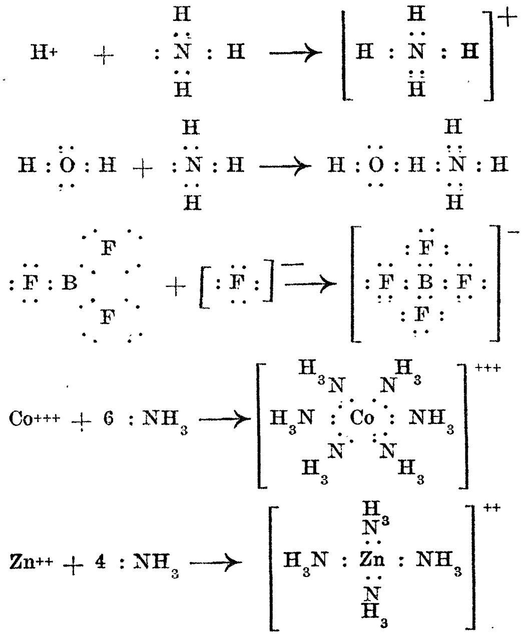
Hg (+80)(2x1)(8x3)(6x3)(8x2)(6x3)(2)
and (+80)(2x1)(8x3)(6x3)(8x3)(6x2)
Nt (+86)(2x1)(8x3)(6x3)(8x3)(6x3) or
(+86)(2x1)(8x3)(6x3)(8x2)(6x3)(4x2)

These and similar formulæ for the other elements express very satisfactorily their known chemical, physical and crystallographic properties. By applying this theory to crystal structures, it has been found possible to determine the arrangements of electrons in nearly all crystals for which the arrangements of atomic centers were already known, and also the atomic and electronic structures *in many cases in which even the atomic marshalling was previously unknown.* These structures furnish incontrovertible proof that this theory of atomic structure, fundamentally and in many of its details, is correct.

An important part of the theory is the idea that a single bond may be formed not only by the attraction between two atoms, each of which contains an unpaired electron in its valence shell, the two single electrons forming a pair, but also by the attraction of an atom containing a "lone electronpair"—one not acting as a bond—for another capable of holding on to this lone pair. The following are typical reactions of this type:



$$\mathrm{H^+} + :\underset{\mathrm{H}}{\underset{\cdot\cdot}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{N}}}}}:\mathrm{H} \longrightarrow \left[\mathrm{H}:\underset{\mathrm{H}}{\underset{\cdot\cdot}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{N}}}}}:\mathrm{H}\right]^{+}$$

$$\mathrm{H}:\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{O}}}:\mathrm{H} + :\underset{\mathrm{H}}{\underset{\cdot\cdot}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{N}}}}}:\mathrm{H} \longrightarrow \mathrm{H}:\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{O}}}:\mathrm{H}:\underset{\mathrm{H}}{\underset{\cdot\cdot}{\overset{\mathrm{H}}{\overset{\cdot\cdot}{\mathrm{N}}}}}:\mathrm{H}$$

$$:\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{F}}}:\mathrm{B}\begin{matrix}\mathrm{F}\\ \\ \mathrm{F}\end{matrix} + \left[:\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{F}}}:\right]^{-} \longrightarrow \left[\begin{matrix} & :\overset{\cdot\cdot}{\mathrm{F}}: & \\ :\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{F}}}: & \underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{B}}} & :\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{F}}}: \\ & :\underset{\cdot\cdot}{\mathrm{F}}: & \end{matrix}\right]^{-}$$

$$\mathrm{Co^{+++}} + 6\ :\mathrm{NH_3} \longrightarrow \left[\begin{matrix} \mathrm{H_3N} & & \mathrm{NH_3} \\ \mathrm{H_3N} & :\mathrm{Co}: & \mathrm{NH_3} \\ \mathrm{H_3N} & & \mathrm{NH_3} \end{matrix}\right]^{+++}$$

$$\mathrm{Zn^{++}} + 4\ :\mathrm{NH_3} \longrightarrow \left[\begin{matrix} & \mathrm{H_3} & \\ & \mathrm{N} & \\ \mathrm{H_3N} & :\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{Zn}}}: & \mathrm{NH_3} \\ & \mathrm{N} & \\ & \mathrm{H_3} & \end{matrix}\right]^{++}$$

In the last two cases the lone pairs of the nitrogen atoms become bond pairs, assuming positions at octahedron corners opposite the six faces of the distorted cube of the cobalt kernel and at tetrahedron corners opposite the four previously unoccupied faces of the zinc kernel octahedron (or, what is the same thing, opposite the four faces of the zinc kernel tetrahedron). We thus have an entirely satisfactory picture of Werner's "auxiliary valencies" and "coordination numbers." In some cases (*e. g.*, in $\mathrm{Ag(NH_3)_2^+}$) all the faces of the kernel polyhedron are not occupied. (In the silver iodide crystal, each silver kernel is surrounded by four electronpairs at tetrahedron corners, showing its true coordination number to be *four.*)

This theory has not yet been applied to the explanation of spectra; nor is it possible to give the *exact* positions of the electrons in each atom. These positions may in fact be merely the centers or foci of electronic orbits. In these and other respects the theory is still incomplete.

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A SIMPLE BUBBLING HYDROGEN ELECTRODE

THE electrode described in this paper is the result of an attempt by the writer to combine the principles of the bubbling type of electrode with simplicity of construction and the necessity for only a small amount of solution. That this has been accomplished, seems to be apparent from a study of the accompanying diagram and the behavior of the electrode in numerous tests.

Four models similar to the one shown in the diagram were constructed by the writer and compared with each other and a Bailey electrode. Various standard buffer solutions were tested and it was found that all electrodes gave results that agreed within .3 of a millivolt, which was the limit of accuracy of the galvanometer in the set up.

While the models constructed by the writer require only about 1.5 c.c. of solution, there seems to be no good reason why, with proper precautions, they can not be constructed for smaller amounts of solution. This can be accomplished, not by a smaller model of the same shape, but by making the bottom of the electrode vessel more conical in shape and taking particular precautions in sealing the electrode as near the base of the vessel as is conveniently possible. It is not desirable to materially decrease the diameter of the upper portion of the electrode vessel, because in so doing, the bubbling process is seriously interfered with.

CONSTRUCTION AND OPERATION

The electrode vessel *E* was made by sealing a short piece of glass tubing to an ordinary three inch soda-lime tube. The glass tube was then bent into position to make the side arm, *A*. The electrode proper, which consists of a piece of platinum foil, was sealed as near the base of the main vessel as possible. The protruding end of the foil was bent into a loop and partially embedded in sealing wax to give added mechanical strength. The rubber stopper, *D*, is used to prevent the rapid diffusion of air into the electrode vessel. The support, *S*, shown in the diagram by means of dotted lines, was made from a No. 12, two-holed rubber stopper by cutting out the portion between the holes.

After platinization of the electrode, about 1.5 c.c. of the solution to be tested are put into the electrode vessel, *E*. Purified hydrogen is bubbled through the solution by way of the side arm, *A*. Usually, about three minutes of bubbling are required for saturation.

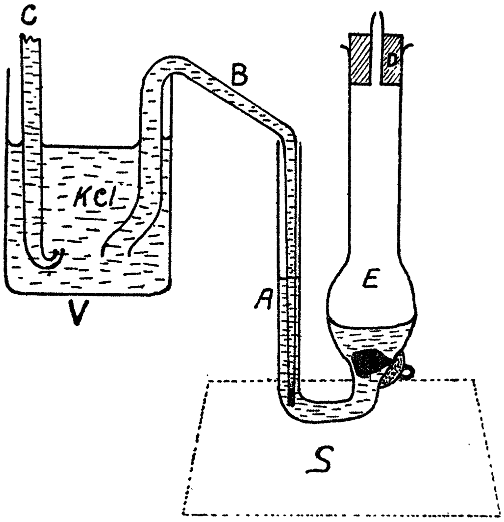

FIG. 1

The diagram shows the electrode in position for a measurement. *C* represents the side arm of the calomel electrode, *V*, a vessel containing a saturated KCl solution, and *B*, a tube filled with saturated KCl and plugged at the smaller end with filter paper to prevent the too rapid siphoning of KCl from *V*.

When properly constructed, this electrode possesses the following features, which should make it applicable for quite general use:

1. Simplicity of construction.
2. Ease of operation.
3. Requires only a very small amount of solution for a determination.

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THE OKLAHOMA ACADEMY OF SCIENCE

THE tenth annual meeting was held in Oklahoma City, on February 10, and at the University of Oklahoma, Norman, on February 11, 1922. The following papers were read:

FEBRUARY 10

Presidential address: *The possibility of the redemption of the Great Plains from its semi-arid condition*: J. B. THOBURN.

Some notes on the Bois Fort Chippewa of Minnesota: ALBERT B. REAGAN.

Identification of Anthoceros in the Oklahoma cryptogamic flora: M. M. WICKHAM.

Notes on the migration of Macrochelys lacertine: M. M. WICKHAM.

Further notes on migration of Terrapene carolina in Oklahoma: M. M. WICKHAM.

Identification of fresh water sponges in the Oklahoma fauna: M. M. WICKHAM.

Red and white blood corpuscles and catalase in the blood of non-complement guinea pigs: L. B. NICE, A. J. NEILL and H. D. MOORE.

The regular tetrahedron in relation to its cube and other solids: OSCAR INGOLD.

Oklahoma geography in the high schools: C. J. BOLLINGER.

The poisonous substance in cotton seed: PAUL MENAUL.

The chemistry of the pecan: W. G. FRIEDEMANN.