

# ABSTRACTS OF THE PHYSICO-CHEMICAL LITERATURE IN JAPAN

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## 1—GENERAL AND PHYSICAL CHEMISTRY

**Chemical studies in the electrodeless ring discharge. The discharge in water vapour.** I. N. Sasaki and E. Ôhara. *J. Chem. Soc. Japan*, **60**, 1161—1169 (1939).—It has been obsd. by Rodebush and Wahl that a concd. aq. soln. of  $H_2O_2$  was obtained in the liquid air trap when water vapour ( $10^{-1}$  mm Hg) subjected to the electrodeless ring discharge was led through the trap. The results of the present research are as follows:—(1) In conformity with the above obsns. we obtained a  $H_2O_2$  soln. more than 50% strong in a liquid oxygen trap, but water only in a trap cooled with solid  $CO_2$  and alcohol. The products in the liquid oxygen trap were condensed in two zones, the upper of which consisted of undissocd. water amtg. to 17% of the water used, and the lower gave a 63%  $H_2O_2$  soln. (2) Discharge with vivid red appearance was necessary for the formation of concd.  $H_2O_2$  soln. (3) A small change in the total number and the density of turns of coil around the discharge tube and the exchange of positions of the spark gap and the condenser gave no effect upon the formation of  $H_2O_2$ . (4) The material of the trap—ordinary glass, "Terex" glass or copper—had an influence upon the formation of  $H_2O_2$ . (5) The length of the tube connecting the discharge tube and the trap reduced the total amt. of  $H_2O_2$  formed, but not the concn. (6) The evolution of oxygen gas from the product was obsd. when it was warmed to room temp.

II. E. Ôhara. *ibid.*, **60**, 1170—1172 (1939).—On warming the solid product formed

in the trap cooled at  $-183^\circ C$  by the electrodeless ring discharge through water vapour, a vivid evolution of oxygen took place and a concd.  $H_2O_2$  soln. remained. This evolution of oxygen began at about  $-115^\circ C$  and the ratio of its total amt. to the residual  $H_2O_2$  was found sensibly const. (120 cc/g  $H_2O_2$ ) as long as the condition of the formation remained the same.

III. *ibid.*, **61**, 17—24 (1940).—The discharge through water vapour with the electrodes inside the discharge tube gave similar results as in the electrodeless ring discharge:—(1) Conc. aq. soln. of  $H_2O_2$  (greater than 50%) may be obtained if the portion of the discharge tube through which water vapour flows is long enough. (2) As the electrodes approach each other, the yield of  $H_2O_2$  decreases and that of permanent gases increases. (3) For the yield and the concn. of  $H_2O_2$ , cylindrical electrodes are more favourable than discoidal electrodes. (4) If the input current of the transformer is increased, the yield of  $H_2O_2$  and its concn. are also increased. (5) As compared with the discharge with 60 cycle current, the high frequency discharge gains in the concn. of  $H_2O_2$ , but loses in the current yield.

IV. *ibid.*, **61**, 257—264 (1940).—It has already been reported by the author that the formation of  $H_2O_2$  by discharge in water vapour is accomplished in a liquid oxygen trap and not in the tube preceding it. As to the seat of the reaction, the author concludes from the results of several expts. that this reaction is brought about by the cold wall

of the trap.

V. *ibid.*, 61, 265—268 (1940).— $H_2O_2$  is formed in the trap only when the temp. is lower than  $-114^\circ C$ . The yield and the concn. of  $H_2O_2$  increase as the temp. is lowered. The same relation was obsd. by Geib and Harteck in the case of formation of  $H_2O_2$  from H and  $O_2$  at low temps. This fact suggests strongly that the formation of  $H_2O_2$  by discharge in water vapour is mainly due to the reaction between H and  $O_2$ .  
Author.

**Dimorphism of n-long chain alcohols.** K. Higasi and M. Kubo. *Sci. Papers Inst. Phys. Chem. Research*, 36, 286—300 (1939). A transition was detected in cetyl and octadecyl alcohols by thermometric, dilatometric and dielectric const. measurements. The solid forms of these alcohols above transition have larger volume, amorphous appearance, significant conductivity and a high dielectric const. which shows a great dependence upon the frequency of the measuring electric field. It was concluded that the molecular dipoles can rotate in these aggregates but not in the low temp. forms. The assumption of rotation round the chain axes alone does not seem to be sufficient to explain the anomalously high dielectric const. of the high temp. modification, and an alternative assumption by Errera that micelles with a large electric moment rotate seems to fit the phenomenon more closely.  
Authors.

**On the variation in the electrical conductivity of some hydrous crystals with temperature.** H. Saegusa and T. Matumoto. *Sci. Repts. Tôhoku Imp. Univ.*, 28, 245—260 (1939).—The electrical conductivity of some hydrous crystals such as, copper sulphate, calcium sulphate, ferrous sulphate, chrome alum and potassium ferrocyanide was studied for various temps. It was found that the electrical conductivity of these crystals increases with temp. and then decreases anomalously at their dehydration temps., and that the electrical conductivity of

the hydrous crystals is larger than that of the anhydrous. The variation of the electrical conductivity of these crystals generally follows the formula  $\log \sigma = B + A/T$  after the water of crystallization is removed, but in the case of chrome alum it shows some different properties. Some consideration is made to explain these exptl. results.  
Authors.

**On the magnetic viscosity of single crystals of iron.** T. Nishina. *Sci. Repts. Tôhoku Imp. Univ.*, 28, 217—224 (1939).—The present investigation was made to det. the magnetic viscosity in cylindrical rods of single crystals of iron by the magnetometric method at the temp. of liquid nitrogen, namely, at  $-195.7^\circ$ . The axes of these rods were made almost to coincide with the direction of the principal axes of the crystal, namely, [100], [110] and [111]. To find the relation between the magnetic field and the magnetic viscosity, the intensity of the external magnetic field was varied; in the case of the [111]-rod the magnetic viscosity was measured with two rods of different diameters.  
Author.

**Magneto-optical anomaly of ordinary and heavy water.** A. Okazaki. *Proc. Phys.-Math. Soc. Japan*, III, 21, 753—758 (1939).—Magneto-optical anomaly  $\gamma$ , which is defined by the modified Becquerel's formula  $\omega = \gamma \frac{e}{2mc^2} \lambda \frac{dn}{d\lambda}$  ( $\omega$  and  $n$  are resp. Verdet's const. and refractive index for the wave-length  $\lambda$ ), of  $H_2O$  and  $D_2O$  at  $19^\circ C$  are calcd. for several wave-lengths from  $\lambda$  5461 to 2655 Å, and also  $\gamma$ -values at various temp. in the range from  $4^\circ C$  to  $92^\circ C$  are evaluated for two wave-lengths  $\lambda$  5893 and 5461 Å.  
Author.

**Changes of density of metaboric acid under heating.** H. Tazaki. *J. Sci. Hiroshima Univ.*, 10, 63—71 (1940).—In the previous expt. two forms of metaboric acid crystals, orthorhombic  $HBO_2$  ( $\alpha$ ) and monoclinic  $HBO_2$  ( $\beta$ ), were produced. In the

present expt. the changes of density of both metaboric acids under heating and the vapour press. of the systems composed of each metaboric acid and its dissoci. substances were obsd.; and the processes by which each metaboric acid is converted into boric anhydride are here discussed on the basis of these data.

Author.

**Thermal and electrical conductivities of metals and alloys at low temperatures.** S. Aoyama and T. Itô.

*Nippon Kinzoku Gakkai-shi*, 4, 3-9, 37-42 (1940).—I. On nickel-copper alloys.

In order to study the relation between thermal and electrical conductivities of alloys at low temps., the conductivities of Ni-Cu alloys were measured at  $-195^{\circ}$  with an improved app. According to the present results, the Wiedemann-Franz-Lorenz law does not hold especially at low temps., and for concd. alloys, the general relation  $\lambda = \lambda_g + \lambda_m = \lambda_g + Z_m k T + \varphi(T) k^2$  holds, which can interpret the results represented by the following exptl. formulas, i. e. for dilute alloys  $w = w_0 + \rho/Z_m T$ ,  $W_0 = -\varphi(T)/Z_m^2 T^2$ , and for concd. alloys  $\lambda = \lambda_g + Z_m k T$  where  $Z_m$  is the Lorenz-ratio  $5.8 \times 10^{-9}$  (cal  $\Omega$  deg $^{-2}$ ) theoretically deduced for the metallic part. The increase of exptl. value of Lorenz-ratio for alloys at low temps. is also explained from the general eq. The relations between  $\lambda$  or  $k$  and concn. of the same alloys are also studied.

**II. On a simple apparatus, and rapid measuring method of thermal conductivity of metals and alloys.** A new comparative method was devised which is simple, rapid and fairly accurate. The results obtained by this app. are described.

**III. On Cu-Zn alloys.** The thermal and electrical conductivities of Cu-Zn alloys (0 to about 50% Zn) were measured at  $0^{\circ}$  and  $-195^{\circ}$ , and their behaviours in relation to concn. were studied. The relation between thermal and electrical conductivities, and the characters of Lorenz-ratio of these alloys are explained on the basis of the authors' conception formerly reported. The temp. depen-

dence of thermal conductivity of these alloys is also interpreted.

**IV. On some heat-resistant alloys.** The thermal and electrical conductivities of 6 kinds of commercial heat-resistant alloys were measured in the boiling nitrogen bath. From the present results and those obtained previously at high temps., the following facts are derived. (1) The temp. coeff. of thermal conductivity is pos. for these heat-resistant alloys. (2) Whereas Lorenz ratios become slightly larger in value than the theoretical one at high temps., they become far larger at lower temps. (3) The thermal conductivity of one of them (Ni-Cr-W-Steel) is nearly  $1/100$  of that of copper at the same temp.

Authors.

**Studies on colour. I. Luminous efficiency of two element complementary colours; white luminescence from Braun tubes.** T. Azuma.

*Mazda Kenkyu Jiho*, 15, 17-22 (1940).—The luminous efficiencies of two-element spectral complementary colours were calcd., according to the I. C. I. colorimetry, taking the Illuminant C as the white point.

The efficiency greater than 330 lm/W was obtained for the combinations of 430-470 m $\mu$  for one component and 568-574 m $\mu$  for the other. In this case, the energy ratio of the longer wave length component to the shorter one is 1:(1.1-1.5) and the similar ratio of the luminous intensities is 1:(10-100). Hence, the larger part (90-99%) of luminous intensity of the white is supplied by the longer wave length component, the shorter one being used as correction of the colour. As an example of application of the theory, the white luminescence from Braun tubes used in television is discussed.

Author.

**Young's moduli of metals and alloys at low tin, lead, antimony and their alloys.** S. Aoyama and T. Fukuroi. *Sci. Repts. Tohoku Imp. Univ.*, 28, 423-434 (1940).—Young's moduli of tin, lead, antimony and their binary alloys were measured

at room and low temps. Dynamical method of measurement was applied to fixed-free bar, carrying an iron load on free end and the frequency of vibration of that end was estimated by means of an equipment newly devised.

Authors.

**On the change in electrical resistance of alkali metals on melting.** A. Hirasima. *Proc. Phys.-Math. Soc. Japan*, III, 21, 679—686 (1939).—Using the concept of the process of melting as stated in a previous paper by the present author, the change

in electrical resistance of alkali metals on melting is calcd. by comparing the mean square deviations of atoms, which are taken to be proportional to the electrical resistance, in the solid and in the liquid. The calcd. values of  $R_l/R_s$  ( $R_l$  and  $R_s$  are electrical resistances of the liquid and the solid resp.) agree well with the obsd. values. Temp. coeff. of resistance of the liquid is also calcd., giving a result of the right order of magnitude. Finally, the relation of the present theory to that of Wigner and Seitz is discussed.

Author.

## 2—ATOMIC STRUCTURE, RADIOCHEMISTRY AND PHOTOCHEMISTRY

**Structure of Cr films deposited on rocksalt.** S. Shirai. *Proc. Phys.-Math. Soc. Japan*, III, 21, 800—807 (1939). Cr films were made on the cleavage planes of rocksalt at high temps., by evaporation *in vacuo*. The structure of the films was examd. by the cathode rays by the transmission method. When the temps. of the substrata were lower than a critical temp., generally the Cr crystals in the films were randomly oriented and when the substrata were at higher temps. than the critical one, in most cases, the author obtained the films which gave the strong electron diffraction pattern due to small Cr crystals, whose (001) and [100] were parallel resp. to (001) and [110] of the substrata. The critical temp. is dependent on the conditions of the substratum, ranging from 506°C to 280°C in various conditions, under which the present expt. was undertaken. These differences may be due to the smoothness of the cleavage plane of rocksalt and the influences of the gas molecules absorbed and adsorbed by rocksalt.

Author.

**Raman effect and dipole moment in relation to free rotation. XI. Raman spectra of deuterio-1, 2-**

**Dibromoethanes.** S. Mizushima, Y. Morino, and A. Suzuki. *Sci. Papers Inst. Phys. Chem. Research*, 36, 281—285 (1939).—The Raman spectrum of liquid tetradeuterio-1, 2-dibromoethane was re-examd. The obsn. in the solid state was also carried out. The exptl. result afforded another confirmation of our previous conclusions for the molecular structure of 1, 2-dihalogenoethane with regard to the internal rotation around the C—C bond as axis; i.e. in the solid state the molecule is nearly in a pure trans state, while in the liquid state or in solns. the mean internal state shows a deviation from this stable position. The Raman lines of trideuterio-1, 2-dibromoethane was also detd.

Authors.

**On the shift of intensity in  $N_2^+$  bands excited in helium and neon.** T. Takamine, T. Suga, and Y. Tanaka. *Sci. Papers Inst. Phys. Chem. Research*, 36, 437—448 (1939).—The second neg. band of ionized nitrogen  $N_2^+ \{B'(^2\Sigma_u)X'(^2\Sigma_g^+)_1\}$  shows a distinct shift in its intensity according as helium or neon is used for the main gas in the discharge tube to which a small amt. of nitrogen is added. A tentative interpretation of the phenomenon is stated.

Authors.

**On the energy states of the valency electrons in some metals. I, II. The nature of the anomalies of zinc and its electronic structure in condensed states.** M. Satô. *Sci. Repts. Tôhoku Imp. Univ.*, I, 28, 143—196 (1939).—From the regularity existing in the intervals of anomalous temps. of zinc, the energy states of the valency electrons assocg. to the energy levels,  $E_1$ ,  $E_2$  and  $E_3$  in the bulk mass of this metal, were investigated and the following results were obtained:— $E_1 \equiv (4s, 4p)$  ( $4s, 5p$ )  $^5D_{4,3,2,1,0}$ ;  $E_2 \equiv (4s, 4d)$   $^5F_{5,4,3,2,1}$ ;  $E_3 \equiv (4s, 5p)$  ( $4s, 9p$ )  $^3P_{1,2,3}$ . Accordingly, the anomaly is explained as due to the electronic transition between the adjacent components of the fine structure of a crystal level. Further it is suggested that the level,  $E_4$ , is assocd. by the electrons, ( $4s, 5p$ ) ( $4s, 2d$ ), and that the transition from supra- to nonsupra-conduction at  $0.79^\circ\text{K}$  is explained as due to the electronic transition, from the lowest component of  $E_4$  to the next. Based on the former investigation computing the heat of sublimation of zinc from the values of its crystal levels, and the structure of log (shearing work of Zn single crystal)- temp. diagram, it is inferred that,  $E_1$  and  $E_4$  belong to one pair of atoms and  $E_2$  and  $E_3$ , to another pair, thus forming ( $E_1, E_4$ )- and ( $E_2, E_3$ )-band. The former are bound mutually by the resonance exchange,  $E_1 \rightleftharpoons E_4$ , and the latter similarly by  $E_2 \rightleftharpoons E_3$ ;  $E_1$  and  $E_4$  bind the atoms in the same net plane, (0001), and  $E_2$  and  $E_3$ , the atoms belonging to different net planes of (0001). Irreversibility of the anomalous change at  $320^\circ\text{C}$  is explained, as due to the fact that special orientations with respect to (0001), of the quantum vectors, S and J of  $E_2$ , are comparatively stable against the disturbance of the thermal vibration. The energy states of zinc atoms in the molten state were also investigated through the specific heat, the heat of vaporization, the surface tension and the heat of fusion. The results obtained are: (1) At the melting point and in the temp. range from this point up to  $905^\circ\text{C}$ , Zn-atoms in the molten form show two kinds of

groups, each consisting of four atoms. The one kind is constructed in such a way that a pair of atoms are bound firstly by the levels,  $E_1$  and  $E_4$ , and a pair of ( $E_1, E_4$ )-bonds are bound by the resonance,  $E_1 \rightleftharpoons E_4$ ; the other kind is formed by  $E_2$  and  $E_3$  in the similar way as above, but differing in the point that, in the latter, the assocn. and dissocn. occur alternately, while in the former the assocn. exists constl. (2) Each atom has three degrees of freedom in the thermal vibration. (3) In the phenomenon of fusion there occurs in the first step the transition  $E_2$ ; ( $4s, 4p$ ) ( $4s, 4d$ );  $^5F_2 \rightarrow ^6F_1$ , a small portion of the heat of fusion being expended as the energy of this transition; in the second step, ( $E_2, E_3$ )-assocn. changes from the permanent to the temporary, the main portion of the heat of fusion being applied in this process as the work to expand against the cohesive force. The anomaly at  $905^\circ\text{C}$  is explained as that in which ( $E_1, E_4$ )-assocn. changes from the permanent state to the temporary. Finally the effect of the internal stress on the anomalous temps., such as the melting point and the recrystallization temp. is explained by attributing it to the change of the magnitude of interval of the fine structure of  $E_2$ ; and its effect on the selective absorption of light and on the dissoln. velocity of zinc into acid is explained as due to the change of the energy distance between  $E_2$  and  $E_3$ . Author.

**On the angular distribution of the fast neutrons scattered by the atoms.** S. Kikuchi, H. Aoki, and T. Wakatuki. *Proc. Phys.-Math. Soc. Japan*, III, 21, 410—420 (1939).—The differential scattering cross section for neutrons of 3.1 mev energy was detd. for proton, carbon, aluminium, iron, copper, tin, lead and bismuth. It was found that the scattering is not isotropic in all the cases including proton. Except in the case of proton, small angle scattering predominates over the large angle scattering, and the degree of asymmetry increases with the atomic number. The problem becomes complicated in the case of proton, as the efficiency

of the detector is different for the primary and the scattered neutrons owing to their difference in energy. It is concluded that the scattering is not isotropic with reference to the system in which the center of gravity is at rest, and that the usual theory of neutron proton interaction, in which only *s*-interaction is taken into consideration, is not correct.

Authors.

**Photoconductance of the dye-sensitized silver bromide and the mechanism of the dye-sensitization. II.** N. Kameyama, and K. Mizuta. *J. Soc. Chem. Ind. Japan*, 42, 912—915 (1939).—In continuation of the previous investigations, the measurements were carried out with regard to the spectral sensitivity of photoconductance of those crystals of silver bromide on which the sensitizer dyes were adsorbed. Dyes examined were erythrosin, indocyanine, thiocarbocyanine, and thiocarboindocyanine. The results confirmed the conclusion attained in the previous paper, namely, the spectral range of the photoconductance well agrees with the range of the photographic sensitivity of the dyed silver bromide. Therefore it is concluded that, in the range sensitized by the dye, the electron is set free or raised to the conductance band by the energy of light absorbed by the dye adsorbed on the crystal.

Authors.

**Excitation of atoms by electron collision.** T. Yamanouchi and M. Kotani. *Proc. Phys.-Math. Soc. Japan*, III, 22, 14—33 (1940).—The expression for the probability that an atom in *L*, *S*-state is excited by electron impact to a state *L'*, *S'*-state of the same configuration but of different multiplicity is obtained by the group-theoretical method and by the method of stationary states. The results are tabulated for *p*<sup>n</sup>-configurations. It is intended that the numerical results of this theory will give reliable quantitative data for the production of the metastable states of oxygen atom and ions in terrestrial and nebular atoms.

Authors.

**Production of metastable states of atom by photo-ionization and recombination.** T. Yamanouchi. *Proc. Phys.-Math. Soc. Japan*, III, 22, 33—41 (1940).—With the same intention as in the preceding paper, the probability of radiative ionization and recombination of an atom in *l*<sup>n</sup>-configuration is obtained by the group-theoretical method, and the results are tabulated for *p*<sup>n</sup>-configurations.

Author.

**Photo-ionization and recombination of oxygen atom.** T. Yamanouchi and M. Kotani. *Proc. Phys.-Math. Soc. Japan*, III, 22, 60—76 (1940).—The probabilities of ionization and recombination by radiative process for various values of energies of photon and electron are calculated by the formulae in the preceding paper. Hartree's functions are used for the wave functions of the bound electrons, and the wave functions of either ejected or recombining electrons are obtained by numerical integration. The results applied for the O atoms in upper atmosphere show that both these probabilities are small owing to the weak intensity of solar radiation in far-ultraviolet region and low electron temperature, e.g.

$$W(^3P \rightarrow ^1S) = 3.25 \times 10^{-9} \text{ sec}^{-1}, \quad W(^4S \rightarrow ^3P) = 4.60 \times 10^{-7} \text{ sec}^{-1}.$$

Authors.

**On the isotopic weights of carbon and nitrogen by the doublet method.** T. Asada, T. Okuda, K. Ogata and S. Yoshimoto. *Proc. Phys.-Math. Soc. Japan*, III, 22, 41—45 (1940).—With a newly constructed mass-spectrograph of Bainbridge and Jordan type, the authors measured the mass differences of <sup>12</sup>CH<sub>4</sub>—<sup>16</sup>O and of <sup>12</sup>CH<sub>2</sub>—<sup>14</sup>N. These ions were produced by electric discharge through a mixture of methane, carbon dioxide and air in a cylindrical discharge tube of the usual type. In addition to these doublets, the lines of NH<sub>3</sub>, NH<sub>2</sub>, CH<sub>3</sub>, CH, and C were also simultaneously obtained on the same photographic plate. By measuring every interval of these lines with <sup>1</sup>H = 1.008, a dispersion coefficient at every point on the plate was determined.

very accurately and the following results were obtained :

Doublet.	Difference of mass.
$^{12}\text{CH}_4\text{—}^{16}\text{O}$	$0.03642 \pm 0.00009$
$^{12}\text{CH}_2\text{—}^{14}\text{N}$	$0.01257 \pm 0.00006$

From these results and Aston's  $^1\text{H} = 1.00812 \pm 0.00004$ , isotopic weights of  $^{12}\text{C}$ , and  $^{14}\text{N}$  can be calcd. as follows :

$$^{12}\text{C} = 12.00394 \pm 0.00018$$

$$^{14}\text{N} = 14.00761 \pm 0.00021$$

Concerning the isotopic weight of  $^{14}\text{N}$ , disagreement is never found beyond the error, but with  $^{12}\text{C}$ , Aston's value  $12.00355 \pm 0.00015$  shows a slight discrepancy in spite of his careful repetition of measurement.

Authors.

**Study of neutrons in the atmosphere with a boron coated counter.** S. Kawata and M. Ito. *Proc. Phys.-Math. Soc. Japan*, III, 22, 116—118 (1940).—Neutrons in the atm. were studied with a boron coated counter with or without cadmium shield at Taihoku (near the sea-level) and at Mt. Ari (2285m), and very rapid increase of C neutrons with height was obsd. Next, effects of shielding the counter with paraffin and lead were studied with the results that the decrease of C neutrons was obsd. in both cases, but it was distinctly smaller than expected from absorption of C neutrons alone in the case of paraffin, and possibly also in the case of lead. These points and some related matters are discussed. Authors.

**$\beta$ -Radioactivities of rhenium.** F. Yamasaki and K. Simma. *Sci. Papers Inst. Phys. Chem. Research*, 37, 10—16 (1940).—A study has been made of radioactivities induced in rhenium by bombardment with slow neutrons (through paraffin) from Be+D and fast neutrons from Li+D (up to 17 Mev.) produced in the cyclotron in our laboratory. The active substances were identified with rhenium isotopes by chem. separations. The decay curve has been analyzed into two components with half-lives of  $16 \pm 1$  hours and  $90 \pm 2$  hours. These two periods have been

found to be assocd. with  $\text{Re}^{185}$  and  $\text{Re}^{187}$  resp. The energy spectra of these two activities were studied with the Wilson cloud chamber method. Both emit electrons and energy upper limits obtained by inspection were 1.05 Mev. for  $\text{Re}^{185}$  and 2.1 Mev. for  $\text{Re}^{187}$ , and those obtained by K-U plots were 1.2 Mev. and 2.5 Mev. resp. Authors.

**The band spectra of sulphur and selenium excited in ignition tubes containing the mixture of hydrogen and oxygen, with a trace of sulphuric acid and selenium respectively.** M. Miyani. *Sci. Papers Inst. Phys. Chem. Research*, 37, 79—84 (1940).—The sulphur and selenium band spectra appeared in the ignition flames of the mixt.  $2\text{H}_2 + \text{O}_2$  containing a small quantity of sulphuric acid and selenium resp. In the discharge tubes of water vapour containing a small quantity of sulphur and selenium they were also remarkably enhanced in the spectral regions where OH bands  $2' \sim 1''$ ,  $1' \sim 0''$  and  $1' \sim 2''$ ,  $0' \sim 1''$  appeared resp. The appearance of these sulphur and selenium bands in the ignition flames as well as their enhancement in the discharge tubes are considered to be due to excited OH molecules. Author.

**Single crystals of metaboric acid.** H. Tazaki. *J. Sci. Hiroshima Univ.*, 10, 37—54 (1940).—In this expt. the author produced new single crystals of metaboric acid in a quantity enough for the Laue and rotating-crystal methods to be applied to them. Moreover, two forms of single crystals (that is, dimorphism of metaboric acid) were found, the one belonging to the orthorhombic system and the other to the monoclinic system. The properties of these new single crystals were also examd. by means of a microscope and the X-rays. Author.

**The structure of orthorhombic metaboric acid,  $\text{HBO}_2(\alpha)$ .** H. Tazaki. *J. Sci. Hiroshima Univ.*, 10, 55—61 (1940).—It has been found by the author that the

single crystal of orthorhombic metaboric acid is produced by heating boric acid in moist air at one atm. press. In this investigation its structure was minutely examd., by means of Fourier projections, on the basis of its rotation X-ray photographs. Author.

**Effects of chemical combination of the  $K\beta$ -lines of chlorine.** H. Tazaki and M. Huzita. *J. Sci. Hiroshima Univ.*, **10**, 73—75 (1940).—The effects of chem. combination on the wave-lengths of the  $K\beta$ -lines of Cl were examd. by using a Siegbahn vacuum spectrograph. The  $K\beta$ -spectra of chlorine could be divided into four groups, according to their appearance, each group being represented by the  $K\beta$ -spectra of Cl in KCl, NaCl, LiCl and CuCl resp. Authors.

**Spectroscopic study on the electric discharges in the air.** Y. Asami and T. Katayama. *Denki Hyoron*, **28**, 168—171 (1940).—Spectroscopic studies were made on glow and arc discharges in the air. The spectra for the glow discharge of weak current consisted of  $N_2$  bands,  $N_2(I)$ ,  $N_2(II)$  bands having appeared in the pos. column and also  $N_2^+$  band near the cathode. The spectra for the glow discharge of heavy current was just like those of weak current near the electrode but in the pos. column they were quite different,  $O_2$  band (Runge band) and a continuous band having been emitted instead of the  $N_2$  bands. The spectra for the arc discharge consisted of atomic lines of the electrode material and the Runge band,  $N_2$  bands near the electrode having disappeared in this case. In the ultra region NO ( $\gamma$ ) band was emitted in all three types of discharges. But its intensity differed according to the electrode material. In the case of Cu and Mg, NO ( $\gamma$ ) band and the Runge band were emitted most intensely. In the glow discharge of heavy current there were intensely emitted the oxide bands of the electrode material; thus new bands of CuO, WO and FeO were discovered. Authors.

**Notes on the theory of ionic lattice potential.** T. Takeuti. *Bull. Tokyo Univ. Eng.*, **9**, 86—87 (1940).—(i) From the consideration of lattice potential, the swelling effect of micelle of fibres in the presence of dielectric liquid was treated. (ii) Assuming that each molecule is confined to a cell or cage formed by its immediate neighbours, an expression for the frequency of oscillation was obtained. Author.

**Fine structures in the  $K$ -absorption edges iron at low temperatures.** A. Aoyama and T. Fukuroi. *Sci. Repts. Tohoku Imp. Univ.*, **28**, 410—422 (1940).—Fine structures in the  $K$ -absorption spectra of iron and its compds.—cementite, magnetite and hematite—were investigated both at room and liquid-air temps. Temp. effect on the said structures, especially on those remote from the principal edge was recognized for metallic iron and magnetite. Wave-length of the principal absorption edge was also compared for various kinds of iron compds. Authors.

**Experiment on the after glow of nitrogen.** M. Kamiyama and T. Sugiura. *Bull. Inst. Phys. Chem. Research*, **18**, 948—956 (1939).—(1) The spectrum of  $N_2^+$  is obsd. in the auroral after glow. The transition between the high vibrational states among the 1st pos. band is not accurately obsd. As to the 1st neg. band of  $N_2^+$ , it is not distinct. (2) The Singlet line is scarcely obsd. in the spectrum of mercury excited in the after glow. The line corresponding to the highest excitation for the lowest term  $^1S_0$  is  $3021.50\text{\AA}$  ( $6^3P_27^3D_3$ ). J. C. I.

**Fluorescent substances. II. Fluorescent spectrum of the fluorescent zinc sulphide-copper crystal. I. Fluorescent spectrum.** Y. Uehara, Y. Kobuya, and K. Tanaka. *Mazda Kenkyu Jiho*, **14**, 110—118 (1939).—The fluorescent spectrum of ZnS—Cu was measured at  $-185^\circ$ . In the spectrum of a pure fluorescent ZnS which does not

contain any radio-active substance and flux, there lie four fluorescence bands at 4680, 4840, 5040 and 5455 Å. In the fluorescent ZnS—Cu,  $\beta$  and  $\alpha$  fluorescence bands are obsd. at 4400 and 5240 Å, which are proved to correspond with  $^3D_2$ — $^1S_0$  of  $Cu^+$  reported in the preceding paper. Fluorescence bands are found in the neighbourhood of 4300 and 6130 Å.

J. C. L.

**On the angular distribution of the fast neutrons scattered by the atoms.**

II. T. Wakatuki and S. Kikuchi. *Proc. Phys.-Math. Soc. Japan*, **III**, **21**, 656—660 (1939).—The present paper describes the results obtained by extending the region of scattering angles ( $23$ — $55^\circ$  in the previous report) up to  $152^\circ$ . The differential scattering cross section is nearly const. for the angle larger than  $55^\circ$ , while for the angle smaller than  $55^\circ$  it increases with decreasing angles. (This general trend in the case of D—D neutrons is similar to the case of Li+D neutrons.) The ratio of the differential scattering cross section obsd. by transmission method is  $1/2$  ( $2.9 \times 10^{-24} \text{ cm}^2$ ) for Pb. The predominance of the small angle scattering is considered to be characteristic of the elastic scattering.

J. C. L.

**Studies on luminescent materials.**

**III. Effect of temperature on the intensity of fluorescence of zinc sulphide crystal phosphor.**

V. Uehara. *J. Chem. Soc. Japan*, **60**, 900—910 (1939); *Mazda Kenkyu Jihō*, **14**, 211—219 (1939).—The intensity of fluorescence of zinc sulphide crystal phosphor was measured in the temp. range from room temp. to  $450^\circ\text{C}$ . Theoretical interpretation is given to the cause of the decrease

in the intensity with the rise of temp.

J.C.L.

**The beta-ray spectrum of radio-chlorine.** Y. Watase and J. Itoh. *Proc. Phys.-Math. Soc. Japan*, **III**, **21**, 625—632 (1939).—The betaray spectrum of radio-chlorine (37.3 min) was investigated by the use of magnetic spectrometer. The beta-rays are composed of at least two clearly resolved groups. The upper limit of the spectrum was 4.99 mev. Some discussions are given about the Fermi and K.-U. plots. From 2.6 mev. to the end point of the spectrum Fermi plots lie on a straight line. By the absorption method, the max. range of electrons was found to be  $2.37 \text{ g/cm}^2$  and the extrapolation of Feather's range-energy relation is discussed.

Authors.

**Improvement of the photon counter.**

T. Asada and N. Mikino. *Gakujutsu Kyōka*, **14**, 218—220 (1939).—In order to get a photon counter sensitive to the visible light, an improvement was made thus: Na was coated by evaporation as a photographic sensitive substance on small discs made of Al, Ni, or Ag so as to prevent the formation of Dark Count. A lattice made of the Mo line 1 mm. in diameter was inserted between the photographic sensitive surface and the anode (iron silk needle), whose point was placed towards the centre of the lattice such a way as it held both the surface and the lattice. For example, weak light corresponding to Count  $4 \times 10^{-13}$  lumen (= photoelectric current of  $10^{-17}$  Amp.) was measured with accuracy of about 10%.

J. C. L.

### 3—ELECTROCHEMISTRY AND THERMOCHEMISTRY

**Contributions to the theory of electrolytic conduction.** S. Kaneko. *Researches Electrotech. Lab.*, **428**, 1—31

(1939).—This report is a collection of the author's papers on electrolytic conduction that have appeared in *J. Chem. Soc. Japan*

and *Bull. Electrotech. Lab.*, and supplements a previous report (*Researches Electrotech. Lab.*, 403 (1937)). The first part of this report is the application of the theory of reaction velocity to diffusion, viscosity, electrolytic conduction and overvoltage. The second part is an extension of Debye-Hückel's theory of strong electrolytes, and treats the subjects of frequency effect, electrolytic conduction of mixed electrolytes and individual activity coeff.

Author.

**Theory of strong electrolytes in the case when non-Coulombic force is acting.** S. Kaneko. *Bull. Electrotech. Lab.*, 3, 645-649 (1939).—By the extension of the previous report (*Bull. Electrotech. Lab.* 3, 419 (1939)) the activity coeffs., heats of dilution, and osmotic coeffs. of strong electrolytes are calcd. when non-Coulombic force is acting.

Author.

**The equilibrium in the reduction of molybdenum dioxide by deuterium.** K. Tonosaki. *Bull. Inst. Phys. Chem. Research*, 19, 133-135 (1940).—The equil.  $1/2 \text{MoO}_2 + \text{D}_2 \rightleftharpoons 1/2 \text{Mo} + \text{D}_2\text{O}(\text{g})$  was studied in the temp. range of 685-845°C by the static method which was described in the previous report. The equil. const. may be expressed by the following eq.  $\log K_p = \log (P_{\text{D}_2\text{O}}/P_{\text{D}_2}) = 0.884 - (1.2115/T)$ . By combining the  $K_p$  eq. for this equil. with that for the equil.  $1/2 \text{MoO}_2 + \text{H}_2 \rightleftharpoons 1/2 \text{Mo} + \text{H}_2\text{O}(\text{g})$  the following result was obtained:  $\text{H}_2\text{O}(\text{g}) + \text{D}_2(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{D}_2\text{O}(\text{g})$ ;  $\log K_p = -0.0573 + (233.1/T)$ .

Author.

**The equilibrium in the reduction of molybdenum dioxide by hydrogen.** K. Tonosaki. *Bull. Inst. Phys. Chem. Research*, 19, 126-132 (1940).—A static method which had been used in the report was used for measuring the equil.  $1/2 \text{MoO}_2 + \text{H}_2 \rightleftharpoons 1/2 \text{Mo} + \text{H}_2\text{O}(\text{g})$  in the temp. range of 645-823°C. The equil. const. is given by  $\log K_p = \log (P_{\text{H}_2\text{O}}/P_{\text{H}_2}) = -(1.4446/T) + 0.9413$ . The values of  $\Delta H$  and  $\Delta F^\circ$  for

this reaction may be expressed as follows:  $1/2 \text{MoO}_2 + \text{H}_2(1 \text{ atm.}) = 1/2 \text{Mo} + \text{H}_2\text{O}(1 \text{ atm.})$   
 $\Delta H = 8877 - 3.755T + 1.47 \times 10^{-3}T^2 + 25150/T$ ,  
 $\Delta F^\circ = 8877 + 3.755T \ln T - 1.47 \times 10^{-3}T^2 + 12575/T - 31.06T$ ,  $\Delta H_{298} = 7973 \text{ cal}$ ,  $\Delta F_{298}^\circ = 5909 \text{ cal}$ . From these data the following thermodynamic values for  $\text{MoO}_2$  may be calcd.  $\text{Mo} + \text{O}_2(1 \text{ atm.}) = \text{MoO}_2(\text{s})$ ,  $\Delta F_{298}^\circ = -120816 \text{ cal}$ ,  $\Delta H_{298} = -131692 \text{ cal}$ ,  $\Delta S_{298} = -36.5 \text{ cal/deg}$ ,  $S_{298}^\circ = 19.3 \text{ cal/deg}$ . By combining the  $\Delta F^\circ$  eq. for the reduction with that for the water gas reaction due to Chipmann the following results were obtained:  $1/2 \text{MoO}_2 + \text{CO}(1 \text{ atm.}) = 1/2 \text{Mo} + \text{CO}_2(1 \text{ atm.})$   
 $\Delta F^\circ = -1143 + 3.355T \ln T - 0.00327T^2 + 0.25 \times 10^{-8}T^3 + 12575/T - 17.43T$ ,  $\Delta H_{298} = -1781 \text{ cal}$ ,  $\Delta F_{298}^\circ = -882 \text{ cal}$ .

Author.

**On the dissociation constants of arsenious acid and hydroxylamine.** F. Ishikawa and I. Aoki. *Bull. Inst. Phys. Chem. Research*, 19, 136-141 (1940).—The  $pH$  values of solns. containing arsenious acid and sodium arsenite were measured at 25°C by means of the glass electrode. The results may be expressed by  $pK = pH + \log \{a - (b - [\text{OH}'])/ (b - [\text{OH}'])\}$  in which  $K$  is the dissocn. const. of the acid,  $a$  is the total concn. of arsenic and  $b$  is that of sodium ion. The value of  $K$  was found to be  $8.4 \times 10^{-10}$ . The hydrolysis of hydroxylamine hydrochloride was studied at 25°C by the same method. The result may be expressed approximately by  $pH = 1/2 pK_A - 1/2 \log [\text{NH}_4\text{O}']$  in which  $K_A$  is the hydrolysis const.,  $[\text{NH}_4\text{O}']$  is the concn. of hydroxylammonium ion.  $K_A$  was found to be  $2.5 \times 10^{-7}$ . Hence the dissocn. const. of hydroxylamine is  $4 \times 10^{-8}$ .

Authors.

**On the residual active layer.** A. Miyata. *Sci. Papers Inst. Phys. Chem. Research*, 37, 30-57 (1940).—When an aluminium plate is anodized in a suitable soln. to obtain a thick oxide film on its surface, almost all of the impressed voltage is consumed due to counter electromotive force of the very thin layer that exists just at the

innermost surface of the film, by keeping away the ground aluminium from the access of the electrolyte. The impressed voltage is not consumed in the form of a potential drop at the resistance due to the porous insulating oxide film already produced, which is permeated by the electrolyte. This thin film is usually called the active layer. What is meant here by the residual active layer is the part of it which persists indefinitely at the bottom of the film till long after the anodic treatment. In this report the author dealt with the remaining residual active layer quantitatively by the following two methods. (i) The const. potential method: the abrupt change of the anodic capacity of the test sample which had previously been anodized at a certain voltage was detd. in an aqu. soln. of ammonium borate at various const. voltages which were successively increased. (ii) The const. current method: the initial voltage from which the residual active layer of the sample began to grow in the subsequent current reforming process was detd. by extrapolation. The author found that

most of the original state of the active layer persists indefinitely. How the active layer of the D.C. film is retained differently from that of the A.C. film was shown. A brief discussion about the elimination of the active layer was given and some practical application for it considered. Author.

**Electrolytic winning of heavy water.** V. K. Noguchi. *J. Electrochem. Assoc. Japan*, 7, 261—265 (1939).—In the second report of this series, it was made clear that the electrolytic separation factor was absolutely independent from the gas press. in electrolytic cells in the press. range of 1~70 atm. The present report shows that the electrolytic separation factor of deuterium under partial vacuum is lowered straightly with lowering of electrolytic gas press.; thus: —electrolyte.....1% NaOH, 0.06% D<sub>2</sub>O; both electrodes.....Nickel; temp. of electrolyte.....22°C; gas press. (mmHg), 240, 340, 400, 500, 630, 760, 800, 1570; isotopic separation factor. 3.2, 3.3, 3.4, 3.6, 3.9, 4.1, 4.1, 4.0. Author.

#### 4—COLLOID CHEMISTRY AND SURFACE CHEMISTRY

**Studies on the oiliness of liquids.**  
VIII. Measurements of the static friction coefficients for silver surfaces. T. Isemura. *Bull. Chem. Soc. Japan*, 14, 297—302 (1939).—Measurements of the static friction coeffs. were made to study the oiliness of liquids. The friction surfaces consisted of a silver plate and a silver piece of spherical surface. The static friction coeffs. of water, hydrocarbons, aliphatic alcohols, aliphatic acids and esters were measured. The static friction coeffs. of these compounds except the acids are all comparable with the results obtained for the glass surfaces. The friction coeffs. of acids diminish rapidly with the number of carbon atoms in the chain of the molecule for the silver surfaces, while they are nearly const. irrespective of the number of carbon atoms

for glass surfaces.

Author.

**Studies on the sorption of gases and vapours by titania gel.** VI. Sorption and desorption equilibria of some organic vapours and the critical limit of capillary condensation phenomena. I. Higuti. *Bull. Inst. Phys. Chem. Research*, 18, 657—684 (1939).—Sorption and desorption and desorption isotherms of CCl<sub>4</sub>, CHCl<sub>3</sub>, CH<sub>2</sub>Cl<sub>2</sub>, CS<sub>2</sub>, (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>O, and C<sub>6</sub>H<sub>6</sub> vapours have been obtained at 0°, 10° and 20°C. The desorption curves showed remarkable hysteresis loops in a range of high relative press., but contrary to the former results obtained with SO<sub>2</sub>, NH<sub>3</sub>, and H<sub>2</sub>O vapours, equil. curves at low relative press. have been found reversible. From the exptl. data the author has

obtained the following results: that condensed liquid volumes of sorbed vapours are almost const. independent of vapour species and temp. not only at satd. values but also at any equal pore radius; that the relations between  $\log p$  and  $\log a$  can be represented by straight lines having a break point where a capillary condensation begins to appear; and that in proportion as the sorbed amt. increases the differential heat of sorption tends to the const. value which is near the heat of condensation. These results may be explained by the assumption of capillary condensation. According to the author's opinion an examn. of the capillary distribution could give some light on the shrinking mech. of gel structure and from this it has been considered that these gels might have pores with narrow apertures and wide inner spaces. This view was obtained by extending McBain's hypothesis on the occurrence of the hysteresis phenomena in sorption. From the above standpoint and the consideration of some properties of the beginning point of hysteresis, the author has come to the conclusion that at that beginning point the capillary condensation would probably commence in those cases. On the other hand, the critical limit of the capillary radius, that is, the smallest radius for meniscus formation has been considered. A number of sources of deviation are discussed. Author.

**High temperature oxidation of carbon monoxide catalyzed by quartz surface.** Y. Kondo and O. Toyama. *This Journal*, 13, 166—175 (1939).

**On the chemisorption of carbon dioxide by reduced iron. IV. Kinetics of the chemisorption.** K. Kawakita. *This Journal*, 14, 1—10 (1939).

**On the nature of foam. III. The foam formation of ternary system, acetic acid—benzene—water.** T. Sasaki. *Bull. Chem. Soc. Japan*, 14, 3—8 (1939).—The foam formation of liquid ternary system of acetic acid—benzene—water (A B W) has been measured by means of a shaking app.,

and a diagram is drawn for the relation between the degree of foam formation and the composition. The foam formation of the homogeneous system of A B W is analogous to that of acetic acid—ethyl ether—water (A E W), showing two maxima of foam formation. In the heterogeneous system of A B W, however, remarkable foam formation can be obsd., instead of mere emulsion droplets containing bubbles in the case of A E W-system. The explanation of foam formation in heterogeneous A B W-system is attempted. Author.

**On the adsorption of electrolytes by active carbon: an application of potarographic method.** Y. Terui. *Bull. Inst. Phys. Chem. Research*, 19, 160—166 (1940).—The weighed amt. of active carbon was added to the aqu. soln. of  $Tl_2SO_4$  and the vessel was shaken in a thermostat maintained at  $25^\circ$ . The change of concn. of  $Tl^+$  due to the adsorption was measured by the polarographic method. The range of initial concns. was 0.004—0.0001 gram-ion/L. The results may be expressed by the Freundlich isotherm as follows:  $a=0.000733 C^{0.519}$ . The same expts. were repeated with  $CdCl_2$ . The concn. range was 0.005—0.0005 gram-ion/L. and the adsorption isotherm  $a=0.000239 C^{0.240}$ . Below 0.0002 gram-ion/L.  $Cd$  ion was completely adsorbed. Author.

**On the disintegration of the starch paste by the irradiation of ultrasonic waves.** S. Ono. *This Journal*, 14, 25—41 (1940).

**The friction coefficients of liquids.** J. Sameshima, H. Akamatu and T. Isemura. *This Journal*, 14, 55—67 (1940).

**The adsorption of ethylene on reduced nickel.** S. Iijima. *This Journal*, 14, 68—78 (1940).