they must be gases dissolved in the liquid, undissociated salt. Owing to the practically complete absence of salt ions in the vapor phase under ordinary conditions, it is improbable that the ions of a fused salt are to be considered as dissolved gases. We conclude, therefore, that a fused salt consists of liquid ions and an unknown amount of liquid undissociated salt. As liquids, the two ions and the undissociated salt singly must have solvent or precipitating action, and this action must be selective. With sodium nitrate, potassium nitrate and lithium nitrate, each salt lowers the freezing point of either of the others.

In aqueous solutions of two salts with a common ion, we have, theoretically at least, a decrease of solubility, on account of the precipitating action of the common ion and an increase in the solubility due to the mutual solvent action of the two salts. If one of the salts is sparingly soluble, the solvent action of the other will be negligible in low concentrations and the precipitating effect of the common ion will be practically the whole thing.

There is no evidence of a complex salt between sodium and potassium nitrate; but potassium nitrate is more soluble in a sodium nitrate solution than in pure water. This is probably due to solvent action by liquid sodium nitrate and its liquid ions, anhydrous or hydrated as the case may be. One can predict that, at high enough temperatures, all the isotherms for water and two salts with a common ion, forming no other solid phases than these two pure salts, will be concave to the water corner of the triangular diagram, instead of being convex, as most of them now are.

If a sparingly soluble salt behaves like a dissociating gas, the concentration of the undissociated portion in a saturated solution should be constant, irrespective of the addition of another salt with a common ion. Arrhenius[6] showed that addition of sodium monochloracetate to a saturated solution of silver monochloracetate forced the total solubility of the silver salt below the calculated concentration of the undissociated silver salt in water. Similar results were obtained with silver propionate and butyrate and the corresponding sodium salts. We do not yet know why this should be; but we know now that the belief that the concentration of the undissociated portion of the silver salt must remain constant was based on the false assumption that the solute must behave in all respects like a gas.

When solid benzene dissolves in liquid toluene at $-20°$, we do not postulate solvation. We merely say that benzene is soluble in toluene—as it is. When sodium nitrate dissolves in nearly pure nitric acid, sodium acetate in pure acetic acid or lead sulfate in pure sulfuric acid, we do not postulate solvation, though it may occur. We say that these substances are soluble in these liquids, just as we say that sodium chloride or sugar is soluble in water. If we start with a saturated solution of lead sulfate in water and add sulfuric acid continuously, there is at first a decrease in solubility owing to the presence of a common ion, and then an increase in solubility.[7] One should say that lead sulfate is soluble in sulfuric acid and is precipitated by water. There is a minimum solubility for lead chloride and hydrochloric acid, calcium sulfate and sulfuric acid, fluorides and hydrofluoric acid, and doubtless in many other cases.

Schukow[8] showed that potassium chloride and sodium chloride increase the solubility of sugar in water, but nobody knows whether this means that sodium and potassium chlorides are soluble in melted sugar.

The general results of this paper are:

(1) All liquid solutions are mixtures of liquids, regardless whether any or all of the pure components are solids, liquids, vapors or gases at the temperature of the experiment.

(2) The ions in a fused salt or in a solution are present as liquids and may exert a precipitating or solvent action.

(3) In low concentration a dissolved liquid or a suspended particle will behave in some respects like a gas. This postulate reconciles the conclusion of van't Hoff on true solutions and of Einstein on sols with the fact that true solutions are mixtures of liquids, showing in some cases the properties of liquids, and with the fact that the dispersed phase in a sol is rarely a gas.

(4) While it is customary and profitable in physical chemistry to treat the solute thermodynamically as a gas under certain circumstances, it is actually a liquid and is a gas only in a metaphysical sense. It is then not preposterous to say that the osmotic pressure may be that of a gas in a volume into which the liquid solute could not possibly be compressed.

(5) When dealing with the effect of one salt on the solubility of another salt, it is not safe to ignore the direct or indirect solvent or precipitating effect of the third ion or the undissociated salt on the solubility of the second salt.

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ON THE FORMATION OF LAKE BALLS

UNDER this heading in SCIENCE for August 30, A. G. Huntsman describes certain balls obtained by Dr. H.

[6] Arrhenius, *Z. physik. Chem.*, 31: 225, 1899.

[7] Ditz and Kanhäuser, *Z. anorg. allgem. Chem.*, 98: 128, 1916.

[8] Schukow, *Z. Vereins deutsch. Zucker-Industrie*, 50: 291, 1900.

S. Everett in 1919 from Little Kedron Lake, New Brunswick, and concludes that they were formed, not by building up around a central core, but by the breaking-up of a mat of the material and subsequent rounding-off by wave action. He adds: "As this method of the formation of lake balls seems not to have been hitherto recognized, it seems worth while to present the case for it." I do not question the accuracy of this last statement so far as the scientific literature is concerned, but Henry D. Thoreau appears to have reached the same conclusion in 1854. In the chapter of "Walden" entitled "The Ponds," writing of Flint's, or Sandy Pond in Lincoln, Massachusetts, he says:

> There also I have found, in considerable quantities, curious balls, composed apparently of fine grass or roots, of pipewort perhaps, from half an inch to four inches in diameter, and perfectly spherical. These wash back and forth in shallow water on a sandy bottom, and are sometimes cast on the shore. They are either solid grass or have a little sand in the middle. At first you would say that they were formed by the action of the waves like a pebble; yet the smallest are made of equally coarse materials, half an inch long, and they are produced only at one season of the year. Moreover, the waves, I suspect, do not so much construct as wear down a material which has already acquired consistency. They preserve their form when dry for an indefinite period.

The first entry in Thoreau's published journal relating to this subject is under date of October 3, 1852: "Collected a parcel of grass (?) balls, some washed up high and dry—part of the shore-line consists of the same material—from a half-inch to four inches in diameter." The place was Flint's Pond, and the finding of grass balls at the same pond is recorded in the journal on August 19, 1854 ("washed up apparently a month ago"), July 22, 1855 ("within a few days"), and July 24, 1856. The "season" referred to in "Walden," was therefore, evidently summer.

Another view of the formation of grass balls was taken by that close observer of the phenomena of the sea beach of Ipswich, Massachusetts, Dr. Charles W. Townsend, who says in his "Sand Dunes and Salt Marshes" (1913):

> As one walks along the edge of the dunes near the beach in summer or winter, his attention may be attracted by a number of balls which appear to be made up of broken pieces of straw or grass. Some of these are not larger than a tennis-ball, others the size of a cocoanut; some are perfectly spherical and firmly matted; others are loosely formed and often elongated in shape. . . . It is evident from a careful study of these balls *and by actually watching their formation* [the italics are the present writer's] that they are gradually built up in shallow water near the shore by the rolling action of the waves on particles of broken thatch [spartina], sticks, seaweed and grass which have collected in hollows and ripple-marks. A nucleus once started, more and more material is added as the ball rolls about.

I have examined Dr. Townsend's manuscript notes, presented by his son to the Boston Society of Natural History, with the hope of finding exactly what he meant by "actually watching their formation," but was disappointed, for these carefully classified note-sheets seem to contain nothing whatever on the subject of grass balls.

My excuse for making these two quotations from what may be called literary literature is that they are both the considered statements of careful observers, and that such records, published outside of strictly scientific journals and books, are too easily overlooked by specialists. My own experience with grass balls has been limited, but my (ornithological) journal for October 16, 1904, records the finding of two at Ipswich and the facts that they consisted of grass fragments crisscrossed every way "like a handful of jackstraws" and that they remained intact after being brought home in my pocket and subjected to rough usage.

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THE PHENOMENON OF MASKING

THOMPSON[1] has recently criticized the application of the term "masking" to the observed diminution of one sound in the presence of a second sound on the grounds that auditory "masking" is a peripheral phenomenon. The term "masking," he insists, has already been appropriated to describe the case in which the phenomenon is of central origin. However, as early as 1924 Wegel and Lane[2] made a thorough study of what they called auditory masking in an effort to obtain quantitative information regarding the phenomena reported by Mayer in 1876. Thus it happens that the term "masking" has sunk its roots too deeply into the literature on audition to permit convenient banishment. Furthermore, Wegel and Lane more than a decade ago pointed out that auditory masking must be both central and peripheral.

Independent of the problem of the priority of usage, there is the more important problem of convenience and utility. The living organism is so constituted that in any sensory modality the presence of a sufficiently strong stimulus obliterates the response to a simultaneous weaker stimulus. This universal phenomenon needs a name—preferably a word whose meaning in the English language is well established and readily understood. The word "masking" is obviously well

[1] I. M. Thompson, SCIENCE, 82: 221, 1935.
[2] R. L. Wegel and C. E. Lane, *Phys. Rev.*, 23: 266, 1924.