where ρ_0 is the average density of the medium. Now the equation for thermal diffusion can be written to a first approximation as

$$\rho_0 D \frac{\partial c_1}{\partial x} = \rho_0 D \alpha \frac{c_1 c_2}{T\ av.} \frac{\Delta T}{d} - \frac{\Delta c_1}{h} \int_0^x (\rho v)\, dx \qquad (4)$$

where ΔT is the temperature difference between the walls and $T\ av.$ is the average temperature of the enclosure. The substitution of (4) in (3) gives for the thermal case

$$\frac{\Delta c_1}{h} = \frac{-\frac{\alpha c_1 (1-c_1)}{\rho_0 D d^2} \frac{\Delta T}{T\ av.} \int_0^d \int_0^x \rho v\, dx.\ \ dx}{1 + \frac{1}{\rho_0^2 D^2 d} \int_0^d ([\int_0^x \rho v\, dx]^2)\, dx}$$

as the equation for the determination of the total change in concentration Δc_1, along the column.

This equation has a number of simple properties: (1) For any given distribution of ρv consistent with equation (2) the value of Δc_1 can be determined by quadratures. (2) The total change in concentration varies directly as the height h of the column. (3) The change in concentration Δc_1 for a column of fixed height h has a maximum value for a definite value of d, the width of the column. For the case where the mass motion is that of thermal convection, *i.e.*,

$$\rho v = \rho_0 v_0 \frac{x}{d} (x - d/_2)(d - x)$$

the position of the maximum computed in this way agrees to within 3 per cent. with Waldmann's value. (4) The last two results are well known. The new and interesting conclusions concern the changes produced in these results by varying the character of the vertical mass motion such as may be accomplished by the appropriate use of baffels or other suitable mechanical means.[3] For the same transport of fluid across one half of the transverse section of the apparatus, the maximum in the value of Δc_1 as a function of d, occurs for certain velocity distributions at a smaller value of d—besides that the maximum value of Δc_1 is greater—the closer the maximum values of the velocity occur to the boundary $x=0$ and $x=d$. (5) Similar results to those stated above in (1), (2) and (3) can be calculated for a centrifuge operating at a frequency f with an appropriate mass motion of the fluid circulating in the direction of the axis of rotation of length h. The type of gas motion seems to be rather critical as these calculations show that not all types of circulation in the direction of the axis lead to an appreciable increase in the separation factor. Some idea of the relative optimum operation of the thermal and centrifugal separator respectively can be gained by com-ing the relative values of the maximum of $\Delta c_1/h$ as a function of the width d. As the width d of the centrifuge is defined the effective radius. For these two distinct types of apparatus the ratio of the maximum of $\Delta c_1/h$ is as the ratio of the static effects. By static effect is meant the change in concentration arising from either thermal diffusion or centrifugal diffusion without any accumulative effect from the circulation in the fluid. It is interesting to note, however, that the calculations predict that for the centrifugal case the transport of fluid across one half of the transverse section of the apparatus, such as may be produced by thermal means in a centrifuge of proper pitch, should be nearly the same per unit area as that of the thermal separator with the circulation produced by thermal convection when both apparatuses are operating under optimum conditions, with the same values for the pressure of the gas and the width of the apparatus.

ewer and Bramley, *Jour. Chem. Phys.*, 7: 972, Oc- 1939; Bramley and Brewer, *Jour. Frank. Inst.*, 940 (Bartol Notes).

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THE STANDARDIZATION OF OSMOTIC PRESSURE AS A TERM

IN physical chemistry osmotic pressure has a long-established meaning: a physico-chemical property of a solution. Any definitions of osmotic pressure should not conflict with this. Confining ourselves to aqueous solutions we may say that osmotic pressure measures the difference of the fugacity of water between that in pure water and that in water acting as the solvent in a solution. This difference in fugacity is more or less proportional to the solute concentration, so that this difference, and hence the osmotic pressure, increases with increasing solute concentration. Osmosis is diffusion of water. Water diffuses from regions of high water fugacity (pure water) to regions with lower water fugacity (solution). Hydrostatic pressure is enhanced in turgid cells; an increase in hydrostatic pressure increases the fugacity of water, *e.g.*, vacuolar water. Since this pressure increases water fugacity the difference between the fugacity of water in the solution under pressure and that of free pure water is diminished and the effective or actual osmotic pressure is also diminished. Cells in water equilibrium have no residual actual or effective osmotic pressure, although the same fluid under no excess pressure would have the osmotic pressure given by its composition. This view obviates the desire for such terms as suction pressure. Suction pressure is the residual effective osmotic pressure when the cell contents are under pressure insufficient for equilibrium.

The definition proposed by Eyster[1] seems to consider that some quantity parallel to fugacity of water should be termed osmotic pressure. He says, "The osmotic

[1] H. C. Eyster, SCIENCE, 92: 171, 1940.

pressure of water in the vacuole of a plant cell is increased by turgor pressure and decreased by the solute concentartion of the cell sap." But physical chemistry, the underlying discipline, teaches that pressure (including turgor pressure) *decreases* the osmotic pressure of solutions, while increased concentration *increases* it.

It is to be hoped that botanists generally will recognize the perfectly clear relations furnished by physical chemistry.

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EQUINOXES AND SOLSTICES

ACCORDING to SCIENCE of September 13, 1940, any implication that the equinoxes and the solstices mark the beginnings and the ends of the seasons riles Professor Sleator, of the University of Michigan, up one side and down the other. He reminds one of the Iowa farmer who "cussed" for a month on receiving by express from a Scotchman a yearling sheep when he had ordered a fine hog. Of course the ruckus between these two honest men was all because to the one "hog" meant a grown-up pig, and to the other a grown-up lamb. So it is with the term "summer." As commonly used it means, even to the astronomer, the warmest season of the year, without, though, a definite time for either beginning or ending as defined by statute or set by common agreement. If, however, we so divide the year into four approximately equal periods that one shall be as much as possible the warmest of all, and call it summer, then throughout most of the northern hemisphere summer would roughly coincide with the three months which together there generally are called summer, namely, June, July and August. The like months in the southern hemisphere, are, of course, December, January and February.

But all this, though sufficient for our everyday needs, is lacking in precision. It does not have that satisfying exactness that pertains to each of the four quarters of the year proposed by astronomers more than two thousand years ago, that is, the periods delimited by the equinoctial and solstitial instants—the two times when the center of the sun is in the plane of the earth's equator and the two times when it is farthest therefrom. One of these periods, the one that runs from about the 22nd of June to the 23rd of September, astronomers call the summer quarter, or summer, for short. Here, as in so many other cases, the scientist just took a loosely used everyday word and changed it into a technical term by giving to it a meaning that is exact, however much or little it may differ from that of the original.

To say that summer begins at the moment of summer solstice and ends at the moment of autumnal equinox is to talk in the same breath astronomical good sense and agricultural nonsense. What, then, shall we do about it? Nothing. So long as it sounds newsy to say that summer began at such or such a particular hour and minute of a certain night, for instance, the papers will just keep on saying it that way. It is up to the reader, as we say, to recognize the fact that the summer in question is not the vaguely determined period in which the local vegetation flourishes, and therefore different for different regions, but that exact period which the astronomer has arbitrarily called summer.

When buying a hog, sight unseen, be certain what sort it is, sheep or pig. Similarly, when we read of summer beginning at a certain minute on the 22nd of June, we have only to remember that this is summer in the technical sense, as the astronomer defines it, and not summer as we personally experience it. Perhaps, though, the annual repetition of this confusion by the papers is not a bad thing, after all, for it does afford occasions for spreading a bit of interesting astronomical information at times when it is likely to be welcome.

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