kept 15-20 volts negative to the negative end of the filament and the other at least 75 volts positive to the anticathode. A third gauze acted as a receiver for the photoelectrons. These gauzes were constructed on metal cylinders so arranged that the only surfaces exposed to the radiation were of metal and at known potentials. The parts of the tube around the photoelectric plate were shielded from the direct action of the radiation. Before making any measurements the tube was baked and evacuated until the pressure under conditions prevailing during experimentation was so low that it would not register on a McLeod gauge which could measure a pressure of 10^{-5} mm. It was found to be impossible to obtain reproducible results at higher pressures.

The curves obtained by plotting the total photoelectric current against the voltage applied to the exciting electrons are similar in appearance to those obtained by Franck and Einsporn for mercury using low voltages. Up to the present time nine distinct breaks have been obtained for iron in the region from 40 to 185 volts. The values for these points are:

Voltage	ν/R	λ
46.8	3.46	264 A
81.7	6.03	151
95.4	7.05	129.6
111.2	8.21	111.0
130.4	9.63	94.6
140.9	10.40	87.8
171.1	10.88	83.9
153.7	11.33	80.5
160.1	11.83	77.0

The wave length, λ, is in Angstrom units, ν is the frequency and R the Rydberg constant.

The first of these points corresponds very well with the value calculated from X-ray data for the transition from the N_5—N_6 level to the M_3—M_4 (the separation between M_3 and M_4 or N_5 and N_6 is too small to be considered in these experiments). This difference can be obtained from the ν/R values for the $K\beta$ and $K\gamma$ lines as given by Siegbahn. The values are 519.55 and 523.1 respectively, giving 3.55 as the difference which is in good agreement with the value of 3.46 as obtained by the writer. The results have also been successfully checked by using the combination principle to calculate lines in the Millikan region. A more detailed account of this work with additional results will be published in the near future.

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(Continued)

Solubility relations among aluminum and antimony salts: E. D. CRITTENDEN. Freezing point curves for pairs of (*a*) aluminum salts and (*b*) antimony salts have been determined by the closed tube method previously employed. With the exception of two compounds in the system, $SbCl_3$-$SbBr_3$, compound formation is entirely lacking in the temperature range investigated. Solubility is limited in several cases and in this regard the almost complete insolubility of AlF_3 in the other aluminum halides may be cited. In the antimony series solubility is more extensive. Several cases of partial miscibility in the solid state have been found. The results indicate that the rules already established by Kendall for binary systems in which the negative radical is constant and the positive varied as widely as possible, apply to the reverse case studied here. By comparing the results in the two series, the marked effect of unsaturation in increasing solubility is clearly indicated.

A reciprocal catalytic pair: A. W. BROWNE. In catalytic actions where the agent is of the "carrier" type, it should be possible to use interchangeably the filled and the empty carrier, particularly if these are distinct chemical compounds that may be isolated, and if therefore the filling of the carrier is a chemical process. These two forms of the carrier constitute what may be termed a *reciprocal catalytic pair*, that is, a pair of chemical compounds which undergo repeated mutual conversion into each other while exerting their catalytic effect upon a given chemical reaction. Potassium azido-dithiocarbonate, $KSCSN_3$, and azido-carbondisulphide $(SCSN_3)_2$, two new compounds that have been isolated and studied at Cornell, have been found to exert an identical catalytic effect upon the reaction between potassium trinitride andiiodine, which may be expressed by the equations:

(1) $2\ KSCSN_3 + I_2 = 2KI — (SCSN_3)_2$

(2) $2\ KN_3 — (SCSN_3)_2 = —2KSCSN_3\ 2N_3$

(3) $2N_3 = 3N_2$

Physical-chemical studies of creatine and creatinine (I) creatine hydrolysis in acid solution: GRAHAM EDGAR AND R. A. WAKEFIELD. An experimental study has been made of the rate of conversion of creatine to creatinine in the pressure of hydrochloric acid of various concentrations, and at temperatures between 25°C. and 100°C. The reaction proves to be monomolecular the reaction velocity constants increasing a little more rapidly the acid concentration. The variation of the constants with temperature is expressed exactly by the Arrhenius equation, the "critical increment" being 20,000 cal., a value of the order of that found by Lewis for the hydrolysis of methyl acetate and cane sugar in the presence of hydrochloric acid.

The degrees of hydrolysis of the sodium salts of some organic developing agents: FELIX A. ELLIOTT. The degrees of hydrolysis have been determined electrometrically at varying concentrations and temperatures of mono- and di-sodium hydroquinonate, mono-, di- and tri-sodium pyrogallate, mono-sodium p-amino phenol and mono-sodium mono methyl p-amino phenol. The order of magnitude suggests that these agents are classifiable with the pseudo-acids of Hantsch.

The diffusion of helium through quartz at room temperature: HOWARD M. ELSEY. Helium confined under one hundred atmospheres pressure at room temperature will diffuse through a thin walled quartz tube rapidly enough to be detected spectroscopically after a few hours.

Physical chemistry of some volcanic phenomena: GEORGE W. MOREY. A characteristic of volcanoes is the building up of pressure of volatile components as the magma cools. This is as would be expected of a system containing both volatile and non-volatile components, when the latter crystallize on cooling; and the development of pressure in a crystallizing magma is competent to explain many phases of volcanism. The intermittent action of many volcanoes of the explosive type is explicable on the basis of the rate of release of volatile materials at different levels, together with the heat available from the Joule-Thomson effect at high temperatures.

Plasticity and elasticity: EUGENE C. BINGHAM. Elasticity is usually so defined as to exclude all liquids, no matter how viscous they may be. But many viscous liquids, such as glass, for example, undergo elastic deformation exactly as do true solids below their elastic limit. The term elasticity should be so extended as to include fluids as well as solids or else we must invent a new term. Elastic deformations are not a function of the time as are viscous or plastic deformations, hence it is easy to distinguish between them. In liquids and in solids above their elastic limits the flow tends to obliterate the strain and therefore elastic deformations tend to disappear, but this does not make the elasticity of these bodies any the less real even though it is more difficult to observe and measure. The elastic after-effect is discussed as an example of plastic flow.

Limiting factors determining the concentration of electrolytic potassium amalgam: CLARE MARTIN AND JAMES R. WITHROW. The authors call attention to, and endeavor to explain the failure of previous workers to obtain concentrated potassium amalgams electrolytically. In a series of experiments with the Shepherd method, they successively eliminate as vital factors (1) exhaustion of the electrolyte, (2) plugging up of the pores of the porous cup, (3) an equilibrium between the rate of formation and decomposition of the amalgam. From a consideration of Kurnakow's curve, they suggest that too low temperature has been the chief limiting factor. Electrolyzing at higher temperatures, they obtain potassium amalgams analyzing 4.69 per cent. potassium. No higher than 2.23 per cent. K. had been previously obtained and Kerp and Bottger state that exceeding 1.6 was accomplished with the greatest difficulty.

The limiting density of phosgene: A. F. O. GERMANN AND LELAND R. SMITH. The volumetric method used by Morley in his classic researches on the densities of oxygen and hydrogen has been employed in a series of determinations of the density of phosgene. The results parallel those of Germann and Jersey, in that the density of successive fractions of phosgene rises to an approximately constant value, which is, however, below the probable density of the gas. Density measurements were made at pressures of 500 mm., 335 mm. and 170 mm., using a five liter globe. While the absolute numerical value of the results is of little moment, still it is important to note that the limiting density found is approximately four per cent. less than the density at 500 mm., that is, the deviation from Boyle's law amounts to about six per cent. per atmosphere at zero. Our knowledge of the properties of vapors near the point of condensation is very incomplete. Probably no perfectly pure specimen of phosgene has as yet been obtained. The usual methods for the preparation of phosgene yield a product difficult to purify because the impurities are for the most part very soluble in the liquefied gas. It is most important for the progress of the study of the properties of phosgene that a method be developed for the rapid and complete purification of the technical product. Work in this direction in cooperation with the chemical warfare service is in progress at the Stanford Laboratory.

Production of metallic beryllium and its al-

loys: B. S. Hopkins and E. A. Engle. BeO was found to be readily soluble in fused cryolite, but the electrolysis of the solution gave aluminium containing little beryllium. Electrolysis of fused sodium beryllium fluoride yielded considerable metallic beryllium, but it flaked off and was mixed with the oxide, carbide and fluoride. These were separated and flaky beryllium 98 per cent. pure was obtained. Similar electrolyses with metallic cathodes gave alloys containing some beryllium. The chief difficulties in preparing these alloys arise (1) from the tendency of the beryllium to oxidize and (2) from the change in density produced by the introduction of beryllium. Some beryllium-aluminium alloy was produced by preventing the fused metal from rising to the surface.

Preparation and properties of some rare earth metals: H. C. Kremers. With few exceptions the rare earth metals are more electropositive than aluminum, but less so than the alkaline earth metals. Reduction of the anhydrous chlorides with sodium gives only impure metal. Electrolysis of flourides or double flourides results in excessive passivity of the anode due to deposition of fluorine. Those rare earths which are more basic than aluminum can not be electrolized by dissolving the oxide in fused cryolite. Electrolysis of the anhydrous chlorides is most satisfactory. Lanthanum and neodymium have been prepared in quantity and many of their properties studied. Lanthanum being most basic tarnishes very rapidly. Neodymium oxidizes only after several hours exposure to air. Neither lanthanum or neodymium show pyrophoric properties in the ordinary way. Sparks are emitted only when the metals are violently struck. Yttrium metal is being prepared by electrolysis of the fused chlorides. Some of its properties are given.

A tantalide of aluminum: W. H. Chapin. The tantalide was first prepared by using a modification of the Goldschmit process directly on powdered tantalite. It was found by analysis to correspond to the formula Al_3Ta. Other methods of preparing the compound have been developed. The properties of this tantalide are proving very interesting and important: It is not acted upon by any single acid except H_2F_2; does not oxidize below white heat; reacts with HCl gas at 600°C. We give $AlCl_3$ ± $TaCl_5$, releasing the equivalent amount of H_2. Other properties are being studied.

A new halogenoid and halogenoid hydracid: A. B. Hoel, G. B. L. Smith and A. W. Browne. Azido-carbondisulphide $(SCSN_3)_2$, prepared by oxidation of sodium or potassium azido-dithiocarbonate in aqueous solution, is a white, crystalline, explosive solid, very slightly soluble in water, but soluble in various organic liquids, particularly acetone. It undergoes autocatalysis even at ordinary temperatures, yielding a mixture of polymeric thiocyanogen and free sulphur as the final product. It dissolves readily in KOH, yielding at low temperatures potassium azido-dithiocarbonate and potassium oxy-azido-dithiocarbonate, analogous to the chloride and hypochlorite formed when free chlorine dissolves in KOH. From the solution obtained, sulphuric acid reprecipitates the "free" azido-carbon-disulphide. Azido-dithiocarbonic acid, $HSCSN_3$, is obtained by treatment of a concentrated solution of sodium or potassium azido-dithiocarbonate with conc. HCl in the cold. It is a white, crystalline solid, soluble in water and in many organic solvents, and is almost as strong an acid as HCl. It decomposes autocatalytically at ordinary temperatures.

A study of adsorption of gases on a surface of mercury: H. H. King and J. Lowe Hall. Preliminary paper: A new method of measuring the angle of contact between mercury and glass, and the determination of surface tension of mercury. The purpose of this investigation is to study the adsorption of various gases under pressure variation on a surface of mercury through the corresponding changes in surface tension. A new method of measuring the angle of contact and determining the surface tension has been worked out wherein the mercury surface has maximum opportunity to remain undisturbed in equilibrium with the gas at the desired pressure throughout the determination.

Demonstration of a projection electroscope and a projection volt-ammeter: Howard M. Elsey. These instruments have been designed to take the place of the slide carrier in a projection lantern. The ease with which experiments in radioactivity and electro-chemistry can be shown to large audiences by the use of these instruments will be demonstrated.

Capillary rise measurements in tubes of various metals a new method of surface tension measurement: E. K. Carver. It was found by Bigelow and Hunter (*Jour. Phys. Chem.*, xv, 367, 1911) that water and benzene rose to different heights in tubes of various metals, and that the height became greater the more electropositive the metal. To verify this an apparatus somewhat similar to theirs was used. A plate of the metal, 1 cm. in diameter, was ground flat and a capillary hole was drilled through it. The diameter of the hole was measured with a micrometer microscope. A glass tube, 1 cm. in diameter, the end of which was ground flat, was placed upright in a battery jar. The metal plate was placed upon the tube after the liquid to be measured had been adjusted exactly to the height of the tube. By siphoning the liquid out of the jar until the liquid broke from the capillary hole in the metal plate, and weighing the liquid withdrawn, the capillary rise could be calculated. In disagreement with Bigelow and Hunter the writers obtained identical results with the different metals. The method is accurate to 0.1 per cent. and is exceedingly rapid.

Studies on the quantitative determination of praseodymium: PAUL H. M. P. BRINTON AND H. ARMIN PAGEL. A study of the much discussed question of the composition of the oxide resulting from the ignition of praseodymium oxalate in air leads to the formula Pr_6O_{11}. This oxide, in absence of other rare earth elements, shows great stability over a wide range of temperatures, and should be used as basis for calculation of analyses. Heating this oxide in vacuo is shown to cause dissociation, with ultimate formation of Pr_2O_3. The disturbing influence of impurities on the composition of this oxide led to the study of a volumetric oxalate method for praseodymium, which is independent of valence changes, and this method is advised for the determination of the element in slightly contaminated material.

The titration of hydrofluoric and hydrofluosilicic acids in the presence of each other: PAUL H. M. P. BRINTON, LANDON A. SARVER AND ARTHUR E. STOPPEL. The differential titration of mixtures of these two acids by sodium hydroxide, first in ice cold solution and then in hot solution, has been studied. Errors from the common method of delivering the samples into platinum weighing vessels from lead tubes have been found, and an improved method of handling the samples has been developed. The effect of silica in standard alkali solutions on the apparent percentages of the two acids has been shown as a source of serious error, and a curve of correction factors for the silica content of alkali solutions, even those which are supposedly pure, has been established.

The use of iodine pentoxide in volumetric gas analysis: C. R. HOOVER AND E. M. BILGER. To replace or supplement the use of cuprous solutions in ordinary gas analysis, it has been found possible to use iodine pentoxide on inert supporting material covered by fuming sulfuric acid. The apparatus employed may be a double absorption pipette for solid and liquid reagent to which a glass stopper has been fitted. The method of manipulation is similar to that employed in the determination of oxygen by means of solid phosphorus. After oxidation in the iodine pentoxide pipette the resulting carbon dioxide is absorbed in a potassium hydroxide pipette. The removal of carbon monoxide by this method is more complete and rapid, and the capacity of the material is greater than is the case with cuprous solutions. In addition, colorimetric indication of the progress of the reaction is provided. Under the proper conditions, removal of carbon monoxide is not interfered with or complicated by the presence of other gases not previously removed during the usual operations of a complete gas analysis.

The determination of iridium in platinum alloys by the method of fusion with lead: RALEIGH GILCHRIST. The method, originally proposed by Deville and Stas, consists of fusion of the platinum alloy with excess of lead, disintegration of the resulting button with nitric acid, followed by treatment with dilute aqua regia to separate the soluble lead-platinum alloy from the insoluble iridium. A critical study of this method was made, using synthetic alloys with iridium content from 0.1 to 20 per cent. Experiments were made to determine the minimum time required for the fusion as well as the optimum temperature, the best proportion of lead, the error due to the solution of iridium by the aqua regia and the effect of the presence of rhodium, palladium ruthenium and iron.

The separation of radium and barium as chromates: L. M. HENDERSON AND F. C. KRACEK. The solubility of the chromates of calcium, strontium and barium decreases with the increasing atomic weights of these elements. Accordingly, radium chromate might be expected to be less soluble than barium chromate. Experiments were carried out to effect a separation of radium from barium by adding definite quantities of potassium chromate to solutions containing both of these elements and at the same time maintaining the volume and acidity of the solutions at such a value that only a small portion of the barium precipitated. It was found that approximately twenty times as much radium was associated with one gram of barium in the precipitate as was associated with a gram of barium in the filtrate. This ratio was practically constant for varying fractions of barium precipitated. Under these conditions the ratio of radium per gram of barium in the precipitate to radium per gram of barium in the original solution varied with the quantity of barium precipitated. It was found that if one fourth of the barium were precipitated, the ratio of radium to barium in the precipitate was 3.5 times that in the original solution.

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