Prior to the introduction of the Rainbow medium multiple indicators had not been used in solid media. The advantage of solid medium is that the reaction at any part of the tube may be approximately determined. Bronfenbrenner had previously advocated a mixture of China-blue and Rosolic acid for liquid media.

The middle of the *Rainbow* scale (yellow-green) indicates approximately neutrality. Violet is strong alkali, and red strong acid. It will be noticed among other things that sulphide formation takes place in only alkaline or neutral conditions.

There would seem a possibility that some modification of this medium might be of value to the phyto-physiologist and pathologist.

251 (2774)

The identity of the pigments in the purple bacteria.

By L. B. BECKING.

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There exist certain groups of bacteria which possess a peculiar purple color. This color ranges from a pale bluish pink to a deep crimson, almost like Ruthenium red. The bacteria concerned may be grouped according to their physiological behavior into four distinct classes:

Name	Chief authors	Phys. characters	React. medium	Relation to oxygen	Relation to light.
I. Purple sulphur bacteria. Thiorhodic.	Winogradsky	Autotrophic	Basic	Oligo-oxyphilous	Needed
II. Molisch bacteria. Athiorhodic.	Molisch Buder (2)	Heterotrophic. Great carbohydrate consumer	Acid	Oligo-oxyphilous	Needed
III. Brine bacteria.	Peirce	Heterotrophic. Do without sugar	Neutral	Oligo-oxyphilous	Not needed, but not harmful, even in high intensities
IV. "Algal" symbiont of Chiodecton.	Uphof	Autotrophic (?)	Acid (?)	(?)	(?)

The morphological variation is also very great.

The almost algal Chromatium, the pediococcoid Thiopedia, Spirillæ, Bacillæ, and Cocci all possess the pigment purple color. There is therefore no *a priori* evidence for the identity of the pigments.

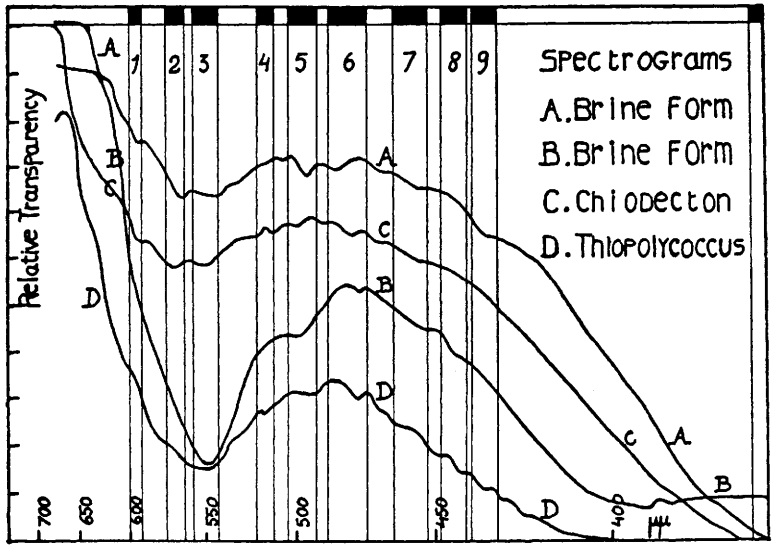
Classes I and II, the true Rhodobacteria, seem to have identical pigments (Molisch). One of them is red, probably a carotinoid, bacterio-erythrin, the other is green, soluble in absolute alcohol and is called bacteriochlorin*. The combination of both pigments is called bacteriopurpurin. Bacteriochlorin has a marked narrow absorption-band with an axis near the sodium lines D.

Bacterio-erythrin is characterized by two distinct absorption bands in the green and bluegreen.

An absolute alcohol extract of Thiopolycoccus yielded a green solution with a bluish green fluorescence. The fluorescence spectrum of this solution will be discussed elsewhere.

The spectra of the following forms were studied.

a. Thiopolycoccus, from a brackish, arsenic-containing, black mud from Owen's lake, California (collected spring 1924 by Dr. F. M. Scott), raspberry color.



*The name bacterioverdin must be reserved for the pigment of the green bacteria. See Buder.[1]

The name bacteriorhodin could be used for another red bacterial pigment, such as prodigiosin.

b. A coccoid brine-form from a saturated brine. Owen's lake (collected autumn 1924 by Dr. R. E. Swain), strawberry color.

c. A short bacillus, isolated from a red brine in a Redwood City saltern by Miss D. Burgess (peptone-brine agar), bluish pink.

d. The Florida lichen Chiodecton (kindly furnished by Dr. J. C. Th. Uphof, Orlando, Florida), vermilion color.

The foregoing forms were studied with the aid of a micro-spectral ocular of Engelmann, combined with a rotating mirror funnel camera with attached slit and movable plate-holder. This arrangement (which will be described elsewhere) enabled us to photograph the spectra of minute organisms ($5 \times 15\mu$). By the construction of two regulable slits in the ocular (one for the comparison spectrum, the other for the absorption spectrum) we were enabled, with the aid of a Leitz monochromator, to perform visual spectrophotometric observations. This last method was used as a preliminary orientation with the following forms:

a. A freshwater Lamprocystis, collected by Dr. A. G. Vestal.

b. Amœbobacter, collected in San Francisquito Creek. The brine forms were also studied with this method. The photo-spectrogram showed three bands: (1) 600-583, (2) 560-540, (3) 510-490 $\mu\mu$. Band[1] is very faint in the brine forms. The violet absorption as recorded by various authors could not be found; the extreme violet, up to less than 400 $\mu\mu$ remained clear.

Photospectrograms (Eastman Panchromatic film), with varying slit width, (illuminant Leitz mignon lamp) revealed the presence of another band with a maximum intensity near 460 $\mu\mu$. This is probobly the band described by Buder,[2] on *Rhodobacillus palustris.*

Through the kindness of Dr. P. A. Ross, of the department of Physics, Stanford University, the author was enabled to measure the opacity of the negatives with the aid of an improved Boys' radiomicrometer.

The illuminant was an electric bulb, in series with seven tungsten filament lamps, and ran on a 104 volt battery current. The light remained constant throughout the observations as determined by check readings. By varying the slit width the radiomicrometer mirror could be adjusted on the 100 mark of the scale division. The logarithm of the reciprocal of this number

[1] Buder, J., *Ber. deutsch. Bot. Ges.*, 1913, xxxi, 80.

[2] Buder, J., *Jahrb. Wiss. Bot.*, 1919, lviii, 525.

—2 had simply to be subtracted from any adjusted reading to obtain a direct measure for the opacity of the negative. The ordinates in the accompanying figure, therefore, represent the relative transparency of the negative. The measurements have no absolute value, inasmuch as several plate factors, such as spectral sensitivity, development, etc. are not taken into account.

The abscissæ are expressed in millimicra. Readings were taken at intervals of .7 millimeters, in other instances at intervals of .35 millimeters. Every curve represents from 150 to 200 measurements. Minima in the curves correspond to absorption maxima. On the steep slopes these minima are difficult to observe, even with the radiomicrometer. Not counting the extreme red and violet absorption, the radiomicrometer measurements show the presence of 9 bands, more or less coincident in the four forms. The following table records their chief peculiarities:

Band.	Range.	Maximum.	Remarks.
1	600-583$\mu\mu$	590$\mu\mu$	Bacteriochlorin. Absence in C due to spacing of measurements.
2	577-560	568	Very faint, invisible to naked eye.
3	558-541	548	Shifted in brine bacteria. Chief bacterioerythrin band.
4	518-511	515	Very faint, only recorded by radiomicrometer.
5	507-493	500	Strong band. Bacterioerythrin.
6	489-473	480	Position varies somewhat, visible on photogram.
7	463-452	459	Faint but unmistakable. Recorded by radiomicrometer. Seen by Buder(?)
8	448-444	446	No trace in Uphof's Chiodecton. Recorded by radiomicrometer only.
9	441-433	438	No trace in Uphof's Chiodecton. Recorded by radiomicrometer.
10	400-380	.....	Endabsorption varies considerably with thickness of layer.

Bands 1, 3, and 5 are visible to the naked eye and are recorded by the older authors. The results presented correspond closely to the visual observations of Molisch[3]. The energy curves are similar to those obtained by Engelmann[4] with the Vivrordt in-

[3] Molisch, H., *die Purpurbakterien.* Jena. 1907.

[4] Engelmann, T. W., *Bot. Ztg.*, 1888, xlvi, 661; Lankester, Ray, *Quart. J. of Micr. sc.*, 1876, xvi, 27; Peirce, G. J., *The Salton Sea,* Carnegie Inst. Publ., 1913, cxciii, 49; Uphof, J. C. Th., *Am. J. Bot.*, 1925, xii, 97; Vahle, C., *Centr. f. Bakt.*, 1910, xxv, 178; Warming, E., *Vidensk, Medd. fra. den Naturhist. Forennig i Kjöbenhavn* No. 20-28, 1875; Winogradsky, S., *Bot. Ztg.*, 1887, xlv, 493.

strument except for the wave-length calibration. Buder's results do not agree very well with ours. Satisfactory agreement with most of the older authors (A. Mayer, Engelmann, Warming, and Ray Lankester) has been obtained.

The evidence obtained tends to show a close relation between the pigments of four classes of purple bacteria.

252 (2775)

The influence of acidity in the intestine upon the absorption of calcium salts by the blood.

By LAURENCE IRVING and JOHN FERGUSON. (Introduced by E. G. Martin).

[*From the Laboratory of Physiology, Stanford University, Calif.*]

If calcium compounds are present in sufficient amounts in the diet, their solubility in the intestinal contents would be a limiting factor for absorption. Apparently calcium chloride and calcium lactate are quite easily absorbed. Salvesen[1] observed that calcium lactate could supply the entire calcium requirement of parathyroidectomized dogs even on a meat diet. Calcium lactate is quite soluble (about 10 per cent) compared with carbonates, phosphates, and most organic salts of calcium.

The solubility of organic calcium salts generally is favored by acidity. It has been suggested[2] that the acidity of the intestine is a factor in calcium absorption. Inouye[3] remarks that lactose feeding favors the maintenance of a sufficiently high blood calcium concentration to prevent tetany in parathyroidectomized dogs, and that this diet favors an acidophile flora. The diffusible calcium salts of milk are increased by acidification, as well as by tryptic digestion.[4]

In order to secure evidence on the absorption of calcium salts from the intestine these experiments were performed. Under

[1] Salvesen, *Acta Medica Scand.*, 1924, lx, suppl. 6, 5-159.

[2] Orr, Holt, Wilkins, Boone, *Am. J. Dis. Child.*, 1924, xxviii, 574-81.

[3] Inouye, *Am. J. Physiol.*, 1924, lxx, 524-37.

[4] György, *Biochem. Zeit.*, 1923, cxlii 1-10.