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MALT SOUP EXTRACT AS AN ANTISCORBUTIC *

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During 1918, while studying the respiratory quotient of scorbutic infants, we decided for definite reasons to feed these infants with Keller's malt soup, a mixture containing 100 gm. of the so-called malt soup extract, which has made for itself a record of producing and never of curing scurvy. Hess,¹ for instance, reports that in his experience the malt soup preparation is the diet which has been associated with scurvy most frequently. September 6, 1918, a patient who had developed a scurvy in another institution on Keller's malt soup was given the same kind of a mixture in pursuance of the above stated aim, but on the fourth day orange juice was added to the diet, and so the surprise which we were to have later in the case of another patient was inadvertently postponed. September 26, 1918, another scorbutic patient, 11 months of age, was brought to the hospital with a history of poor development and bad stools (Table 1). He was bottle-fed since birth. From the age of 1 month on until he was 10 months old he was fed a mixture of one-half milk and one-half oatmeal water with cane sugar. Then he received for another month two-thirds milk and one-third oatmeal water. During this month he suffered from diarrhea, and as a result, the stepmother, who took charge of him at this time, frequently gave him castor oil, but without beneficial effect on the painful lower extremity. The physical examination showed a decided case of scurvy, the patient having swollen and bleeding gums about the upper and lower incisors, enlarged epiphyses, a rosary, an enlarged spleen, and increased permeability of capillaries, a swollen right knee and a very sensitive left knee. For our purposes of respiratory quotient study he was also put on Keller's soup. On the day of his admission to the hospital he received a mixture of one-half skimmed milk and one-half oatmeal, and on the following day he was offered Keller's soup, but refused most of it, taking only a total of 250 c.c. On the next day, however, he took 820 c.c. and then the full 1,000 c.c. offered him. We expected no improvement, and as we wished to see the effect of the

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1. Hess, Alfred F.: Infantile Scurvy. V. A Study of Its Pathogenesis. *Am. J. Dis. Child.* 14:347 (Nov.) 1917.

orange juice on the respiratory quotient and as we also wished to have the same carbohydrate intake in the preliminary period as would occur in the regular period, we gave him, besides 1,000 c.c. of Keller's soup, 60 c.c. of a 10 per cent. solution of sugar, composed of 6.5 per cent. of glucose and 3.5 per cent. of sucrose. The higher percentage of glucose was used because levulose was not available.

TABLE 1.—ANALYSIS OF CLINICAL HISTORY OF SECOND SCURVY PATIENT

Date, 1918	Food		Weight, Gm.	Temperature			Stools	Clinical Condition and Symptoms
	Kind	Amt., C.c.						
Sept. 26	Skimmed milk ½, OMW ½	600		38.1	37.6	27.6	E	Pallor; restless; bleeding and swollen gums about incisors; right knee swollen and very sensi- tive, left also sensitive. Child also showed a marked rosary, enlarg- ed spleen and epiphysis on admission; had diar- rhea for a long time before admission
Sept. 27	Skimmed milk ½, OMW ½	100	5,610	38.2	37.8	37.9	1 T	Same
Sept. 28	Keller's soup	250	5,480	37.0	37.3	38.0	3 T	No change noticed
Sept. 29	Keller's soup	820	5,550	37.9	37.6		3 T	No special observation made
Sept. 30*	Keller's soup	1,000	5,725	36.6			2 N	Child's improved dispo- sition noted
Oct. 1	Keller's soup	1,000	5,855	36.8			1 T	
Oct. 2	Keller's soup	1,000	5,845	37.0	37.4		2 N	Gums normal; joint sen- sitive and swelling gone
Oct. 3	Keller's soup	1,000	5,800	37.0	37.6		5 N	Same; very happy; looks much better
Oct. 4	Keller's soup	1,000	5,790	37.2	37.6		4 N	Same; joints negative to pressure
Oct. 5	Keller's soup	1,000	5,800	37.4	37.6		3 N	Continued general im- provement
Oct. 6	Keller's soup	1,000	5,800	37.9	37.9		2 N	Color better
Oct. 7	Keller's soup	825	5,790	37.0	37.2		1 SN	
Oct. 8	Keller's soup	100	5,900	37.2	37.2		2 T	
Oct. 9	Keller's soup	100	5,970	37.0	37.0		1 SN	
Oct. 10	Keller's soup	100	5,945	36.8	37.8		2 N	
Oct. 11	Keller's soup	100	5,900	37.2	36.2		1 SN	
Oct. 12	Keller's soup	100	5,950	37.4	37.4		2 SN	

* September 30, the patient received 60 c.c. of a 10 per cent. sucrose solution; October 1 to 7, inclusive, 90 c.c. of a solution containing 3.5 per cent sucrose and 6.5 per cent. glucose daily; October 8 and 9, 660 c.c. and October 10, 11 and 12, 90 c.c. of the same solution daily.

October 1, it was noticed that the child seemed different, but no particular attention was paid to the scorbutic symptoms, simply because we did not expect any special change. October 2, however, the child seemed so normal that an accurate inspection of the gums was made, and to our great surprise these were found to be absolutely normal. The swelling of the right knee joint had lessened, and the sensitive-ness of both the left and the right knee had practically gone. With each succeeding day the child improved in general appearance and disposition, so that we could say definitely that the child had been cured of scurvy, at least of the severe, active stage of scurvy. This experi-ence was so remarkable that nothing was said about it and observations were made to determine whether through some error the child had not

received an antiscorbutic. No evidence in this connection was discovered, however, and so it was decided to say nothing and wait for the next opportunity, which came Dec. 13, 1918.

This third patient had an enormous hematoma of the right femur, and after three days of half milk, half oatmeal water, and 2½ per cent. of cane sugar, the child was given Keller's soup, prepared with the same malt extract that had been used in the previous cases. The gums of this child were perfectly normal, and we had to depend entirely on the sensitiveness and the size of the large swelling to decide whether we had much improvement or not. After three days' observation there was no definite and positive improvement, and as the child was quite ill and had a temperature of 38.5 C., and as the respiratory quotient curves showed certain interesting features, we decided to give orange juice at this time, with the result that within a few days the child showed a distinct improvement. But the improvement was gradual, even with 90 c.c. of orange juice in twenty-four hours, so that, after all, we did not know from his experience whether or not the Keller's soup or the malt extract in the Keller's soup had also exerted any antiscorbutic influence in this child. So again we decided to wait for another opportunity, which came Dec. 30, 1918.

This fourth patient, a colored infant, 10 months of age, was brought to the hospital with a history of stomach trouble and swollen feet (Table 2). She had been artificially fed since the third week, at first for six weeks with a milk dilution, then for six months with bread and tea, and finally during the last three months with a cane sugar one-half milk and one-half water mixture. On physical examination the child showed a very marked rosary and a decided swelling of the lower extremities—especially below the knees. All the tissues about and especially above the right ankle were very much indurated, and all of these swollen areas were extremely sensitive to the slightest pressure. The child objected to moving its legs and was very unhappy and irritable. The gums showed no lesions, even though too small lower incisors had just erupted. This finding is not so very uncommon in cases of scurvy, especially as regards the lower incisors, and in no manner speaks against the correctness of the diagnosis of this case. We have had occasion to see undoubted symptoms of scurvy develop, when the gums of both the lower as well as of the upper incisors were normal. It is unquestionably true, however, that swollen, bleeding, bluish-red gums are the most dependable and characteristic sign of infantile scurvy. The epiphyses at the wrists were only slightly enlarged. After three days feeding with two-thirds milk and one-third oatmeal water, with 3 per cent. cane sugar, during which time no improvement was noticed, she was given Keller's soup made up with the same malt soup extract that had been employed for the last two cases. Ninety c.c. of artificial

orange juice were also given. The next day, January 3, the infant seemed to be passing more urine, and especially was this difference noted the following day. No attempt, however, was made to get an accurate record of the amount of urine excreted, as the patient was a little girl. After twenty-four hours of Keller's soup the child's disposition seemed to be changed for the better, and January 5 there was a marked reduction in the sensitiveness to pressure on the knees, the

TABLE 2.—ANALYSIS OF CLINICAL HISTORY OF FOURTH SCURVY PATIENT

Date, 1918	Food		Weight, Gm.	Temperature	Stools	Clinical Condition and Symptoms
	Kind	Amt., C.c.				
Dec. 30	OMW $\frac{1}{2}$, milk $\frac{1}{2}$, cane sugar 3%	700		37.3 37.5 37.1	...	Marked fretfulness and restlessness; pain on the slightest movement of lower extremities; decided swelling and in- duration of tissue above knee and especi- ally below; marked sen- sitivity to slightest touch; gums normal. Child shows a very marked rosary
Dec. 31	OMW $\frac{1}{2}$, milk $\frac{1}{2}$, cane sugar 3%	900	5,370	37.6 37.2 37.6	1 N	Same
Jan. 1	OMW $\frac{1}{2}$, milk $\frac{1}{2}$, cane sugar 3%	700	5,370	38.0 37.1 37.6	1 N	Same
Jan. 2*	Keller's soup	900	5,175	36.4 36.6	3 N	Same
Jan. 3	Keller's soup	900	5,145	36.6 37.2 36.6	6 SN	Disposition seems better; urinates more
Jan. 4	Keller's soup	900	5,130	36.2 36.5	3 SN	Seems more comfortable; urination much incr.
Jan. 5	Keller's soup	900	5,100	36.6 37.5	3 SN	Less sensitive; wet all the time
Jan. 6	Keller's soup	900	5,130	37.0 37.2	3 SN	Swelling practically gone; sensitive only to deep pressure; happy
Jan. 7	Keller's soup	900	4,925	36.6 37.4	2 N	Laughs and is contented; still very wet
Jan. 8	Keller's soup	900	4,905	36.5 36.6	2 N	Legs show no swelling whatever; no pain even on deep pressure; seems entirely well
Jan. 9	Keller's soup	900	4,870	36.5 37.2	4 N	
Jan. 10	Keller's soup	900	4,840	36.1 37.2	2 N	
Jan. 11	Keller's soup	900	4,900	36.1 37.1	2 N	
Jan. 12	Keller's soup	900	4,850	36.0 36.5	2 N	
Jan. 13	Keller's soup	900	4,910	36.6 37.6	2 N	
Jan. 14	Keller's soup	900	4,850	36.1 37.0	3 T	
Jan. 15	Keller's soup	900	4,910	36.6 37.3	1 N	
Jan. 16	Keller's soup	900	4,800	36.5 37.3	1 N	
Jan. 17	Keller's soup	900	4,990	36.8 38.0 36.0	2 N	
Jan. 18	Keller's soup	900	4,990	36.5 37.5	1 N	Pertussis vaccine; left knee and right ankle sensitive to pressure; is fretful. Due to effects of vaccine injection

* From January 2 to 8, inclusive, the patient received 90 c.c. of artificial orange juice daily and from January 9 to 18, 90 c.c. of orange juice daily.

tibiae and the ankles. January 6 there was an enormous improvement, the legs being sensitive only to every deep pressure, the swelling and induration having practically disappeared. The baby moved its legs about and appeared to be all right. January 8 no swelling whatsoever could be found, and even severe pressure brought no response; the baby laughed and was very happy and contented. So that in this case we

can maintain that the child was definitely cured without receiving orange juice or any other hitherto known antiscorbutic. January 9 orange juice was given for respiratory quotient study, but no further change in the condition of the child was noticed, except on the eighteenth, when the child received an injection of pertussis vaccine and as a result developed fever and, what is interesting, a sensitiveness of the left knee and of the right ankle. This renewed sensitiveness, however, disappeared within a few days, and evidently had some direct connection with the injection of the pertussis vaccine.

TABLE 3.—ANALYSIS OF CLINICAL HISTORY OF FIFTH SCURVY PATIENT

Date, 1919	Food		Weight, Gm.	Temperature			Stools	Clinical Condition and Symptoms
	Kind	Amt., O.c.						
May 10*	S. M. A.	250					1 SN	Pallor, fretfulness, marked swelling of right ankle and thigh; knees and ankles sensitive to slightest touch; suppurating hematoma in right buttock. Râles at both bases
May 11	S. M. A.	490	7,170	39.7	38.8	39.6	2 SN	Same
May 12	S. M. A.	390	7,340	40.2	38.0	39.0	3 SN	General condition decidedly better; no local change
May 13	S. M. A.	690	7,260	37.7	39.4	38.4	2 SN	Much improved generally; looks about
May 14	S. M. A.	790	7,220	39.0	38.5	37.5	3 SN	Marked increase in urination; even more comfortable. Still breathes rapidly, looks "pneumonic"
May 15	S. M. A.	970	7,430	39.4	38.8	39.2	3 SN	Marked increase in urination; swelling of right ankle gone entirely; legs can be moved with little discomfort; tries to smile. Pseudolabor pneumonia at left base
May 16	S. M. A.	960	7,210	38.3	39.4	37.7	5 T	Right ankle also much reduced; sensitiveness of joints practically gone; smiles. While scorbutic symptoms have markedly improved, pneumonic picture remains unchanged
May 17	S. M. A.	970	7,290	39.5	38.4	38.6	5 T	Child moves legs about of own accord without pain; no tenderness except in right hematoma area
May 18	S. M. A.	900	7,330	38.4	39.5	38.0	3 T	Is interested and can smile
May 19	S. M. A.	905	7,620	39.5	39.5	38.0	3 T	
May 20	S. M. A.	960	7,550	37.0	37.6	38.2	3 T	Pneumonia picture changed
May 21	S. M. A.	950	7,340	37.4	37.4	36.8	5 SN	Pneumonia picture gone
May 22	S. M. A.	1,000	7,320	36.9	37.0	37.1	1 N	
May 23	S. M. A.	990	7,330	37.0	36.8	36.4	4 SN	Right thigh still slightly tender; healing of suppurative hematoma. Looks fine; seems very well; few râles still present at left base
May 24	S. M. A.	985	7,340	36.6	37.2	37.5	6 SN	
May 25	S. M. A.	985	7,295	36.8	36.9	37.5	5 SN	
May 26	S. M. A.	885	7,295	36.8	37.4	37.7	8 SN	

* May 10, the patient received 60 gm. of malt soup extract, and from that day on, 100 gm. daily.

May 10, 1919, a fifth baby, 8 months old, was brought to Lakeside Hospital with a diagnosis of osteomyelitis (Table 3). The mother stated that the child had been coughing for two weeks, and had also developed at about that time a large swelling on the right buttock, which was opened by a physician. While this wound had drained quite

well, the tumor below the abscess seemed to get larger and more tender. The patient was admitted on the surgical service and then taken over to the pediatric service with a diagnosis of scurvy. The right thigh between the knee and hip was markedly swollen and the old incision was still oozing slightly. Both knees and the right ankle were especially sensitive, also the left ankle, but not as much as the other three joints. Around and especially above the right ankle there was marked and hard induration, and through the skin bluish areas could be seen. The child was pale, had a marked rosary of the "necropsy chest" type, enlarged epiphyses at the wrists, was very fretful, laid in a frog fashion, and would cry severely as soon as its lower extremities were moved.

Instead of giving this child Keller's soup we gave it S. M. A. (synthetic milk adapted) in order to exclude the possible therapeutic effect of the one-third certified milk that had been used in the Keller's soup for the other children recorded above. A large batch of 20 quarts of S. M. A. was made at one time and prepared over the regular route of pasteurization. We offered the child 1,000 c.c. of S. M. A., but inasmuch as its appetite was very poor we had to resort to gavage after a few days. The antiscorbutic value of S. M. A. is small, and not adequate to prevent a normal child that is getting nothing but S. M. A. from developing scurvy, so that any therapeutic effect obtained by the giving of S. M. A. could not be explained by its administration. Therefore, in this case we gave the malt soup extract, a part of the same lot that had been used for the preparation of the other Keller's soup mixture used in the previously described cases, in the same amount in which it had been administered in the form of Keller's soup, namely, 100 gm. for each twenty-four hours. May 11, the child received 60 gm.; May 12, 100 gm., and after that 100 gm. daily were given of the malt soup extract in addition to the 1,000 c.c. of S. M. A. At first the malt soup extract was given separately, later on it was mixed with the S. M. A., just before it was offered to the child, and so it was not exposed to a temperature above 37 C. The subjection of this malt soup extract to a higher temperature would have made no difference, however, because it was exposed to boiling temperature in all of the previous cases, and in all but the last to an additional temperature above 100 C., but it still retained sufficient antiscorbutic value to cure, without question, the second and fourth infants.

When this patient was first admitted it showed besides the lesions already described, râles at both bases, especially on the left side, accompanied with a temperature that varied daily anywhere from 37.8 to 40.1 C. May 15 there was a definite and marked impairment of resonance of the left lower lobe, accompanied by bronchial breathing so that we could make a diagnosis of pseudolobar pneumonia. As a result of

this pneumonia, the infant did not make a complete change for the better until May 20. The presence of the pneumonia, however, did not obscure the definite and marked improvement in the scorbutic symptoms after the beginning of the malt soup therapy.

As stated above, May 11 the child received its first malt soup extract, and May 13 there could be seen a marked improvement in the joint sensitiveness. As a matter of fact, some improvement was noted May 12, twenty-four hours after the beginning of the therapy. May 14 a marked increase in urinary excretion was also noted, but inasmuch as the fluid intake was low, owing to the poor appetite of the child and its resistance to gavage, the increased urination may have been due more to the increased intake rather than to any diuretic effect of the malt soup extract, although, in all probability, the latter was a factor when one considers that the other children did take more fluid before they received their malt soup extract in the form of Keller's soup and, nevertheless, showed a marked increase in urinary excretion. May 15 the brawny induration of the right ankle was entirely gone, the tenderness of the left knee was markedly diminished, and the child offered no complaint when the left knee and thigh were flexed on the abdomen. Only the right thigh, owing to the presence of the suppurating hematoma, was still protected by the infant against too marked a movement, but even this swelling of the right thigh had been reduced in size, and there was also a decided improvement in the general condition of the child. It became interested in things, and, even though it was still very sick with its pneumonia, it tried to smile and would watch objects that were placed before it, something which it had not done before.

On the next day, May 16, the right thigh had reduced in size enormously and the baby was much more improved, as far as its general disposition was concerned; it smiled and the knees could be flexed without causing any pain. The same was true of the ankles. The pneumonia was still causing a rise of temperature up to 39.5 C., giving beautiful proof that the improvement was due to something different than a change in the condition of the lungs, which clinically could not be recognized. To our great surprise and amazement it was learned from the history that this infant had received nothing but its mother's breast-milk. No oranges, tomatoes, potatoes or any other foodstuffs were given it. The mother herself was well, had no bleeding gums, no painful extremities, and had been eating a general diet, including potatoes. This child was the result of the sixth pregnancy, the first two having ended at six months, while the third, fourth, and fifth went to full term and brought forth infants who are living and well.

We appreciate fully that this history raises a justified doubt as to whether the symptoms in this child were due to scurvy. And yet, after considering the physical findings and the type and course of improvement in the picture after the giving of the malt soup extract, on the one hand, and, on the other, the great improbability that under the same treatment such a marked and rapid change in the condition of the extremities could have occurred if the lesions were due solely to some sort of an infection—we cannot come to any other conclusion than that this case is one of the rare cases of scurvy in breast-fed infants. Possibly when the etiology and the pathogenesis of scurvy will have been clearly established cases such as this one will appear less enigmatic.

So this last patient is also put down as a severe case of scurvy cured in its acute stage by the administration of malt soup extract in a dose of 100 gm. per twenty-four hours, making a total of at least three cases of severe and unquestionable scurvy, cured by the administration of malt soup extract.²

As stated before, Keller's malt soup is a food that is very prone to cause scurvy in infants, and yet there can be no question as to its curative effect in three of the above described cases, an effect that can be dissociated in these severe and yet rapidly cured cases from the quantity of the milk, the heating factor and the ageing factor, as all of these detrimental factors existed in each of the three cases of cure, as the following data will show:

The only factor, besides the malt soup extract itself, that might be considered as having been responsible for the improvement is the quality of the milk, for certified milk was used in the preparation of each batch of food, and it might be imagined that cows producing certified milk are possibly given a diet that would put into the milk more anti-scorbutic substances than would be found in the milk of the ordinary milk cows, which most likely has been used, as a rule, in the making of Keller's soup.

However, neither the fact that certified milk was used, nor the possibility of a greater anti-scorbutic content of such a milk make this idea seem at all probable, as the certified milk used in making the curative Keller's soup for infants came from the same certified dairy from which is obtained the certified skimmed milk which is used in the manufacture of S. M. A. milk, a food which will cause scurvy, even though it contains the same amount of milk as Keller's soup, if no anti-scorbutic is given in addition. And, finally, the food which the cows at the certified farm received was dry and varied in its source, as one would

2. The malt soup extract used in this work was labeled 8149 by the Borchardt Company.

have expected from the fact that the one infant was fed from Sept. 27 to Oct. 12, 1918; the other from Jan. 2 to Jan. 18, 1919; and the third from May 10 to May 26, 1919. So it would be a strange coincidence indeed that cows fed at such widely separate periods on dry food-stuffs, known to have come from different sources, should produce a milk of such high antiscorbutic power that even in the quantity of not more than 330 c.c. for twenty-four hours, boiled, pasteurized, or even sterilized under pressure, and from two to three weeks old, would produce results so paradox to the universal proscorbutic experience with Keller's soup. Therefore, it would seem much more rational to assume that the one and the same batch of malt soup extract which was used in the case of each of these infants was, in all probability, responsible for the good therapeutic results.

The second infant received Keller's soup which was made with certified milk in the ordinary way by boiling, and which then, in addition, was sterilized under pressure for thirty minutes. The entire batch consisted of thirty-two quarts, and for seventeen consecutive days the patient received exactly the same food, making the last quart eighteen days old.

It may be interesting to note in this connection that the remainder of this lot of Keller's soup which cured this infant of its scurvy, produced a fatal scurvy in a number of guinea-pigs, even though their stools were normal during the earlier half of the experiment and decidedly diarrheic during the latter half, and even though they ate more than enough to meet their caloric and fluid requirements. At the necropsy most of these pigs had their large intestines one-half to two-thirds full of a soft, thin stool.

The fourth infant received Keller's soup, all of which was also made at one time, and the last quart of which was fourteen days old when consumed. This batch of food, however, was not subjected to sterilization under pressure.

Evidently, all of these factors were not adequate to reduce the curative properties of the malt soup extract to a level below immediate and marked therapeutic efficacy.

No conclusive facts regarding the cause of the presence of the antiscorbutic properties of malt soup extract No. 8149 can be given at this time. In the light of our present knowledge, however, there can be only one explanation, as a visit to the factory and a conference with the manufacturer of the malt soup extract convinced me that lot 8149 was alkalized in the prescribed manner with methyl red as the indicator.

The most probable explanation would seem to us to be that the barley from which the malt used for the manufacture of the malt

soup extract was derived, had reached an age and stage of germination at which much antiscorbutic substance was produced, or that the barley grain itself possessed an unusually high amount of potential antiscorbutic material.

Valentin Fürst³ called attention to the fact that while plain barley, oats, peas, etc., have none or not sufficient antiscorbutic powers to prevent the development of scurvy in guinea-pigs, the very same barley, oats, peas, etc., when brought to germination by being kept in a moist warm room for about three days, develop marked and adequate antiscorbutic properties, as tested out on guinea-pigs, and recently in the Chemical Abstracts (April 10, 1919) H. S. Paine⁴ reports that E. Weill, G. Mouriquard and Mlle. Peronnet have found that cereal grains of ten days germination age have a greater antiscorbutic value than those of three days old.

If this is the true explanation of the presence of the antiscorbutic factor in the malt soup extract, then it should be possible to use in the manufacture of malt soup extract only malt that has been made from barley of the proper age and state of germination. This would be an addition to our present list of antiscorbutics of another agent of real value as malt soup extract can be used to advantage in other respects in the diets of infants and young children, especially of those that are inclined to be constipated.

The difference in therapeutic results between infants, on the one hand, and guinea-pigs, on the other hand, is undoubtedly due to the decidedly larger antiscorbutic requirements of the guinea-pigs.⁵ From the work of Chick, Hume, Skelton⁶ we know that a guinea-pig of about 250 gm. weight requires from 80 to 100 c.c. of raw milk daily to prevent the development of scurvy or, at least, to postpone its appearance for a long time, and according to Hess⁷ the infant requires about 500 c.c. of raw milk in twenty-four hours. Such infants will weigh on an average at least 5,000 gm.; in other words, twenty times as much as a guinea-pig, and yet infants require only five times as much milk as do guinea-pigs to protect them against the development of scurvy.

3. Fürst, Valentin: Weitere Beiträge zur Aetiologie des experimentellen Skorbutus des Meerschweinchens, *Ztschr. Hyg. u. Infekt. Krankh.* **72**:132, 1912.

4. Paine, H. S.: Chemical Abstracts **13**:749 (April 10) 1919. Appearance of an Antiscorbutic Substance During Germination of Cereals. E. Weill, G. Mouriquard, and Mlle. Peronnet, *Compt. rend. soc. biol.* **81**:607, 1918.

5. Chick, H., Hume, H., and Skelton, R.: Antiscorbutic Principles in Limes and Lemons, *Lancet* **2**:735 (Nov. 30) 1918.

6. Chick, H., Hume, H., and Skelton, R.: Antiscorbutic Value of Milk in Infant Feeding, *Lancet* **1**:1 (Jan. 5) 1918.

7. Hess, A. F., and Unger, L. J.: Factors Affecting the Antiscorbutic Value of Foods, *Am J. Dis Child.* **17**:239 (April) 1919.

This experience with the guinea-pigs and infants fed with the same Keller's soup would indicate that the antiscorbutic content of the malt soup extract was relatively not as great as that of orange juice or tomato juice, although it was evidently sufficient to cure severe acute cases of scurvy in infants, and it may well be possible that a malt soup extract could be manufactured whose antiscorbutic powers would be distinctly greater than those present in the lots used for this work.⁸

CONCLUSIONS

1. A report is made of a rapid and marked cure, such as is experienced with orange juice, of three cases of severe infantile scurvy by the administration of 100 gm. of malt soup extract. In two of these the malt soup extract was given in the form of Keller's soup, in the third, in conjunction with S. M. A.

2. The explanation offered for the presence of the antiscorbutic property in this No. 8,149 lot of malt soup extract is that it was, in all

8. Since this article was submitted, the remainder of lot 8,149 was given to three infants, two of whom had clear-cut cases of scurvy, while the other never got beyond what at most could be called a subacute form. The data obtained were inconclusive and consequently are of no value. In the last mentioned child, seen during September, 1919, an otitis media, a pyelitis and a probable enteritis follicularis were responsible for the poor condition and the lack of improvement. The malt soup extract was given mainly together with S. M. A., but for five days it received it in the form of Keller's soup made with certified milk which came from the same farm that produced the milk used in the feedings for the cured cases presented in the article.

The first child had a clear-cut scurvy and came to the hospital during a severe hot spell in July, 1919, suffering in addition from a severe dyspepsia. The vomiting greatly limited the amount of malt soup extract retained and as signs of dehydration appeared the observation had to be stopped and the diet replaced by large doses of orange juice, barley water ad libitum and saline infusions with beneficial results.

The other child, 7 months old and weighing 7,000 gm., was seen in November, 1919, ill with a definite scurvy. It received the very last part of lot 8,149, which was just enough for four days. No definite improvement was registered at the end of this time. It was then given for four days 100 gm. of lot 9,322, neutralized with potassium carbonate, which had recently been made at the factory. This also was without beneficial result and so for the next five days 100 gm. of lot 9,322, to which, however, no potassium carbonate had been added at the factory, were administered, but again no betterment was observed. Thirty c.c. of orange juice were given four times per day and this brought good results. The symptoms, however, did not disappear as completely and as quickly as usual. It is possible that this child required an especially large amount of antiscorbutic to remain well, as the mother, who is intelligent and who seems dependable, states emphatically that the child got 1 teaspoonful of orange juice daily from his third month on and "did not need any more, because his bowels were all right." This child was fed since its second month on a simple dilution mixture at one of the local infant welfare stations.

probability, made from barley of the proper age and state of germination or from a lot of barley possessing an unusually high amount of potential antiscorbutic material.

3. The suggestion is made that all malt soup extract could be manufactured from barley of an age and state of germination that would insure its large and adequate content of the antiscorbutic factor, and that in this manner another antiscorbutic, of value also in other respects to infants and children, could be added to the list of our regular and dependable antiscorbutics.