SOLUBLE SOLIDS IN CITRUS FRUITS

SUTHERST[1] and Haas and Klotz[2] have shown that a physiological gradient exists in mature citrus fruits. Haas and Klotz found that the osmotic pressure of the juice from the pulp of the stylar-end third of Valencia fruits in late summer was approximately 18.34 atm while that from the stem-end third was only 13.49 atm. In making a study of an abnormal physiological condition in Valencia fruits, many thousands of fruits have been cut and observed. In many instances, and especially during the summer of 1937, after the low temperatures of the preceding winter, fruit segments were found to be frozen at the stylar end and not at the stem end. The high osmotic pressure in the stylar end of the fruits would naturally indicate that any freeze injury which might occur should be found in the stem end rather than in the stylar end of the fruit.

Between January 5 and March 21 the soluble solids content of the juice in the stem and stylar halves of each locular segment in 50 Valencia and 15 navel oranges and in 9 grapefruits was determined separately—1,542 determinations. The determinations were made with an Abbé refractometer.

Of the 268 segments from Valencia fruits picked between January 5 and February 16, twenty-two per cent. had a lower soluble solids content in the stylar end than in the stem-end half. The remainder of the tests on Valencia segments (248) were made between March 11 and March 21 when the fruits had become more mature. During this period only one segment was found that had a lower soluble-solids content in the stylar than in the stem half.

Most of the low temperatures in California come in the months of December and January. The results just mentioned explain why freeze injury may occur in the stylar end of a Valencia segment and not in the stem end. They indicate that the soluble solids polarity, so far as the stem and stylar ends of the Valencia fruit are concerned, does not become noticeably evident until the fruit has nearly or actually reached maturity.

In making a study of the results of the soluble-solids tests, another interesting and unexpected evidence of polarity in citrus fruits was discovered. Thirty-nine of the 44 Valencia fruits picked from the twigs on the *outside* of the trees had a higher soluble-solids content in the three north segments than in the three south segments of the same fruit. This condition prevailed in the stem half as well as in the stylar half of the segments and was equally true for fruits borne on the north, east, south or west side of the trees. The differences were not great but apparently significant. The amounts of soluble solids in the fruit having the greatest difference were 12.17 per cent. in the three south segments and 13.27 per cent. in the three north segments. Similar figures for the one showing the least difference were 11.56 per cent. and 11.62 per cent., respectively. These figures represent an actual difference in amount of materials of 8 per cent. in the former and 1 per cent. in the latter, or an average of 3.4 per cent. One of the 44 fruits had equal amounts of soluble solids in the three north and in the three south segments, while in four of them the soluble-solids content of the three south segments was slightly greater than that of the three north segments. The results of tests on other Valencia fruits, based on dry weight rather than on per cent. of soluble solids, gave results similar to those already recorded in this paragraph, except that the differences were slightly higher.

The remaining six of the 50 Valencia fruits tested for soluble solids were taken from the *inside* of the trees, near the trunk. The soluble-solids content of four of these was greatest for the three south segments and only two had the highest content in the three north segments. It was of interest to find that there was a difference, one way or the other, in all but one of the 50 Valencia fruits tested.

The navel oranges and grapefruits, picked between January 10 and February 28, showed a north-south polarity of soluble solids similar to that in the Valencias. The average difference was more pronounced in the navel (6 per cent.) than in either the Valencia (3.4 per cent.), or the grapefruit (4 per cent.).

A more complete report of these and further results will be published elsewhere in the near future.

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[1] Sutherst, *California Cultivator*, 36: 612, 1911.
[2] Haas and Klotz, *Hilgardia*, 9: 181–217, 1935.

A RELATION BETWEEN THE ELECTRONIC RADIUS AND THE COMPTON WAVE-LENGTH OF THE PROTON

THE classical radius of the electron ($a = e^2/(mc^2)$) and the Compton wave-length of the proton ($b = h/(m_p c)$) seem to be in the simple ratio of 3 to $\sqrt{2}$. We have by definition

$$\frac{a}{b} = \frac{m_p/m}{2\pi\alpha}$$

where $\alpha (= (hc)/(2\pi e^2))$ is the reciprocal of Sommerfeld's fine-structure constant. If, in accordance with Birge,[1] we insert the values $m_p/m = 1835$, and $\alpha = 137.06$, we find as an empirical value $a/b = 2.13$, whereas $3/\sqrt{2}$ is 2.1213. The divergence seems to be within the limits of observational error.

[1] R. T. Birge, *Phys. Rev.*, 49: 203, 1936.

The relation $a/b = 3/\sqrt{2}$ may perhaps be derived by starting with a result of Sitte and Glaser. These authors[2] derived the following relation:

$$h/(Z\, m_p c) = R/(Z'\, \sqrt{Z'})$$

where Z' is the total number of particles in the universe, Z the total number of "heavy" particles (whose mass is large in comparison with the mass of the electron), and R the equilibrium radius of the universe. If we distinguish between protons and neutrons (a distinction not made by Sitte and Glaser), we must put

$$Z' = 2P + N,\ Z = P + N$$

where P is the total number of protons or electrons, and N the total number of neutrons, respectively.

We thus find

$$\frac{h}{(P+N)\, m_p c} = \frac{R}{(2P+N)\, \sqrt{P+N}}$$

or

$$b = R\, \sqrt{P+N}/(2P+N).$$

Now, according to Eddington[3] and the author[4]

$$R^2 = P\, a^2,$$

or the surface of a sphere which would include the total equilibrium volume of the universe, is equal to the sum of the spheres of action of all electrons. Hence

$$a/b = (2P+N)\, /\sqrt{(P+N)P}.$$

If we make the very simple assumption that in the state of equilibrium the number of protons equals the number of neutrons, we thus actually find

$$a/b = 3/\sqrt{2}.$$

The occurrence of the integers three and two in this formula finds its explanation in the fact that we distinguish three essential types of primordial particles, two of which are "heavy."

Conversely, we may conclude from the observational value of the ratio between the electronic radius and the Compton wave-length of the proton that in the equilibrium state of the universe one third of its primordial particles are protons, one third electrons and one third neutrons.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A GROWING YEAST MEDIUM FOR THE CULTIVATION OF AN HEMOPHILIC BACILLI AND OF AN ORGANISM CAUSING A BRONCHITIS IN CHICKENS[1]

THE writers obtained much better growth of *Hemophilus gallinarum* and *Hemophilus influenzae*[2] when cultivated with growing yeast[3] than could be obtained with the use of a chicken blood medium.

The growing yeast supplies all the growth requirements for both organisms, and they have been successfully cultivated for several months in such a blood-free medium (by weekly transfers).

The yeast and the hemophilic bacilli were cultivated on a medium of the following composition: Difco dehydrated nutrient agar, 23 grams; Difco phenol red maltose, 10 grams; salt, 8 grams; added to 1,000 cc of the broth in which 400 grams of raw potato had been cooked. The sterilized tubed medium was used in the form of slants, at the base of which a small amount of sodium chloride solution was used to prevent drying of the surface. The growing yeast on this medium results in a change of the pH from acid to alkaline in reaction within 24 hours at 37° C. incubation. The change in pH is possibly responsible for the success of the medium. Difco phenol red dextrose and sucrose have been substituted and used instead of the maltose, with similar results. A medium prepared by using plain agar, Bacto beef extract, maltose, phenol red and salt, in the same proportions as the medium already described, would indicate the change from acid to alkaline results from the reaction of the yeast on the beef extract, because, when Bacto peptone is substituted for the beef extract, the medium remains acid.

Since the growing yeast fulfilled the growth requirements of the hemophilic organisms better than blood, the question arose as to whether it would be of value in studying other respiratory diseases of poultry.

An infectious bronchitis of chickens of a clinically similar type[4] as that which our studies had indicated was of a filterable virus nature was studied in this respect.

Cultures were carefully obtained from the edematous fluids of the lungs of infected birds and used along with pure cultures of yeast to inoculate the medium. Previous investigations had indicated that the lungs were frequently free of bacteria as found by the use of chicken blood media.

Growth other than yeast was obtained from one chicken out of five in this manner. Stained preparations indicated two different types of organisms in

[2] K. Sitte and W. Glaser, *Zeitschr. f. Physik*, 88: 103, 1934.

[3] A. S. Eddington, *Proc. Roy. Soc. London* (A), 133: 605, 1931.

[1] Published by permission of the Director of Research as Contribution No. 527 of the Rhode Island Agricultural Experiment Station.

[2] Cultures obtained through the courtesy of Dr. John H. Dingle, Harvard Medical School.

[3] Pure yeast obtained from Fleischmann's Stock and Poultry Yeast.

[4] A. Haas, *Anz. Akad. Wiss. Vienna*, 67: 161, 1930 and 69: 91, 1932.

[4] J. P. Delaplane, L. E. Erwin and H. O. Stuart, *Jour. Agr. Res.*, 52: 5, 382, 1936.