relevant, but must be deferred.

I propose in a future communication to show that perverted activity of the tongue may also bear a causal relationship to two other deformities of the jaw—namely, (1) inferior protrusion or “underhung” bite; and (2) open bite.

## I.—THE ANTISCORBUTIC AND GROWTH-PROMOTING VALUE OF CANNED VEGETABLES.

BY MABEL E. D. CAMPBELL AND HARRIETTE CHICK.

(From the Lister Institute, Department of Experimental Pathology.)

THE experimental work described below was undertaken in August, 1918, at the request of the Controller of Horticulture, Food Production Department, and Miss Campbell, of that department, was detailed to work upon this problem at the Lister Institute. It forms one of a series of researches on experimental scurvy carried out at this Institute. The aim was to ascertain what changes take place in the nutritive value of vegetables during the process of canning, with special reference to vitamin-content.

It was to be presumed, from the information already available as to the destructive effect of heat upon the antiscorbutic factor in cabbage leaves (Delf, 1918), that canned vegetables would suffer considerable deterioration in antiscorbutic value owing to the high temperature to which they are exposed in the process of preparation. The present work was directed to obtaining an accurate estimate of what that loss might be. Cabbage and green (runner) bean pods were selected as suitable vegetables for the experiment. Cabbage was chosen because many data as to its antiscorbutic value, both in the raw and cooked condition, were already available from the researches of Dr. Marion Delf (1918) at the Lister Institute; green runner beans because they are a good example of a vegetable frequently chosen by the public for preservation by canning.

The experiments consisted essentially in estimating and comparing the minimal amounts of these vegetables—(a) when raw, and (b) after canning—which must be added daily to a basal scurvy-producing diet in order to protect young guinea-pigs from scurvy over a period of three months. These results are set out in the accompanying table, in which data obtained with other foodstuffs are included for purposes of comparison.

#### *Method of Experiment.*

The method of experiment was the same as that adopted generally in the series of researches on experimental scurvy published from this Institute.<sup>8-10</sup> It is based on that employed by Holst and Fröhlich,<sup>1,2</sup> who chose the guinea-pig as experimental animal and grain of various kinds with water as the basal “scurvy diet.” On such a diet young guinea-pigs are found to sicken and die of scurvy in from three to four weeks with great loss of weight.

In a study of the antiscorbutic value of foodstuffs the aim is to devise a diet which shall afford abundance of all necessary factors except the antiscorbutic factor. This basal diet must contain suitable proportions of (a) carbohydrate and (b) fat, the right kind and amount of (c) mineral salts and (d) protein, and in addition an adequate quantity of the two so-called growth accessory factors described by McCollum and his co-workers as (e) “fat-soluble” growth factor and (f) “water-soluble” or antineuritic (antiberi-beri) factor. In the diet of oats, bran and water which we have employed in many cases (a), (b), and (f) are provided in sufficient quantity and probably in the mixture of the two grains, oats and wheat (c) and (d), are also adequate for the nutrition of the guinea-pig. The diet is, however, deficient in both the antiscorbutic factor and the “fat-soluble” growth factor. It has therefore been our practice in many experiments to supply the latter by means of a daily ration (60 c.cm.) of milk heated for one hour to 120° C. to destroy its original antiscorbutic properties. This addition also affords an extra supply of protein of a highly nutritious character, and upon this “scurvy diet” the animals grow well until loss of weight sets in with the occurrence of scurvy symptoms. Death from scurvy occurs in from four to six weeks.

By addition to the basal diet of various weighed daily rations of (a) raw beans and canned beans, (b) raw cabbage and canned cabbage, the minimal amounts required to protect from scurvy were estimated. On comparison of these values the degree of destruction experienced by the antiscorbutic factor during the process of canning and storage could be approximately determined.

Weighed amounts of the vegetables (cut into small pieces) were offered to the animals daily. Usually the ration was consumed greedily, but any residue noted on the next day was weighed (after soaking in water) and the amount deducted from the original weight given. If a residue was found on several succeeding days the animal was rejected, as hand-feeding of soft vegetables is too laborious and inaccurate a procedure. While animals were developing scurvy, hand-feeding of milk with a glass syringe was frequently resorted to in order to maintain an average consumption of 60 c.cm. daily.

namely, 2-3 months. All canned samples were drained and turned out into a dish immediately on opening the can. The residue not used for the day's ration was kept in cold store. It was rarely used later than two days after opening. *Cabbage*—(1) *Antiscorbutic value*.—In this case the experiments were arranged to test the canned material as fresh as possible; it was never more than three weeks old, and the average age was two weeks. Previous results obtained by Dr. Marion Delf (1918) showed that 1.5 g. of raw cabbage added to a diet of oats, bran and autoclaved milk sufficed to prevent scurvy in young guinea-pigs, but that

Diet.			No. of animals.	Length of experiment.	Result as regards—		Observer.
Special ration.	Amount (grams).	Basal.			Growth.	Occurrence of Scurvy.	
Cabbage leaves—				Days.			
(1) Raw ... ..	5.0	Oats, bran, autoclaved milk.	3	90	Good.	Protection.	Delf, 1918.
	2.5		5	90	Fair.	"	"
	1.5		6	70-90	"	"	"
	0.5		4	67-90	Very little.	Scurvy, but some degree of protection.	"
(2) Cooked in steam—		Oats, bran, autoclaved milk.				Severe scurvy.	"
(a) 60 min. 90° C. ...	5.0		4	21-50	"	Protection almost complete.	"
(b) 20 min. 100° C. ...	5.0		4	90	Fair.	Protection.	"
(3) Canned—60 min. 90-100° C.	7.5		3	90-95	Very good.	Scurvy, but some degree of protection in 2 cases.	Campbell and Chick.
" "	5.0		3	33-90	Good in 2 cases.	"	"
(4) Raw ... ..	15.0	Oats, bran, water.	4	90	Very good.	Protection.	Delf, 1918.
(5) Cooked in steam—							
60 min. 100° C. ...	15.0		3	90	"	"	"
(6) Canned—60 min. 90-100° C.	15.0		3	66-93	Very poor.	"	Campbell and Chick.
" "	15.0	+ 20 c.cm. liquor from cans.	3	90	Fair.	"	"
Runner beans—							
(1) Raw ... ..	5.0	Oats, bran, autoclaved milk.	3	84-91	Good.	"	"
	2.5		3	59-64	Very little.	Scurvy.	"
	1.5		4	48-61	"	"	"
	0.5		3	28-40	"	"	"
(2) Canned—140 min. 100° C.	20.0	Oats, bran, autoclaved milk.	3	28-40	"	"	"
	10.0		1	28	None.	"	"
Carrot juice. Raw. ...	20.0		3	75-95	Fair.	Protection.	Chick and Rhodes, 1918.
Swede " " ...	2.5		4	90-100	Good.	"	Chick, Hume, Skelton and Smith, 1918, and unpublished experiments.
Lemon " " ...	1.5	"	4	90	"	"	Chick, Hume and Skelton, 1918, I., and unpublished experiments.
Fresh milk ... ..	100-150	Oats, bran, water.	2	90-113	"	"	Chick and Delf, 1919.
Germinating peas ... ..	5.0	Oats, bran, autoclaved milk.	5	87-97	"	"	
Dried cabbage* ... ..	5.0	Oats, bran, water.	6	66-134	None.	Protection in some cases.	Delf and Skelton, 1918.

\* Equivalent to 50 g. fresh cabbage.

Methods Employed in Canning.

*Cabbage*.—The methods used were those advocated by the Food Production Department in their pamphlet No. 34. Fresh green outer leaves were chosen. These were washed in cold water, blanched, and cold-dipped (i.e., exposed to boiling water containing a little sodium bicarbonate for 3 minutes, then plunged into cold water), and packed into lacquered cans. These were filled with boiling water to within ¼ inch of the top, and at once hermetically sealed by soldering the lids. Sterilisation was effected by exposure of the cans to steam at 100° C. for 1½ hours in a closed boiler. After cooling by plunging into cold water the cans were stored at laboratory temperature (60-65° F.). Experiments with control tins in which the lids were replaced by corks carrying thermometers showed that this process of canning involved the exposure of the cabbage in the cans to a temperature of 90-100° C. for 1 hour. The average proportion of cabbage to water in the cans was found to be 1.6 to 1.0 by weight and the water content of the drained cabbage as fed to the animals, 90-92 per cent., was approximately the same as that of fresh cabbage. The approximate mean age when tested was two weeks after canning. *Beans*.—Young crisp runner bean pods were selected where possible. The method in outline resembled that used with cabbage, with the difference that the blanching lasted 4 minutes, and the sterilising was done intermittently—i.e., for 1½ hours on one day and 1 hour on the succeeding day. Control experiments showed that the contents of the cans were exposed to a temperature of 100° C. for a total period of approximately 2 hours 20 minutes. The proportion of beans to water was approximately 1.7 to 1.0, and the water content of the canned samples 94-96 per cent. The time of storage at laboratory temperature before testing of the canned beans was longer than was the case with the canned cabbage,

0.5 g. daily was insufficient for that purpose. With 7.5 g. daily of canned cabbage growth was well maintained in three animals, and there were no symptoms of scurvy during life or post mortem. With a 5 g. ration daily, good health was enjoyed by two animals out of three, but in these cases distinct signs of scurvy were shown by soreness of the limbs and characteristic hæmorrhages post mortem. The third animal developed severe scurvy during life and showed the usual signs at post-mortem examination. Although these animals showed good health in two cases out of three the degree of protection from scurvy was less than that enjoyed upon a 1.5 g. ration of raw cabbage; it was, however, distinctly greater than upon a 0.5 g. ration. *The loss of antiscorbutic value during canning would, therefore, appear to be about 70 per cent.—i.e., an antiscorbutic value of 5 g. raw cabbage was reduced to that of about 1.5 g. raw cabbage.* (2) *Growth-promoting value*.—In a further set of experiments an attempt was made to trace the fate during canning of the growth-promoting "fat-soluble" accessory factor known to be present in green leaves (McCullum, Simmonds, and Pitz, 1916). The ration was much increased—viz., to 15 g. daily—and autoclaved milk, which provided the "fat soluble" growth factor in the preceding experiments, was omitted from the dietary, which consisted therefore of oats and bran alone. Delf (loc. cit.) has shown that a diet of oats and bran and 15 g. of raw cabbage is sufficient to promote good growth and provide ample protection from scurvy. This ration of fresh green leaves provides a large excess of the antiscorbutic factor, and is evidently also large enough to afford the necessary fat-soluble growth factor and to supplement any defect in the nature of the proteins in oats and bran, if such exists. After heating in steam for 1-2 hours at 100° C., Delf found the same ration, 15 g., adequate for

the purpose; the animals were maintained in good health, and in one case healthy young were born.

In the case of canned cabbage, also employing a 15 g. ration, the result was otherwise. Scurvy was certainly prevented, but the animals showed little or no growth during the three months of the experiment. In the case of one animal autoclaved milk was provided from the sixty-fourth day, and growth immediately began. This result suggests that during heating and storing in water the growth-promoting vitamine originally present in the green leaves was either (1) destroyed to a large extent, or (2) had escaped into the water in which they had been immersed (the proportion of cabbage to water by weight in the cans was approximately 3:2). A series of further experiments was made in which the water in the tins was fed to the animals, together with the canned cabbage; much better growth was obtained, a result which seems to support the second view.

In the experiments described in the preceding section with smaller rations of canned cabbage, 5 to 7.5 g., the "fat-soluble" growth-promoting factor was provided in the ration of autoclaved milk.

**Beans.—Antiscorbutic value.**—There are no quantitative data available as to the antiscorbutic value of the raw runner bean pods in comparison with other vegetables. Special experiments had therefore to be made in order to determine the minimum amount which must be fed daily to guinea-pigs on a scurvy diet in order to prevent onset of the disease. They showed that a 5 g. ration may be taken as the minimum amount giving protection from scurvy. With 2.5 g. and less all animals developed the disease, and with 5 g. and over all escaped. After canning, however, a daily ration of 20 g. was found inadequate, and severe scurvy was developed in every case. *By the process of canning, therefore, the antiscorbutic value of 20 g. raw bean pods was reduced to less than that of 5 g., and was not superior to 1.5 or 2.5 g. raw bean pods—in other words, 75 per cent. to 90 per cent. had been destroyed.*

#### Conclusion.

1. In the process of canning vegetables the greater part of the original antiscorbutic value of the raw vegetable is destroyed. In the case of runner bean pods the loss is estimated at about 90 per cent. of the original value; in the case of cabbage at about 70 per cent. of the original value. The process of canning cabbage included heating in water for about one hour at 90° to 100° C., and for beans the process was repeated on the day following.

2. This loss is primarily due to the destruction of antiscorbutic material occurring during the heating involved in the process of canning. A further loss may be expected to take place during the period of storage. The canned cabbage was examined two weeks after preparation and the canned beans three months after.

3. In the case of green-leaf vegetables which possess, in addition to the antiscorbutic vitamine, the "fat-soluble" growth-promoting accessory factor, the latter substance is also lacking in the canned material unless the liquor be also taken.

4. *The value of canned vegetables as regard antiscorbutic and growth-promoting properties must be regarded as negligible.*

**References.**—1. Holst and Fröhlich (1907): *Journal of Hygiene*, vol. vii., p. 619. 2. Holst and Fröhlich (1912): *Zeitschrift f. Hygiene*, vol. lxxii., p. 1. 3. Chick and Hume (1917): *Trans. Soc. Trop. Med. and Hygiene*, vol. x., p. 141. 4. Chick, Hume, and Skelton (1918): *Biochemical Journal*, vol. xii., p. 131; and (5) *THE LANCET*, Jan. 5th. 6. Chick, Hume, Skelton, and Smith (1918): *THE LANCET*, Nov. 30th. 7. Chick and Delf (1919): *Biochem. Journal*, vol. xiii., p. 199. 8. Chick and Rhodes (1918): *THE LANCET*, Dec. 7th. 9. Delf (1918): *Biochemical Journal*, vol. xii., p. 416. 10. Delf and Skelton (1918): *Biochemical Journal*, vol. xii., p. 448. 11. McCollum, Simmonds, and Pitz (1916): *Amer. Jour. Phys.*, xli., p. 361.

## II.—THE ANTISCORBUTIC VALUE OF SOME INDIAN DRIED FRUITS:

(a) TAMARIND, (b) COCUM, AND (c) MANGO ("AMCHUR").

BY HARRIETTE CHICK, E. MARGARET HUME, AND RUTH F. SKELTON.

(From the Lister Institute, Department of Experimental Pathology.)

THE experimental investigation of these dried fruits was undertaken early in 1917, at a period in the war when scurvy was still proving a serious menace to our native troops in Asia. These and similar materials have long been esteemed as antiscorbutics by the native population of India,

and instances are to be found in the literature and elsewhere in which the prevention and cure of human scurvy has been attributed to their agency. For example, MacNab<sup>1</sup> (1837) relates how an outbreak of Scurvy at Nassirabad, Rajputana, in 1833-34 was treated with good results by an infusion made from "anola," the dried fruits of *Phyllanthus emblica*. This product was commonly bought and sold in the native bazaars and considered to possess great antiscorbutic virtue. The dose taken amounted to  $\frac{1}{2}$  oz. (14 g.) daily, calculated on the original dry material.

Major-General Sir Havelock Charles,<sup>2</sup> who was attached as medical officer to the Afghan Boundary Commission in 1884-86, ascribes the freedom from scurvy of the native troops accompanying this expedition to the regular consumption of "amchur," or dried mango, whenever fresh fruits or vegetables were unavailable. It was at his suggestion that we undertook the following experimental study, and the samples of tamarind, cocum, and amchur investigated were obtained from India with his assistance. Of these, the two first-named are commonly included in the native soldiers' ration.

The method adopted for studying the antiscorbutic value of these fruits was as follows. Guinea-pigs were used as experimental animals, following in principle the methods employed by Holst and Fröhlich<sup>3</sup> as modified by Chick and Hume.<sup>4</sup> If greenstuff is removed from their normal diet of grain and green leaves these animals sicken and die of scurvy in 3-6 weeks. In the present experiments the basal "scurvy" diet consisted of oats and bran *ad libitum*, together with a daily ration of 60 c.cm. of milk, heated to 120° C., for one hour to destroy its original antiscorbutic value. This diet is satisfactory for the nourishment of these animals in every respect save only that it lacks the antiscorbutic vitamine. Good growth is made until the onset of scurvy. The antiscorbutic value of any foodstuff is determined by observing the effect of adding measured daily rations to the basal diet and estimating the average minimum daily addition necessary to prevent scurvy.

*Antiscorbutic Value of Dried Tamarind, Cocum and Amchur, compared with other Fruits and Vegetables in the Fresh Condition, based on Experimental Work with Guinea-pigs.*

Basal diet: Oats and bran *ad libitum*; autoclaved milk, 60 c.cm. daily.

Antiscorbutic material.	Dose.	No. of animals.	Time of experiment.	Result.
None.	—	4	days. 34-40	Death from scurvy in 4-6 weeks.
Tamarind	3.5 g.	4	60-92	Scurvy, but some protection, life prolonged.
Cocum.	4 g.	4	38-91	Scurvy, but some protection, life prolonged in some cases.
"Amchur."	4.5 g.	4	50-71	Scurvy, but some protection.
Fresh meat juice, raw.	20 c.cm.	4	29-66	Scurvy, slight protection in some cases, life prolonged to 9 weeks in 1 case.
Beetroot juice, raw.	20 c.cm.	2	67-88	Scurvy, slight protection only.
* Carrot juice, raw.	20 c.cm.	4	58-95	Protection from scurvy.
* Swede "	2.5 c.cm.	4	90-100	
* Cabbage leaves.	1.5 g.	6	70-90	
* Germinated peas.	5 g.	5	87-97	
* Green bean-pods (scarlet runner).	5 g.	3	84-91	
* Fresh lemon juice.	1.5 c.cm.	4	90	Protection from scurvy.
*† Fresh lime juice.	10 c.cm.	2	61-90	
* Potato, cooked.	20 c.cm.	3	73-92	

\* Minimum doses required for prevention of scurvy.

† Sour lime, West Indian.

The investigation of these dried fruits presented great technical difficulty, as the animals could not be induced to eat them in the dry condition. It was necessary to make decoctions by soaking in water and squeezing the pulp through muslin and hand-feeding the thick liquor obtained to the animals by means of a syringe. Even so it was distasteful, and there was a limit to the amount that could be tolerated. The daily doses shown in the accompanying table, 3 to 5 g., are calculated in terms of the original dry material, and represent the largest amounts it was found possible to administer.