What mechanism may be producing the positive findings in the different cases, it is difficult to say. At any rate, various factors, such as the constriction of the pupil in the case of opium, vasomotor changes produced by antipyretics, specific effect upon the retinal ganglia and nerves and central cerebral effects must be all considered.

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The relation of growth and swelling of plants and biocolloids to temperature.

[*From the Desert Laboratory, Tucson, Arizona.*]

By **D. T. MacDougal.**

The varying constitution and resultant water-relations of the plants may be simulated by mixtures consisting of agar and albumen, or albuminous derivatives, or most successfully by proteins extracted from beans or oats.

The swelling of living and dried sections of plants and of dried plates of such biocolloids in various solutions has been found by the author to depend upon the history or previous treatment of the material, the proportions of protein or albuminous derivatives, and pentosans present, concentration of the solutions and the temperature.

According to Taylor heat should diminish imbibition in gels, while cold and pressure will increase it.[1] The velocity and swelling capacity of two biocolloids at temperatures within the range of growth of plants used for comparison are illustrated by the following auxographic measurements expressed in percentages of increase of the original diameter of sections of dried plates:

Swelling of Thin Plates of Agar, 90 Parts, Bean-protein 10 Parts and Nutrient Salts .8 Part.

Increase in thickness in percentages of the original.

Temp.	Duration of Swelling.			
	4 Hours.	8 Hours.	10–12 Hours.	20–22 Hours.
15–16° C.	888%	1,113%	....	1,325%
21–23° C.	1,388	1,550	....	1,900
30–31° C.	1,472	1,735	....	2,022
39° C.	2,486.1	2,736.0	(12 hours) 2,791	Complete
46–47° C.	2,153	2,347	(10 hours) 2,361	Complete
48–49° C.	2,361	2,514	Complete	....

[1] Taylor, "The Chemistry of Colloids," p. 155, 1916.

The sections swelled at temperatures of 15–23° C., were .20 mm., those at higher temperatures, .18 mm. in thickness.

Plates of agar, 90 parts and oat-protein, 10 parts, show the highest hydration capacity of any mixture tested, the measurements obtained being as follows:

Temp.	4 Hours.	8 Hours.	10–12 Hours.	20–28 Hours.
15–16° C., .18 mm.......	1,167%	1,459%	....	1,794%
22–23° C., .18 mm.......	1,388	1,550	....	1,900
30–31° C., .16 mm.......	2,172	2,763	....	3,078
38–39° C., .18 mm.......	2,541.6	2,861	(12 hours) 2,791%	Complete
46–47° C., .18 mm.......	2,555.5	2,833.1	(10 hours) 2,361%	Complete
48–49° C., .16 mm.......	1,906.3	2,031	Complete	....

The swelling of discs 10–12 mm. in thickness, cut from joints of *Opuntia*, in water and salt solutions in illustrated by the following measurements:

Percentage of increase and duration of swelling.

	Dist. Water.	Potass. Nitrate, .01 *M.*	Potass. Nitrate Citric Acid, .01 *M.*
18–20° C..........	11.8% (42 hrs.)	14% (42 hrs.)	8.8% (32 hrs.)
24–25° C..........	13.6% (40 hrs.)	14.4% (42 hrs.)	13.2% (42 hrs.)
44–45° C..........	7.6% (5 hrs.)	8.4% (7 hrs.)	4.9% (2.5 hrs.)

The swelling of the biocolloids is seen to increase in initial velocity and total amount to a maximum between 39° and 46° C. in the salted mixture, and to 46° C. in the unsalted plates. The sections of plants increase similarly to a point undetermined and the swelling may be much greater in preparations freed from mechanical tissues. These increases are parallel to accelerations and retardations of growth by living plants under the influence of temperature.

The hydration in question constitutes 97 per cent. or more of the volume increases known as growth and manifestly may not be regarded as the form of imbibition to which Chatelier's theorem may be applied simply as has been attempted by Taylor and others. The relation to swelling demonstrated in the above tables is one which finds a parallel in the action of agar-agar in my experiments. The high swelling coefficients displayed by the mixtures are probably associated with or due to the fact that the two main colloids are unequally distributed in the two phases of the system. True *adsorption* must as Zsigmondy has pointed out[1] play an important part but the reactions imply that *absorption* also takes place. The arrangement of the denser continuous phase of the gel in the form of a fine sponge or of a close mesh of plates or fibers would offer conditions in which both adsorption and absorption might occur. The parallelism of hydration in biocolloids with hydration and growth in plants with regard to temperature implies identity of structural arrangement and similarity of action. The end points, maxima or totals in the swelling of the biocolloids given above probably represent the point at which dispersion assumes a high rate, and available information is not sufficient to identify this with the upper temperature limit of growth.

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The chemical basis of morphological polarity in regeneration

By JACQUES LOEB.

[*From the Rockefeller Institute for Medical Research.*]

When a piece is cut out of the stem of a plant (*Bryophyllum calycinum*) the most apical buds will grow out into shoots, while roots develop chiefly but not exclusively at the basal end. The writer suggests the following explanation of this phenomenon of polarity. In the normal stem the growing region at the apex as well as the leaves send out special inhibitory substances toward the base of the plant which prevent the growth of the more basally situated dormant buds capable of giving rise to shoots. When a piece is cut out from the stem these inhibitory substances continue to flow in the piece toward the base and the most apical node will be the first one sufficiently free from these inhibitory substances and hence the two dormant buds situated at this node will grow out first. As soon as they grow out they produce and also send out inhibitory substances toward the base, thereby preventing the more basally situated buds from growing out into shoots.

A brief outline of the experiments supporting this hypothesis has been published in *Science*.[2]

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[1] Chemistry of Colloids, p. 59, 1917.

[2] Loeb, J., *Science*, 1917, xlvi, 547.