regard this event as initiating the next transformation. The captured electron, considered as a projectile entering the nucleus with a definite energy, can transfer this energy, together with the energy difference between that of RaE^+ and RaF^+, to *two* electrons within the nucleus, both of which might thus be emitted with different energies subject only to the condition that the sum of these energies is constant. These are obviously conditions for a continuous β-ray spectrum with a maximum intensity corresponding to the most probable velocity of emergence. The subsequent return of an electron to the shell from which it had been captured would give rise to some x-ray characteristic of RaF. The question whether or not the captured electron is one of the two emitted is probably meaningless.

The idea that a β-ray disintegration may be initiated by the instability of an extra-nuclear electron is not new, since it was proposed by H. T. Wolff as early as 1915.[1] This seems to be the first case in which such an extra-nuclear electron is needed for other reasons. It will be noticed that we must assume so much independence of the intranuclear and extra-nuclear systems as may be necessary to provide a certain degree of randomness in the impacts of captured electrons. On these views the number of β-rays emitted in the process should be twice the number of RaE atoms disintegrating.

This note is based upon a discussion with Professor A. H. Compton, who suggested, in particular, that the initial event in the proposed two-electron emission should be the capture of a third electron by the nucleus of RaE.

L. W. McKeehan
Sloane Physics Laboratory,
Yale University,
November 16, 1931.

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[1] H. T. Wolff, Phys. Zeits. **16**, 416–419 (1915).

Distribution of Mobilities of Ions in Air

In the last issue of the Physical Review [**38**, 1716 (1931)] Loeb and Bradbury in discussing a paper of mine [Phys. Rev. **34**, 310 (1929)], in which I showed that aged ions in moist air have mobilities spread over a considerable range of values, make the following statement: "In this investigation most sources of error have been critically analyzed with the possible exception of the action of the moving air stream in aspirating more ions (and perhaps a larger spatial extent of ionization) into his chamber than is evident from the measurements". I should like to show that this hypothesized source of error was not present in my experiments. It should be recalled that in these experiments a *slow*, non-turbulent system of air was made to flow axially in the space between two concentric cylinders and that a relatively small amount of air, partially ionized in an auxiliary chamber, was gently forced into the main air stream through 102 small holes along a circumference of the outer of the two cylinders. The rate at which this ionized air entered the apparatus was controlled by water flowing under a constant pressure head into a gasometer and after a steady state of flow was reached this rate could not be affected by an aspiratory action of the main air stream. Moreover, this rate, which entered the calculations as a small quantity, was actually measured during the progress of each set of observations while the main air stream was flowing continuously. Incidentally the rate was found to be the same whether the main air stream was flowing or not. It should be noted, too, that the behavior of the jets of air as they entered the apparatus was carefully studied in a duplicate apparatus made partly of glass. The jets were made visible by an admixture of smoke and showed no widening such as is mentioned in the above quotation as having possibly been present.

John Zeleny
Sloane Physics Laboratory,
Yale University,
November 20, 1931.

The Deepest Term in the Au II Spectrum

The first spark spectrum of gold was analyzed by McLennan and McLay (Trans. Roy. Soc. Can. **22**, 103 (1928)) who did not locate the lowest term, $d^{10}\ {}^1S_0$, because of lack of range of the fluorite spectrograph used in their investigation. In the course of an investigation in this laboratory of the excitation of the gold spectrum in an atmosphere of helium, the spectrum of a gold hollow cathode discharge in helium has been photographed with a 1 meter vacuum spectrograph. Only three combinations between $d^{10}\ ^1S_0$ and known terms are possible, *viz.*, combinations with $^3P_1^0$, $^3D_1^0$, and $^1P_1^0$ of the d^9p configuration. Only three lines with the expected frequency differences appear in the region and thus locate $^1S_0$ with certainty. The lines are:

Int.	λ	ν	Classification
4	1362.44	73398	$^1S_0-d^9p\ ^3P_1^0$
7	1224.65	81655	$^1S_0-d^9p\ ^1P_1^0$
5	1166.81	85704	$^1S_0-d^9p\ ^3D_1^0$

The wave-lengths are believed good to somewhat better than one-tenth of an Angstrom and the separations somewhat better. The frequency differences agree with McLennan's analysis to within 2 frequency units. The value of $^1S_0$ based on McLennan's term values is -15036.

This value of the low level is further confirmed from a study of the spectrum of the low voltage arc in helium and gold vapor. In this excitation lines from the two levels $d^97S\ ^3D_1$ and $^1D_2$, which are respectively 24.11 and 24.15 volts above the normal state of the gold atom and thus nearly in resonance with the He ion (24.47 volts), are very strongly excited.

R. A. Sawyer
Kenneth Thomson

University of Michigan,
November 25, 1931.

A Band Spectrum due to the Molecule N_2O_3

During a study of the absorption of light by N_2O (Abstract No. 19 Chicago Meeting of the American Physical Society, Nov. 27–28, 1931), the authors were lead to an investigation of mixtures of NO and NO_2, and have observed, in the near ultraviolet, an absorption spectrum consisting of apparently diffuse bands, due in all probability to the molecule N_2O_3. The bands are observed in relatively large amounts of NO when small amounts of NO_2 are added, the new bands predominating over the absorption of NO_2 under these conditions. Their centers are located approximately at wave-lengths 3843, 3682, 3539, 3509, 3417, 3386, 3305, 3279. The bands do not appear to possess sharp edges nor to show any pronounced tendency to degrade one way or the other. The first member is exceptionally diffuse. The third member appears most intense. The bands grow weaker as they proceed to shorter wave-lengths suggesting that there may be further weaker members among the NO_2 absorption. The new bands show qualitatively the dependence to be expected upon the pressures of NO and NO_2, and upon the temperature, decreasing noticeably with increasing temperature. A more detailed description of this spectrum will be published later.

Eugene H. Melvin
Oliver R. Wulf

U. S. Bureau of Chemistry and Soils,
November 23, 1931.

A. Effect of Crystal Symmetry on the Energy Levels of Solids.
B. Experimental Evidence of Definite Orientation of Coordinated Water Molecules About Rare Earth Ions in Solution

Because of its interest to physicists, who perhaps would not see the complete paper in a chemical journal, we think that it is desirable to publish a brief summary of an article which we shall submit soon to the Journal of the American Chemical Society.

A. Photographs were taken of the absorption spectra of the Gd^{+++} ion in monoclinic crystals of $GdCl_3\cdot 6H_2O$, $GdBr_3\cdot 6H_2O$, $Gd_2(SO_4)_3\cdot 8H_2O$; in hexagonal crystals of $Gd(BrO_3)_3\cdot 9H_2O$, $Gd(C_2H_5SO_4)_3\cdot 9H_2O$, and in a triclinic crystal, $Gd(NO_3)_3\cdot 6H_2O$. Gadolinium IV was chosen because it is by far the most desirable ion for this type of work. It gives sharp lines at room temperature, it has the simplest spectrum of any of the rare earths, its lines and multiplets being well separated from one another, and its basic level, $^8S_{7/2}$, is known to be single. Its chief disadvantage is that its absorption lines occur in the ultraviolet.[1]

In all cases the same multiplets were observed at approximately the same frequencies, although a slight shift of the multiplets toward shorter wave-lengths was noticeable in the case of crystals of higher symmetry. The lines within the multiplets were, however, greatly affected by changes in the crystal system.

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[1] Freed and Spedding, Nature **123**, 525 (1929); Phys. Rev. **34**, 945 (1929); ibid. **38**, 670 (1931); Spedding, Phys. Rev, **37**, 777 (1931).