We hear from many quarters that the native by no means takes kindly to germinated beans or peas, and is not at all enthusiastic as regards raw vegetables in his stew.

The possible use of lucerne as a source of Vitamin C for the native anti-scorbutic would probably create still more difficulty in its application, and hence Dr. M. Delf's counsel considers also, and rightly, the "psychological" aspect of nutrition.

As regards the availability of the Vitamin C in a fodder plant, high in "crude fibre," like lucerne, this is discussed by Fox and Levy (1936), who say that, for experiments conducted on guinea-pigs, "the amounts found in liver and adrenals are closely similar to those obtained by feeding the same quantity of ascorbic acid contained in orange juice. This affords an interesting proof of the availability of the vitamin in green leaves as compared with a fruit juice."

The digestive system of an herbivorous animal like the guinea-pig would no doubt be able to utilise most of the vitamins and nutrients contained in the cellular elements of lucerne, rich as it is in "pentosans," "hemi-celluloses," "celluloses," and "lignins."

The guinea-pig is very likely provided with "cytases," "cellulases," etc., and also an intestinal micro-flora capable of resolving "crude fibre."

The ability of man, however, to satisfactorily resolve "lucerne" could be questioned. Digestive enzymes capable of solubilising "crude fibre" (and lucerne at some stages of maturity is high in "crude fibre"), are not known for man. Crude fibre is possibly resolved to some extent by the intestinal micro-flora, and Khouvine (1934) has described an organism capable of dissolving "cellulose." The utilisation of crude fibre in man is discussed in papers by Woodman (1930), Folling (1931), and Mangold (1934). Thorpe (1928) gives the crude fibre content of very young lucerne as 4.4%; before flowering, as 6.8%; in full flower, as 7.8%; and lucerne hay, 27.0 to 29.5%. Konig (1903) gives the "crude fibre" content of carrots as 0.82 to 1.13%; turnips, 0.6 to 1.16%; peas, 1.4 to 2.4%; and cabbage, 0.6 to 1.10%.

The "crude fibre" content of vegetables, to mention a few common ones, such as carrot, turnip, peas and cabbages, are relatively low as compared with "lucerne" and the nutritive contents, therefore, more likely to be assimilable.

**CITRUS FRUITS FOR THE PREVENTION OF SCURVY.**

Vitamin C, or ascorbic acid, in the juice of *Citrus* fruits exists in the "free" condition, and not "bound," as is known for some vegetables, etc.
Pryde (1931) quotes Herbert Spencer's "Study of Sociology (1880)" concerning the early use of *Citrus* juices for the cure of scurvy:

"It was in 1593 that sour juices were first recommended by Albertus, and in the same year Sir R. Hawkins cured his crew of scurvy by lemon-juice. In 1600, Commodore Lancaster, who took out the first squadron of the East India Company's ships, kept the crew of his own ship in perfect health by lemon-juice, while the crews of the accompanying ships were so disabled that he had to send his own men on board to set sails. In 1636, this remedy was again recommended in medical works on scurvy. Admiral Wagner, commanding our fleet in the Baltic in 1726, once more showed it to be a specific. John Woodall, in 1628, used lemon-juice for the treatment of scurvy, and gave a full description in his 'Vitiaticum, being the Pathway to the Surgeon's Chest' (1628). 'The virtues of orange juice for scurvy dates back to 1671, when Venette, considered orange and lemon juice contained 'something which was directly opposed to the causes of scurvy,' cited by Browning (1931). 'Vitamins': Special Report Series No. 167 (1932); Medical Research Council, London, contains an interesting account of the experience of Lind (1747). Lind had twelve scurvy patients on his hands on board the "Salisbury" at sea, on the 20th May, 1747. 'They all in general had putrid gums, the spots, and lassitude, with weakness of the knees . . . . . and had one diet common to all, viz., water-gruel sweetened with sugar in the morning, fresh mutton-broth often times for dinner, at other times light-puddings, boiled biscuit and sugar, etc., and for supper barley and raisins, rice and currants, sago and wine or the like.' Lind treated two each of his patients with (1) cyder, (2) *elixir vitriol*, (3) vinegar, (4) sea-water, (5) an electuary composed of garlic, mustard seed, *radaphan*, balsam of Peru, and gum myrrh, and (6) 'two oranges and one lemon given them every day.' Supplies of oranges and lemons lasted for six days. 'The consequence was, that the most sudden and visible good effects were perceived from the use of oranges and lemons; one of those who had taken them being at the end of six days fit for duty. The spots were not indeed quite off his body, nor his gums sound; but, without any other medicine, than a gargarism of *elixir vitriol*, he became quite healthy before we came to Plymouth, which was on the 16th June. The other (on the orange and lemon ration) was the best recovered of any in his position, and, being deemed pretty well, was appointed nurse to the rest of the sick.'"

Since these early days of scurvy on land and sea, the juice of *Citrus* fruits have been always regarded as the more efficacious remedy, and modern science confirming their merits as the best and cheapest of anti-scorbutics. At sea, to-day, by an Order in Council (Statutory Rules and Orders, 1927, Merchant Shipping), provision is made for the issue of orange juice—concentrated
orange juice containing not less than 70% of total solids—at the rate of 1½ fl. ozs. mixed with six times its volume of water.

**ORANGE JUICE AS A PREVENTIVE OF SCURVY.**

Delf (1920) demonstrated the merits of orange juice as a rich source of the anti-scurvy vitamin, and determined 1.5 ml. as the minimum protective dose for guinea-pigs and all later research has confirmed the superior merits of orange juice.

Delf (1921) examined South African navel oranges, and found 1.5 ml. as the minimum protective dose for guinea-pigs. More recent work on the Vitamin C content of oranges bought on the London market are given by Harris and Ray (1933), who find 60 mgms. per 100 ml. of juice; Birch, Harris and Ray (1933) for oranges bought in England, record 48.6 and 75 mgms. per 100 ml. of juice; Harris and Ray (1933) report 57 to 91 mgms. per 100 ml. of juice; and an average of 72 mgms. for South African oranges, also 47.6 to 75.7 mgms. per 100 ml. of juice and an average of 57.0 mgms. for Brazilian oranges; Bacharach, Cook and Smith (1934) report 34 to 68 mgms. per 100 ml. of juice and an average of 57 mgms. for South African oranges; 50 to 90 mgms. per 100 ml. of juice, and an average of 68 mgms. for Spanish oranges; 40 to 60 mgms. per 100 ml. of juice and an average of 49.0 mgms. for Brazilian oranges, and 53 to 63 mgms. per 100 ml. of juice, and an average of 58 mgms. for Jaffa (Palestine) oranges. They also report a loss of 20% of anti-scorbutic activity after one month’s storage of oranges. Levy and Fox (1935) report 38 to 77 mgms. per 100 ml. of juice for South African oranges, and also for South African navels, 52 to 63 mgms. per 100 ml. of juice, and for South African seedlings, 60 to 77 mgms. per 100 ml. of juice. Bergmann (1936) examined by biological test the juice of South African oranges purchased on the Stockholm market, and reported the “juice offered the same protection against scurvy as the juice of the Messina and Valencia oranges.”

In our laboratory, 50 samples of oranges were examined, and a range of 34 to 60 mgms. found, and an average of 46.0 mgms. per 100 ml. of juice. South African oranges are, therefore, rich in Vitamin C and suitable for use as anti-scorbutics of high potency.

**LEMON JUICE AS A PREVENTIVE OF SCURVY.**

Delf (1921) did not include lemons in her studies of the anti-scorbutic properties of South African foodstuffs. Results for the Vitamin C reported by Harris and Ray (1933) on lemons bought in England indicated 55 mgms. per 100 ml. of juice; Birch, Harris and Ray (1933) record 60 to 62 mgms. per 100 ml. of juice; Bacharach, Cook and Smith (1934) found 47 to 62 mgms. per 100 ml. of juice; Lund, Spur and Fridericia (1934) find 39 and 56 mgms. per 100 ml. of juice for Messina lemons.
Twenty-seven samples examined in our laboratory contained 20 to 73.2 mgms. of Vitamin C per 100 ml. of juice and an average of 36.5 mgms. Most investigators comment on the wide variation in the Vitamin C content of lemons. Bennett and Tarbert (1933), reporting on a series of samples, find the lowest sample having only 60% of the highest and found striking differences between individual lemons off the same tree; Harris and Ray (1933) record 47 mgms. per 100 ml. of juice as the average of twenty samples, with a range of 18.3 to 69.4; the lowest result was found for a very large lemon, and the highest result for a very small withered lemon; Harris and Ray (1933), and Key and Morgan (1933) confirm results indicating a wide variation in Vitamin C content; Bennett and Tarbert (1933) say the Vitamin C content of oranges is more constant and rather higher than lemon juice. Our own experience supports his reported figures. The effect of storage of lemons is reported by Bacharach, Cook and Smith (1934), and they record a loss of Vitamin C after 1 month’s storage.

**LIME JUICE AS A PREVENTIVE OF SCURVY.**

In early days, lime juice was regarded as the most potent fruit juice known for the treatment of scurvy. Henderson-Smith (1918, 1919) proved that, during the last years of the 18th Century and up to the middle of the 19th Century, lime juice as used in the Royal Navy and on most Polar Expeditions was in fact usually the juice of the lemon, and any limes that may have been rationed were sweet-limes of Mediterranean origin, and not the sour-limes now used for the preparation of lime juice of the West Indies.

The sour-lemon (*Citrus medica, var.: acida*) happened to have about one-quarter of the anti-scorbutic value of the lemon (*Citrus medica, var.: limonum*), and the methods of preparing and preserving "lime juice" had taken away from it what merit it originally contained. The historical aspect of the subject will be found fully treated in "Vitamins" : Special Report, Series No. 167 (1932) : Medical Research Council, London. The poor anti-scorbutic merits of limes was verified by the work of Chick, Hume and Skelton (1918) and Robison (1919). Hassan and Basili (1932) confirmed the earlier work of Chick and her colleagues, and considers that low results for Vitamin C are due to deterioration as they find no difference between the anti-scorbutic value of *truly fresh* Egyptian limes and that of the fresh lemon. These investigators found 1.5 ml. as the protective dose for *fresh and daily prepared lime juice*, and, after two months’ storage in a refrigerator, 3 ml. failed to protect. In our laboratory, twelve samples were found to contain 20 to 32 mgms. of Vitamin C per 100 ml. juice and an average of 27.0 mgms. This low Vitamin C content of 27 mgms. as an average for twelve samples of limes, compares unfavourably with 27 samples of
lemons of an average of 36.5 mgms. and with 50 samples of oranges with an average of 46.0 mgms., all per 100 ml. of juice.

**OTHER CITRUS FRUITS AS PREVENTIVES OF SCURVY.**

Grape-fruit juice is high in Vitamin C, and for fruit purchased on the London market, Birch, Harris and Ray (1933) record 59 to 65 mgms. per 100 ml. of juice. South African grape-fruit examined by Bracewell and Zilva (1931) was reported high in Vitamin C potency. Twenty-one samples examined in our laboratory gave 49.3 to 66.5 mgms., and an average of 58.5 mgms. of Vitamin C per 100 ml. of juice.

S.A. Naartjes were tested by Delf (1921), and she reported them “rather less effective than that of orange juice.” Two samples examined in our laboratory were found to be high in Vitamin C—59.5 and 65.0 mgms. per 100 ml. of juice.

**CAUSE OF VARIATION OF VITAMIN C CONTENT OF "CITRUS" FRUITS.**

Possible causes of the variation in the Vitamin C content of Citrus fruits are many, and still require systematic study. Factors such as:

(a) climatic condition, including seasonal and yearly variation in sunshine, rainfall, humidity;
(b) variety of fruit;
(c) soils, fertilisers, and other agricultural conditions;
(d) size and maturity of individual fruits;
(e) effects of irrigation;
(f) methods of ripening;
(g) period of storage;
(h) effects of agricultural sprays, fumigants, etc.

In connection with agricultural sprays, Nelson and Mottern (1932) report that lead arsenate lowered the Vitamin C content 33 to 50% of oranges of the same variety and same degree of maturity from unsprayed trees. They also observed that heating oranges for 8 hours at 110°F. for destruction of the larvae of the Mediterranean fruit fly did not affect the Vitamin C content of oranges.

**EFFECTS OF PRESERVATIVES ON THE VITAMIN C CONTENT OF CITRUS JUICES.**

Davey (1921) found for lemon juice preserved with 600 and 900 ppm. of sulphur dioxide (potassium metabi-sulphite was used)
and left at 0°C., a considerable loss of Vitamin C, and suggested that sulphur dioxide had a destructive effect; Delf (1925) found 600 ppm. of sulphur dioxide (form used not stated) retained only one-sixth of its original Vitamin C content after a long storage; Morgan and Field (1929) reported that dried and sulphur dioxide-treated peaches retained the full Vitamin C content; Morgan, Field and Nicholls (1931) found that sulphur dioxide used prior to drying of prunes and apricots protected the full Vitamin C content present in the original fresh fruit and considered the presence of at least 500 ppm. of sulphur dioxide is necessary. If the fruit was sun-dried or dehydrated without initial treatment with sulphur dioxide, all the Vitamin C was lost. Nichols and Cruess (1932) supported these results. Williams and Corran (1930) found for lemon juice preserved with 200 ppm. of sulphur dioxide (potassium metabisulphite used) after 2½ months' storage at room temperature, a loss of nearly all the Vitamin C, or using 400 ppm. of sulphur dioxide (potassium metabisulphite used) nearly 50% of Vitamin C was lost; Bennett and Tarbert (1933) reported considerable loss of Vitamin C for lemon juice preserved with sulphur dioxide (form used is not stated); Bennett (1934) found lemon juice preserved with 300 ppm. of sulphur dioxide (form used not stated) gave a reducing value of 5.0 ml. of indicator after 56 days' storage, and 4.3 ml. after 110 days' storage. The original juice reduced 7.3 ml. of indicator, and, therefore, a loss occurs of 30% of its potency after 56 days, and a 40% loss after 110 days.

Preliminary results obtained in our laboratory indicate that by our methods of preservation of Citrus fruit juices, a loss of Vitamin C takes place rapidly in the early stages of storage, then falls slowly, and remains relatively constant for a considerable length of time. Our experience leads us to believe that sulphur dioxide is a valuable preservative, both for juice and for Vitamin C. We have tested juice after nearly eight months' storage, and found it high in Vitamin C and above the minimum we guarantee—viz., 23 mgms. of Vitamin C per 2½ fl. ozs. tot—and the results have been confirmed by a leading Pharmacological Laboratory in London. All juice supplied by us for use as an anti-scorbutic is first allowed to attain this "maturity," and only when the Vitamin C content is steady is it supplied after testing.

Benzoic acid is useless as a preservative of juice and of Vitamin C.

As to the effects of sulphur dioxide, Huggett (1935) states that 1,000 ppm. of sulphite have no effect on man and it requires large amounts, such as 4 to 6 grams, to produce gastro-intestinal irritation. Such irritation could be caused by "free" sulphur dioxide, but in fruit juices a large proportion of the sulphur dioxide is "bound."
Dr. Julian S. Huxley, in his "Scientific Research and Social Needs" (London: Watts & Co: 1934), writes of his experience in Africa:—"I also found when I was out there that the belief still lingered among some white employers of black labour that the black man needed only a few handfuls of maize-meal to keep him in good trim. This is, as a matter of fact, a complete fallacy: a black man has the same general physiology as a white man; and many complaints about "lazy niggers" and the like owe their existence entirely to the short-sighted policy of the white employers, who want to get a great deal in labour for next to nothing in the shape of food, and provide a cheap diet on which no human being, white or black, can help being listless and without energy.

Although there has been much improvement of late years in the diet provided for native labour, especially by big concerns like mines, it still remains true that improper and inadequate diet, whether due to their own or their white employers' fault, is one great cause of backwardness among the native inhabitants of Africa."

The ration was gazetted on the 8th December, 1920: Government Notice No. 2241, and reads:—

**MINIMUM RATION SCALE FOR NATIVE LABOURERS (1).**

<table>
<thead>
<tr>
<th>Article</th>
<th>Minimum Allowance</th>
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<tbody>
<tr>
<td>1. Mealie meal, including that used for marewu</td>
<td>24 ozs. per day</td>
</tr>
<tr>
<td>2. Bread</td>
<td>6 ozs. per day</td>
</tr>
<tr>
<td>3. Beans or peas, at least half of which to be germinated</td>
<td>3 ozs. per day</td>
</tr>
<tr>
<td>4. Meat:—</td>
<td></td>
</tr>
<tr>
<td>(a) dressed, and containing not more than 25% of bone</td>
<td>3 lbs. per week</td>
</tr>
<tr>
<td>(b) soup meat (heads, heels, liver, etc.)</td>
<td>¾ lb. per week</td>
</tr>
<tr>
<td>5. Peanuts</td>
<td>2 ozs. per day or additional ¼ oz. animal or vegetable fat, plus extra 1 oz. dried peas or beans.</td>
</tr>
</tbody>
</table>

(1) A. J. Orenstein, in "Notes on Elementary Hygiene, etc., for Compound Officials" (Central Mining Rand Mines Group publication) 1930, p. 35, confirms the ration scale tabulated above, and includes 6 ozs. daily of Kaffir Beer.
6. Sugar .................................................... 1 oz. per day
7. Fresh vegetables, exclusive of carrot
tops and maize husks ................................ 5 ozs. per day
8. Salt .................................................... ¼ oz. per day
9. Cocoa .................................................... ¼ oz. per day

Only the following vegetables to be issued:—

Potatoes Squash
Sweet Potatoes Marrow
Carrots Onions
Green Maize Leeks
Cabbage Tomatoes
Pumpkin

**DIRECTIONS.**

(1) *Mealie Meal.* Should the Director of Native Labour, after consultation with the Medical Officer, deem it desirable, kaffir corn or other cereal in such quantity as the Director may approve shall be substituted for part of the mealie meal ration.

(2) *Bread.* The bread ration issued shall have the following composition:—Not less than 64% of wheaten flour, and not more than 36% of mealie meal.

(3) *Beans or Peas.* Beans and peas supplied shall be of good quality and free from weevils.

(4) *Meat.* 3 lbs. dressed meat of good quality to contain not more than 25% bone, plus ⅛ lb. of soup meat (i.e., heads, heels, liver, etc.). The dressed meat to be issued raw at least twice weekly, not less than 16 ozs. to each native at each issue. On each remaining day the meat to be issued in the form of soup and/or stew.

(5) *Peanuts.* Instead of issuing two ounces of peanuts per day, the equivalent amount can be issued three times per week.

(6) *Fresh Vegetables.* In order to encourage the consumption of raw vegetables by natives where possible, it is recommended that vegetables such as cabbages, carrots, or leeks, or any other vegetable which the native would eat raw, be minced up fine and stirred raw into the stew or beans immediately prior to issue.

(7) *Germinated beans and vegetables* should be kept in cooking pots as short a time as possible, and in any case not more than 45 minutes; they should not be mashed or cut fine before cooking but this may be done after cooking, if desired.

(8) If, during the months of July, August, September and October, an orange or other approved substitute be issued every second day, the vegetables ration may be reduced to 3 ozs. per day.

(9) *Cocoa or Coffee.* Cocoa issued shall contain not less than
25% of cocoa fat, and the coffee shall contain not less than 75% of pure coffee, the remainder being pure chicory.

(10) Prior to going on shift, each native is to be issued his daily bread ration, and either ten ounces of properly prepared soup or stew, or ten ounces of cocoa, which shall be properly sweetened.

(11) Only wooden vats and utensils are to be used in the brewing and storing of marewu.

In 1928, comments on this ration and its application appear in the "Annual Report of the Department of Public Health: Union of South Africa (1928)".—

"The rationing was also found in many cases to be unsatisfactory, more particularly in regard to the provision of vitamins. Such vitamin deficiency, though rarely sufficient to actually produce diseases such as scurvy, must result in a considerable lowering of vitality and of resistance to disease infections."

We read in the same official report for 1929:—

"Some of the kitchens were found defective, and the supervision of the cooking inadequate. In particular, the vegetables (which are required to be added to the ration to prevent the occurrence of scurvy and to raise the general resistance of the workers against disease) were sometimes found to be over-cooked, thereby greatly reducing their vitamin value, or prepared in such a way as to be unpalatable to the native, who then picks them out with his fingers and throws them away.

"There was also evidence that in some mines the regulations regarding rations were being deliberately evaded or not properly carried out. Thus the anti-scorbutic ration of germinated beans was not found to be issued at all mines. Again, the regulations require that the bread issued shall consist of not less than 64% of wheaten flour or whole meal, and not more than 36% of mealie meal. This regulation is difficult to enforce, owing to the fact that the characteristics of starch grains are obscured or destroyed by baking, so that, after baking, determination of the precise proportions is difficult or impossible. But on many of the mines inspected, the bread appeared on naked eye inspection and to the taste to be grossly inferior, and there was little doubt that it was composed largely of mealie meal. The diet of the native workers already errs on the side of too much mealie meal."

The 1930 official report states:—

"The diet of the natives was found in general to be satisfactory. On a few mines, scurvy is still unnecessarily prevalent. This is only partially due to the sub-scorbutic state in which many of the natives arrive on the Reef. Over-cooking of the vegetables was still found to be a not uncommon fault. Some of the mines
were still not issuing the anti-scorbutic ration of germinated beans. Following representations made by the Department, steps were taken by the industry to ensure germinated beans forming a portion of the ration on all mines."

The 1931 official report states:—

"Difficulties still arise in regard to suitable dietaries; this is almost unavoidable with a large mass of primitive native labourers content to subsist almost exclusively on a limited and badly balanced dietary seriously deficient in vitamins. The necessary foods accessory to mealie meal are provided by all the mines, but, unless there is careful supervision, many natives will not utilise them. This no doubt accounts for the not infrequent cases of scurvy which crop up and is probably an important factor in the high incidence of pneumonia.

Those natives have mealie meal as their staple article of diet; but it is supplemented by meat, vegetables, germinated beans, etc., so that, provided the native makes use of these additional substances, a reasonably balanced diet adequately supplied with vitamins is obtained.

There can be no doubt, however, that if mealie meal, with its necessarily long period of cooking, is eaten to the virtual exclusion of all other food substances, very unsatisfactory conditions result in the human body. This unfortunately occurs to a considerable extent in the native territories, in the native compounds and locations of many industries other than the Transvaal gold mines, and among a large section of the European population which has become impoverished from various causes. The effect of this on the Bantu is clearly brought out when he is put on hard work. In the Territories the male lives an indolent life, with his skin freely exposed to air and sunlight, and the effect of a qualitatively inadequate diet may not be immediately obvious. When, however, he is recruited for work on the mines, he is liable to succumb to disease if special precautions are not taken. If he is put on hard work immediately scurvy and/or pneumonia are likely to occur. This is well recognised by employers of mine labour. The usual procedure is to allow him all the food he can manage and to keep him on light work during the first week or two.

A similar reaction to hard work was found to be occurring in the Durban Prison Command two years ago. The disease Pellagra was found to be occurring extensively in new prisoners brought in from Zululand. The evidence again pointed to the fact that it was the hard work immediately on arrival in gaol which brought out the pellagra in a badly nourished native.

A consideration of the composition of mealie meal will immediately make it clear that if used as the only food it cannot support healthy mammalian life. It consists of 77.4% starch, 9.9% protein and 2.1% fat; vitamins A and B are present in it,
but not C or D. If a considerable amount of mealie meal is used in a dietary, it becomes imperative to add substances specially rich in the necessary proteins, fat and vitamins."

Scurvy is discussed in the 1933 official report, and reads:—

"This disease continues to cause trouble in spite of the provision throughout the mines of anti-scorbutic substances to supplement the mealie-meal on which the natives largely subsist. The number is large when it is borne in mind that only severe cases are treated primarily for this condition. Many accident cases, for instance, develop scurvy, but are not recorded as such for statistical purposes.

"Florid scurvy frequently develops in recent recruits who are put on to hard work underground. The reason for this is that they arrive on the mines in a sub-scorbutic state due to their subsistence in the territories almost exclusively on mealie meal, which is devoid of Vitamin C. Owing to the easy life at home, scurvy may not become manifest there, but it quickly shows itself on the mines if the boy is immediately put on to hard work without a preliminary feeding up on the good mine diet. Even in older boys the condition will develop if they deliberately discard the anti-scorbutic substances provided. This is now obviated on many of the mines by grinding up the raw vegetables to a pulp which is stirred into the stew at the end of the cooking process."

In the 1934 Official Report of the Department of Public Health, Union of South Africa, we read:—

"The sub-scorbutic state of mine recruits is fully appreciated on the Witwatersrand. On the mines, experience has proved the necessity of allowing the new boys a period of loafing while they are permitted to eat as much as they like of the nourishing food adequately provided with protein and vitamins. These facts indicate clearly that even when the mealie meal pap is plentiful the natives are still being starved of the essential constituents of food. This starvation results in much morbidity and consequently mortality among them."

These excerpts, quoted from official sources, serve to demonstrate that the provision made for inclusion of Vitamin C in the diet of native labourers—germinated beans and peas—is in practice not always carried out with due regard to very necessary precautions, and our estimate of 23 mgms. of Vitamin C in the 1 1/2 ozs. of germinated beans or peas is in practice not always likely to be realised.

The use of orange juice is "fool proof," and involves merely the daily issue of a preventive tot of 2 1/4 fl. ozs. of a palatable sweetened drink ready for use. No germination! No cooking! No supervision to see that the ration is taken! The 2 1/4 ozs. of sweetened orange juice contains a guaranteed minimum quantity of Vitamin C, not less than 23 mgms. of Vitamin C in the 2 1/4 fl. oz. tot.
The deletion of germinated beans or peas from the gazetted ration and the substitution of orange juice is a measure likely to ensure that the native labourer is definitely receiving a preventive dose of anti-scorbutic and at less trouble and expense as compared with the existing provision.

Suitably preserved orange juice is available at all times of the year, and its strength in Vitamin C is guaranteed.

Orange juice, as compared with oranges, presents the following advantages:

(a) Supplies available all times of the year.
(b) Price consistent and not so subject to market fluctuations common for the fruit.
(c) The Vitamin C content is known and guaranteed.
(d) Correctly preserved juice will keep indefinitely, and no loss due to attack of "mould" so frequent for oranges in bags.
(e) Oranges vary in their juice content, which, in the case of "Export" fruit, is controlled by Government Regulations. "Non-exportable" quality fruit, which is the kind on local markets, is not sold to standard of juice content.
(f) Bulk supplies of market quality oranges vary considerably in size, from "marbles" to "very large," and therefore, as the juice content must vary, so also must the amount of Vitamin C in oranges of different sizes. It would not be possible to give each boy a correct 2½ fl. oz. dose containing a known quantity of the Vitamin C.
(g) The litter of peel about compounds is avoided.

THE CITRUS FRUITS INDUSTRY IN SOUTH AFRICA

The growth of the South African Citrus fruits industry may be gauged from a consideration of the number of trees under cultivation in the Union.

In 1911, for all districts, but excluding native reserves and locations, census figures show approximately 1,562,560 trees (1), and by 1930 this had increased to 4,352,500 trees, the produce of which is grown for sale.

In 1930, the proportion of orange trees was approximately 89.2%; lemon trees, 4.5%; and naartjie trees, 6.3%; figures for grape-fruit are not available.

The development of the Citrus fruits industry has risen from a production of 3,000 boxes of oranges exported in 1907 to 2,622,793 (1) boxes exported in 1934, including oranges, grape-fruit, lemons and naartjes.

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(1) Year Book No. 16 (1933-34), Union of South Africa.
In 1933, the value of exports of *Citrus* fruits amounted to £1,114,442 (1).

In order to maintain a high standard of fruit for export, certain Government regulations have been made, and it is possible that only half of the fruit grown in South Africa reaches the required standard.

A large surplus of *Citrus* fruits are therefore available annually for consumption in the Union. This "surplus," "cull," or "non-exportable" standard fruit, which in itself is excellent fruit, is available in very considerable quantities at certain periods of the year, and a "glut" of fruit is frequently inevitable on local markets.

As the *Citrus* industry is still expanding, it seems likely that still larger quantities of such grade fruit will become available on local markets.

It is, of course, evident that many practical and economic difficulties exist, were it possible to hold such grade of fruit in cold storage, and draw on it for consumption during the off-season or other periods of scarcity.

It is possible as a commercial undertaking to extract the juice of *Citrus* fruits at the period of abundance and to suitably preserve and store such juice in large vats. A sound method of preservation and storage has little influence on the merits of orange juice as an anti-scorbutic.

Probably no other country in the world offers a better market for the utilisation of large quantities of orange juice than we have here in South Africa.

Professor R. A. Dart, of the Witwatersrand University, in an article entitled, "Futilities must be swept from the World," and appearing in the *Natal Mercury* of October 30th, 1934, wrote:

"Scores of thousands of our Bantu are sub-scorbutic and sub-pellagric. We at least know that such conditions are due to lack of a vitamin present in *Citrus* fruits. Yet normally thousands of tons of valuable fruit leave the country and other thousands of tons rot in our citrus orchards."

For the 1933 *Citrus* fruits export season, 69,372 tons (of 2,000 lbs.), or 2,017,315 cases of oranges were exported. On the basis of an equal proportion of "non-exportable" fruit retained in the country, this tonnage of oranges would represent approximately 5½ million gallons of orange juice. It is interesting to note that, if our 5,761,000 sub-scorbutic Bantus were all rationed on 2 fl. ozs. of orange juice per person per day, the 5½ million gallons of orange juice could last only 76 days!

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(1) Year Book No. 16 (1933–34). Union of South Africa.
We are not suggesting that the entire Bantu population could be provided with orange juice, highly desirable as this would be.

We do suggest that South Africa can produce sufficient orange juice as a source of anti-scorbutic vitamin as a preventive of scurvy, and, if introduced on a large scale amongst our subscurbutic Bantus, would elevate their level of health and approach nearer to the standard required for work on the gold mines, and assist in making available a larger proportion than 5% of our total Bantu population fit for employment in this great industry.

Orange juice could be freely used in all industries to assure that the native is not likely to break down in health in industry, owing to the development of scurbutic conditions. Orange juice as a preventive of scurvy and freely used will correct "lassitude" and "fatigue," and eliminate economic loss due to such subscurbutic trouble. On the basis of an issue of a preventive dose of 2 fl. ozs. (or its equivalent of 2½ fl. ozs. of sweetened) of orange juice per person per day, and continued for one year, the following outlets for its beneficial use are suggested and summarised in Table 4:

TABLE 4.

<table>
<thead>
<tr>
<th>Concern.</th>
<th>Number of Natives</th>
<th>Census Period.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Mining (Rand)</td>
<td>252,000</td>
<td>1934</td>
</tr>
<tr>
<td>Sugar (Natal)</td>
<td>35,000</td>
<td>1933-34</td>
</tr>
<tr>
<td>Railways and Harbours (Union)</td>
<td>25,000</td>
<td>1933-34</td>
</tr>
<tr>
<td>Coal</td>
<td>24,500</td>
<td>1934</td>
</tr>
<tr>
<td>Diamonds</td>
<td>19,500</td>
<td>1934</td>
</tr>
<tr>
<td>Industries (Factories)</td>
<td>95,850</td>
<td>1932-33</td>
</tr>
<tr>
<td>School Children</td>
<td>430,000</td>
<td>1933</td>
</tr>
<tr>
<td>Hospitals</td>
<td>2,724</td>
<td>1933-34</td>
</tr>
<tr>
<td>Mental Institutions</td>
<td>4,025</td>
<td>1933</td>
</tr>
<tr>
<td>Leper Institutions</td>
<td>2,000</td>
<td>1933-34</td>
</tr>
<tr>
<td>Prisons</td>
<td>18,000</td>
<td>1934</td>
</tr>
<tr>
<td>Total</td>
<td>908,599</td>
<td></td>
</tr>
</tbody>
</table>

The total quantity of oranges required were all the above listed concerns rationed with orange juice would amount to 51,816 tons (of 2,000 lbs.), or equivalent to 1,501,478 export cases of 69 lbs. nett weight of oranges. The gold mining industry alone could absorb 14,372 tons of oranges or 416,580 cases per year.

A further application of orange juice would be its issue to European school children, numbering 361,660 in 1933. This
would utilise about 20,627 tons (of 2,000 lbs.), or 597,884 cases of oranges. Malnutrition occurs in a large proportion of school children, particularly in rural areas.

Milk is issued free to school children in some areas, and, in connection with this, Hess and Fish (1914) described an outbreak of infantile scurvy among infants who had been fed for several months upon a diet of pasteurised cow's milk. Previously, the infants had always been provided with orange juice as an extra source of anti-scorbutic, but the practice was discontinued as a result of a report made by the American Medical Milk Commission (1912) that heated milk might be considered the equivalent of raw milk. The non-inclusion of orange juice resulted in an outbreak of scurvy, and this was demonstrated by the prompt cessation of the illness when orange juice was restored to the diet.
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