noted and seemed to merit this preliminary note, because of the ease with which it may be recognized without apparatus by fruit growers as well as by botanists.

The smallest veinlets of the leaf form a continuous network and the meshes of this network are areas of parenchymatous tissue. The size of these areas is not only remarkably uniform in a mature leaf but is directly dependent upon the age of the plant upon which the leaf is growing. The older the plant, the smaller are the vein-areas of the leaf. This difference can be seen with a hand lens by holding the leaves up to the light. In *Vitis riparia,* for example, accurate measurements of hundreds of areas in leaves picked from different parts of the same vine, gave an average (vine 26 years old) area of .20398 sq. mm., while the largest measured .217 sq. mm. and the smallest .185 sq. mm. The comparison for leaves from vines of different ages is shown by the following table, which gives averages from leaves picked from many plants.

	4-5 Growth Rings.	6-12 G. R.	15-30.	35-50.
Cuttings of *V. riparia*...	.44 sq. mm.	.35	.29	
Wild vines of *V. riparia.*	.42	.33	.24	.16

Even where the leaves are very large, as in the case of those borne on water-shoots from living stumps, the size of the areas is that characteristic of leaves borne on the tree the age of the stump. One of the several series of this kind follows:

Tree of *Castanea dentata*	8 Rings	15 R., Water-shoot	30 R.	Tree 50 R.
Size of area	.07 sq. mm.	.05 sq. mm.	.04 sq. mm.	.03 sq. mm.

The results with cuttings, water shoots and selected vines plainly indicates that the difference in size of areas is not due to external conditions. The reason that a leaf from a tree 25 years old differs in its venation from a leaf of a tree 10 years old is therefore that the meristematic tissue, in the two trees of the same species growing under the same conditions, is different. Apparently the meristem of the older tree produces less efficient specialized tissues than does the younger. The parenchyma is less permeable, the vessels less efficient in conducting; the sap must be brought into closer contact with all the leaf protoplasm. Since the amount of carbohydrate producing parenchyma is being gradually decreased by the inroads of the conducting system, the leaf is becoming a less efficient manufacturer of carbohydrate and ultimately the plant must starve.

If the changes in the size of the vein-areas be plotted as a curve, the nature of the resulting curve is the same as when the recognized senility changes in man and animals are plotted. It is interesting to note that changes in the vascular system in plants are due to the increasing senility of the meristem, just as changes in the vascular system of animals are due to senility. Dr. Osler says that "a man is as old as his arteries," and it may be said of plants that they are as old as their veins.

Since the leaves borne by cuttings showed but slight increase in the proportion of carbohydrate-producing tissue as compared with those on the original plant, it would appear that vegetative propagation can not and does not produce a young plant. The fact that the normal span of life for woody trees and vines extends in some cases over hundreds of years accounts for the fact that the approach of senility in vegetatively propagated plants is not more obvious. Plants which naturally reproduce by seed will tend to "run out" after long-continued vegetative propagation, ultimately dying of senility, and it is therefore incumbent upon our plant breeders to develop new varieties from seed, to take their place.

H. M. Benedict
University of Cincinnati

THE WASHINGTON MEETING OF THE AMERICAN CHEMICAL SOCIETY.

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

G. D. Rosengarten, *chairman.*

F. E. Gallagher, *secretary.*

H. C. Sherman, D. A. Bartlett and N. E. Weatherless: *Relation of Ultimate Composition to Calorific Power in Coal.*

The analyses and calorific powers of 67 coals from 17 states as published in Professional Paper 48 of the U. S. Geological Survey were considered. Estimates of calorific power by the usual formula

$$x = 8{,}080\,C + 34{,}500\,(H - \tfrac{1}{8}\,O) + 2{,}250\,S$$

("Welter's rule")

gave results too low in seven eighths of the cases, the average result being 98.9 per cent. of the calorific power actually found.

The formula

$$x = 8{,}080\,(C - \tfrac{3}{8}\,O) + 34{,}500\,H + 2{,}250\,S$$

("Walker's rule")

gave an average result 100.37 per cent. of the calorific power actually determined. The latter formula also showed a smaller proportion of serious errors in individual cases, and a smaller maximum error.

H. C. SHERMAN and S. H. REGESTER: *Relation of Proximate Composition to Calorific Power in Coal.* (Preliminary report.)

Analysis of the data for 500 samples of coal from different parts of the country are averaged to show the general course of the curve for calorific power of dry, ash-free substance with increasing proportions of volatile matter. As the proportion of volatile matter increases the mean deviations of individual samples from the average becomes greater. Where the volatile matter is over 48 per cent. of the dry ash-free substance the individual variations are so great as to deprive the average relation of any appreciable significance. Even with coals of low or moderate proportions of volatile matter, individual samples often differ from the average relation by 2 to 5 per cent. or more, so that if anything more than a crude approximation is desired the calorific power should be determined directly by combustion in a bomb calorimeter.

CHARLES E. MUNROE: *Note on the Production of Mercury Fulminate.*

Describes the preliminary steps taken in the production of substituted fulminic acids from the higher alcohols and of mercury fulminate and these substituted acids from acetaldehyde and the higher aldehydes.

CHARLES E. MUNROE: *The Present Status of the Gas Industry and Its Outlook.*

Attention was called to the fact that the centenary of the gas industry occurs in April, 1912, this being the one hundredth anniversary of the incorporation of the first Gas Light Company in London, England. The industry began in this country with the incorporation of the gas company in Baltimore in 1816. To-day there are 1,296 establishments in the United States, having a capital of $915,537,000; employing over 50,000 persons; manufacturing 150,835,793 M. cubic feet of gas; and having a value for its products of $166,814,000. To graphically depict the status and outlook of the industry a brief review of the various difficulties which it has encountered and the competitors which it has met and outranked was given, and it was admitted that the developments in the adaptation of electric energy to use presented now a more critical situation than the gas industry had perhaps ever before encountered; but he found in the development of the gas oven; in the employment of the chemical engineer; in the reduction of heat losses; in the more complete recovery of the by-products and their more complete utilization; and in the discovery and application of flameless incandescent surface combustion, means by which the gas industry could more than hold its own for a considerable time.

G. A. BURRELL: *New Forms of Gas Analysis Apparatus.*

This paper treats of gas analysis apparatus assembled by the author for work having to do with gas investigations carried on by the Bureau of Mines. Both accurate apparatus for use with mercury and apparatus for technical purposes are described. Exact and simple forms of apparatus for the examination of mine air and for use in ventilation studies are also described, both portable and laboratory forms. A special apparatus for the analysis of natural gas is also included. Also new apparatus for determining carbon monoxide by means of the iodic acid method.

F. M. WILLIAMS: *New Forms of Apparatus for Gas Analysis.*

J. T. BAKER: *Problems in Manufacture of C. P. Acids.*

This paper relates to the improvements made in recent years in the forms of apparatus for distilling acids on a larger scale. These are devised for working continuously by feeding the acid into the still as rapidly as the contents distills off and providing a gradual overflow for the tailings in order to remove the non-volatile impurities.

Apparatuses made of glass and porcelain are used and have a capacity of from 2,000 pounds to 4,000 pounds distillate in 24 hours. The advantages are less breakage with a minimum amount of labor and consumption of fuel.

J. R. CAIN and J. C. HOSTETTER: *A Rapid Method for the Determination of Vanadium in Steel, Ore, etc., based on its Quantitative Inclusion by the Phosphomolybdate Precipitate.*

Conditions are given for the quantitative precipitation of vanadium from solutions of steel, ores, etc., by coprecipitation with ammonium phosphomolybdate. Some methods of separating the vanadium from the precipitate are described. Attempts to determine the vanadium in the precipitate by Gregory's colorimetric method were unsuccessful. The vanadium may be reduced by sulphurous acid without reducing the molybdenum, and titrated against permanganate, but the method recommended by the authors is to reduce by hydrogen peroxide in concentrated sulphuric acid solution and titrate against permanganate, adhering closely to the conditions prescribed in the paper.

ERNEST BIDTEL: *Valuation of Fluorspar.*

Determinations usually required: Calcium-fluoride, silica, calcium-carbonate, sometimes lead, iron, zinc, sulphur.

Calcium-carbonate is determined by dissolving with ten per cent. acetic acid, taking the solubility of calcium-fluoride into consideration. Residue treated by yellow mercuric oxide to oxidize the sulphides, and silica volatilized by evaporation with hydrofluoric acid; loss in weight is silica.

Calcium-fluoride is eliminated without decomposing the ore. Iron oxide is transformed to iron-fluoride and separated together with lead and zinc sulphate by a solution of ammonium acetate containing ammonium citrate.

L. B. LOCKHART: *The Quality of Commercial Kerosene.*

PERCY A. BOECK: *Notes on a New Form of Extraction Thimble.*

Notes collected from various investigators on a new type of inorganic extraction thimbles and filters known as alundum. Manufacture described. Articles are made from bonded alundum grain, which is the product of the fusion of bauxite in the electric furnace and is practically pure fused alumina. Any texture, filtering capacity, melting point, tensile strength, etc., for any purpose can be obtained by varying method of manufacture. Articles filter rapidly, without any previous preparation and without changing the concentration of the solution, absorb only slightly, require little washing, and can be cleaned and sterilized by dry heating. Several types of extraction and filtering appliances for various kinds of work mentioned.

JOHN P. SIMMONS and O. J. TEEPLE, JR.: *The Effect of Filtration upon the Physical Properties of Petroleum Oils.*

FREDERIC P. DEWEY: *The Direct Determination of Small Amounts of Platinum in Ores and Bullion.*

Platinum alloyed with silver being soluble in nitric acid, the solution obtained in parting gold from silver in ordinary assays is treated with a limited amount of hydrogen sulphide, after roasting, the precipitate is cupelled with a small amount of lead and the bead parted in strong sulphuric acid. Any platinum present will be left as a white metal, generally recognizable as platinum, but it may be tested to prove its identity or the presence of platinum metals.

FRANKLIN PEALE SUMMERS: *The Product Patent.*

This paper deals with the differences existing between our patent laws and those of the other countries with reference to the product patent on foods, drinks and medicinals. Practically all the other countries with the exception of England and the United States refuse to grant a product patent on the commodities above mentioned. The result is that, first, they permit competition on the necessities of their citizens, and secondly, they encourage the growth of chemistry in the respective countries, by opening and keeping open new fields for chemical research.

As long as these alien countries will not grant to an American citizen the same privilege that the United States grants to their citizens, it does not seem equitable that we should continue to grant the product patent on foods, drinks or medicinals.

In so doing our country continues to retard the growth of chemistry in a field that the other countries keep open. Thus in one product, aspirin, our citizens are annually paying a tribute to Germany of approximately two hundred thousand dollars, over and above what this same commodity sells for in Canada where no product patent is valid. This is due to the fact that in England and Germany the field for the production of acetyl salicylic acid is an open one and competition is permitted.

Were our country to change its patent laws so as to conform with these other countries in this respect, it would open a vast field in the production of organic synthetic compounds. We would be enabled to compete with these countries in an industry whose financial return is many millions of dollars. We would also offer still further inducement for the chemist, and by so doing we would more than ever narrow down the handicap now held by Germany for supremacy in chemical fields.

JAMES O. HANDY: *The Use of Potassium Cyanide Solution in the Investigation of the Structure and Conductivity of Copper, Copper-covered Steel and Other Metals.*

A 25-per-cent. aqueous solution of potassium cyanide dissolves, when boiled, an amount of copper equal to 5 per cent. of the KCy used. Steel and iron are almost insoluble in the same solvent.

Copper containing iron or arsenic shows a characteristic crystalline and colored appearance when etched with KCy solution. Pure cast copper is but slightly affected.

The structure of the "*welded* on" or "alloyed on" copper coverings of copper-covered steel wire has been studied by means of KCy solution. The "alloyed on" coverings have shown their impure nature. The conductivity of the composite wires and of the bare steel cores (after dissolving off the copper by KCy solution) showed in one case as follows:

	Steel Per Cent.	Copper Per Cent.	Conductivity of Composite Wire Per Cent.
"Welded" ...	77.20	22.80	36.20
"Alloyed" ...	56.00	44.00	34.00

The conductivity of the steel cores approximated 14 per cent. The low conductivity of the sample highest in copper shows its inferiority.

E. P. HARDING and E. JOHNSON: *An Apparatus and Improved Method for Determining Quantitatively Hydrogen Sulfide in Illuminating Gas.*

H. E. KIEFER: *Free Lime in Portland Cement.*

This paper cites numerous experiments to show that free lime is not the sole cause of disintegration of Portland cement as shown by the boiling test. If free lime is a real cause, as little as three tenths of one per cent. will cause rupture. Shows that carbon dioxide is not essential to seasoning and that the absorption of as little as one tenth of one per cent. of water will under certain conditions cure a very defective cement. That under other conditions neither water nor carbon dioxide is essential. Advances a theory of disintegration on physical lines to account for the seasoning of unsound cements.

W. C. TAYLOR and E. C. SULLIVAN: *Glass Analysis.*

A rapid method for analysis of glasses has been developed, depending on the decomposition of the glass by means of hydrofluoric and oxalic acids. Results for alkalies agree very well with those given by the Lawrence Smith method and results for lead, alumina, iron, manganese, lime, magnesia and zinc are accurate also.

The method of Wherry for the determination of boric oxide has been applied to glasses with necessary modifications where zinc or lead is present.

GEORGE L. HEATH: *The Estimation of Absorbed Gases and Oxygen in Copper by Ignition in Carbon Dioxide and Hydrogen.*

Thirty-seven years ago Dr. W. Hampe, of Germany, devised a process for the quantitative estimation of the percentage of oxygen in commercial copper by heating filings, or drillings, in an atmosphere of pure hydrogen gas in a hard-glass bulb tube, determining the loss in weight of the metal, and as an alternative the weight of water produced by the union of the hydrogen with the oxygen existing in the copper. Archbutt, Hofman and the writer have improved the process, but there is an error and omission in all published accounts, which it is important to correct by announcing the results obtained in a recent search for a method to show us, not only the oxygen, but also the original absorbed gases in all refined, or cast, copper of trade, which mainly consists of hydrogen (as hydride, or solid solution), with *traces* of carbon monoxide, carbonic dioxide, nitrogen, and possibly argon.

A separation which is accurate enough for analytical purposes is made possible by heating the copper, first, in carbon dioxide, for absorbed gases; secondly, in hydrogen to take out the oxygen; thirdly, in carbonic acid for a short time to take out considerable residual hydrogen, which would be, otherwise, retained.

Copper absorbs and retains but traces of pure carbonic acid, so that gas will expel hydrogen under heat. The first and third propositions have, hitherto, been overlooked.

DIVISION OF FERTILIZER CHEMISTRY

Paul Rudnick, *chairman*
J. E. Breckenridge, *secretary*

PAUL RUDNICK (chairman's address): *Fertilizer Chemistry—A Report of Progress.*

The consumption of commercial fertilizers for the year 1910 is estimated, in round numbers, at about 5,750,000 tons, an increase of approximately 14 per cent. over that of 1909. The average annual increase in the past decade has been close to 11.3 per cent.

The cost of ammoniates which supply the nitrogen in fertilizers has materially advanced, as the demand is greater than the supply. Inorganic ammoniates, including nitrate of soda, sulphate of ammonia and the products made from atmospheric nitrogen by chemical and electrochemical processes, are produced in constantly increasing quantities, but organic ammoniates, including tankage, blood, etc., can not be produced in sufficient quantity to meet the demand and can not be entirely replaced by the inorganic sources of nitrogen for reasons involving mechanical condition, so that the fertilizer may be applied to the soil by suitable machinery. Much care and thought should be given to methods of control by state fertilizer authorities, so that arbitrary methods of analysis may not prevent the utilization of organic ammoniates which are now being wasted and thus the cost of the necessary organic ammoniates be forced up beyond all reasonable bounds. This is a matter of conservation of resources as well. The nitrogen of practically all the coal burned in this country should be recovered in the form of sulphate of ammonia.

In striking contrast to the demand for high availability of nitrogen is the proposal to use raw phosphate rock, the phosphoric acid of which is admittedly not available or at least so slowly that its application does not pay. It is highly desirable that commercial methods of producing available phosphoric acid from phosphate rock by cheaper and more efficient means than by conversion into acid phosphate should be found, although the Wisconsin Agricultural Experiment Station has recently pointed out that the sulphur in acid phosphate, present as calcium sulphate and produced by the treatment of phosphate rock with sulphuric acid, is a very necessary element in fertilizers, as much as and in some cases more so, than phosphoric acid.

The German potash controversy has stimulated renewed activity in the search for sources of commercial potash salts in this country, so that we may not be dependent upon Germany for this important constituent. The U. S. Geological Survey is now engaged in drilling a well, at Fallon, Nevada, as it seems likely that such deposits may exist in that region.

After discussing the various theories proposed to explain the action of commercial fertilizers, the possibility is pointed out that the results obtained from the use of commercial fertilizers may in part be due to a protective action which they exercise on the cells of the plant in some way similar to the action of the salts in sea water on animal organisms.

The need of a comprehensive and scientifically accurate theory of fertilizers is pointed out, so that wasteful and unscientific use may give way to the most efficient and economical, hence most profitable, use.

Burt L. Hartwell and F. R. Pember: *The Effect of the "Wet Process" on the Availability of Low-grade Nitrogenous Materials.*

In all, two crops of Japanese millet, two of oats and one of buckwheat were grown in pots on two different soils which were supplied with all the necessary non-nitrogenous manures. The amount of nitrogen supplied in the various nitrogenous materials which were tested was the same for each crop. Hair tankage, garbage tankage and roasted leather were used both before and after being subjected to digestion in the presence of phosphate rock and sulfuric acid (the "wet process").

The nitrogen of the garbage tankage had a very low availability both before and after acidulation; while that in roasted leather and hair tankage, although of low availability before, was much more available after, treatment.

The treatment by the "wet process" of these nitrogenous materials individually was conducted in the laboratory, but a mixture of the three was treated by the regular "wet process" in a fertilizer factory. Over 70 per cent. of the nitrogen in the "base goods" so manufactured was soluble in water and highly available, but the insoluble nitrogen was of no immediate value.

F. B. Porter: *A Method for Testing Out Problems in Acid Phosphate Manufacture.*

1.1 grams rock dust are weighed into 5″ × ⅝″ test tube, known amount of acid added from Mohr's pipette. Stir three minutes, keep at any desired temperature for any desired time.

Transfer on to 9 cm. filter paper with water and determine insoluble phosphoric acid.

Average of three or four tests taken for result.

I. K. Phelps: *Exact Work in Fertilizer Analysis.*

C. H. Jones: *Activity of Organic Nitrogen as Measured by the Alkaline Permanganate Method.*

The alkaline permanganate method for nitrogen activity is described in detail, together with the form now used for reporting results.

Results on fourteen different crude nitrogenous stock samples, 8 commercial fertilizers, and 13 mixtures of known composition are stated in tabular form, and explanations are given as to their interpretation from a standpoint of nitrogen activity.

A method is presented for determining the percentage of "nitrogen in the organic and volatile matter." Its application to fertilizers and crude stock as a means of determining whether the organic nitrogen present came from materials rich or poor in that element is discussed.

H. G. BELL: *Fertilizer Economics.*

Advantages of mixed fertilizer are brought forth.

The fertilizer industry an essential factor in the business and life of the country.

European and American yields on wheat, oats, barley and potatoes are compared, showing Europe far ahead in crop yields.

North Atlantic states compared with middle Atlantic states shows gains for north Atlantic states in yield per acre due to rational use of mixed fertilizer.

Records of large gains by using fertilizer are given in Indiana and Ohio.

Sound economic principles as the basis of manufacture and sale of fertilizer are considered.

E. B. HART: *The Sulphur Requirements of Crops in Relation to the Soil and Air Supply.* (From the Laboratory of Agricultural Chemistry, University of Wisconsin.)

The average crop of cereal grains and straws removes about two thirds as much sulphur as phosphorus, mixed grasses remove the two in about equal proportions, while alfalfa removes about 60 per cent. more sulphur than phosphorus. Members of the Cruciferæ, such as cabbage and turnips, may remove two to three times as much sulphur as phosphorus.

The superior results often obtained in the case of acid phosphate as compared with other sources of phosphoric acid may not be due entirely to the solubility of the phosphoric acid, but also to the additional sulphur supplied by the acid phosphate in the form of calcium sulphate. The idea that sulphur may become a limiting element in crop production would further account for the beneficial results obtained from gypsum, sulphate of potash and other sources of sulphur commonly contained in fertilizers.

J. P. STREET: *Note on the Neutral Permanganate Method for Availability of Organic Nitrogen.*

The adding of one gram of sodium carbonate to the neutral permanganate solution just before adding material to be tested largely overcomes the loss in availability when high-grade ammoniates are mixed with large proportions of acid phosphate.

Results on many organic ammoniates in presence of acid phosphate are given, showing that the method does differentiate between high and low grade materials.

A. J. PATTON and C. S. ROBINSON: *Conductivity Method of Making Neutral Ammonium Citrate Solution.*

This method, worked out independently by the authors, is essentially the same as that proposed in the meantime by Hall and Bell[1] and later shown by Hall[2] to be quite suitable for ordinary laboratory use, and their results are fully confirmed by this work. In addition comparative determinations of insoluble phosphoric acid were made, using solutions neutralized by the conductivity method and by the indicator method. The data justified the conclusion that the conductivity method is much to be preferred in every way to the indicator method.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

H. P. TALBOT, *chairman*

S. L. BIGELOW, *secretary*

JAMES R. WITHROW: *The Relative Densities of Sodium Amalgam and Mercury.*

R. B. MOORE: *The Formation of Helium from the Thorium Emanation.*

A. B. DAVIS, IVY MILLER and R. B. MOORE: *Nipponium.*

H. H. WILLARD: *The Quantitative Separation of Lithium from Sodium and Potassium.*

Sodium and potassium may be separated from lithium by precipitation as silicofluoride in methyl alcohol solution. Ethyl alcohol and acetone cause a large amount of lithium to be precipitated with the sodium and potassium. To the solution, which should be very small in volume—not over 10 c.c.—is added a little hydrochloric acid, then hydrofluosilicic acid, and 75 or 80 c.c. methyl alcohol. Several hours are required for complete precipitation. If the amount of lithium is large, the precipitate must be dissolved and reprecipitated. It may be dried at 150°–180°.

Lithium may be quantitatively precipitated from a neutral solution by means of tribasic tetramethyl-ammonium phosphate, methyl alcohol being added to make the precipitation more complete. If present in considerable amount, a little sodium is carried down, but a second precipitation will give a complete separation.

H. H. WILLARD: *The Preparation of Perchloric Acid.*

Ammonium perchlorate is oxidized by means of nitrohydrochloric acid, the ammonium being thus

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[1] *Jour. of the Am. Chem. Soc.*, 33, p. 711, 1911.

[2] *Jour. of Ind. and Eng. Chem.*, 3, p. 559, 1911.

removed and perchloric acid remaining. The best proportions are: 1 kg. ammonium perchlorate, 800 c.c. water, 600 c.c. nitric acid (sp. gr. 1.42), 200 c.c. hydrochloric acid (sp. gr. 1.2). The hydrochloric acid is added slowly to the boiling solution of the other substances, using a reflux condenser. After about one hour the solution is evaporated until all nitric and hydrochloric acid is removed. The yield is the theoretical.

CHARLES H. WHITE: *A Colorimeter for Rapid Work with Widely Varying Standards.*

The standard and the unknown solution are compared in hollow wedge-shaped prisms of glass, placed vertically in a camera behind screens provided with a narrow horizontal opening opposite the eye for the simultaneous observation of the two solutions. The wedges are held in graduated carriers, by the vertical movement of which the thickness of the section of solution observed is varied. The wedge containing the unknown is set at the graduation representing the percentage of color-producing agent in the standard. The standard is then adjusted to match the color of the unknown and the percentage in the unknown is read directly.

IRVING LANGMUIR: *The Dissociation of Hydrogen into Atoms at High Temperatures.*

In a previous paper (to be published in the *Phys. Rev.*) it was shown that the laws of heat convection in gases are much simpler than has been generally supposed. In fact, the problem reduces to one of simple conduction through a film of relatively stationary gas held in place by viscosity. The thickness of the film in any gas under any given conditions may be calculated accurately by simple formulas. If the energy loss for a tungsten filament in hydrogen be calculated in this way the results agree with observed values within the experimental error up to a temperature of about 2300° K., but above this show rapidly increasing differences. At 3300° K. the observed energy loss is over four times the calculated. It is assumed that this difference is due to the dissociation of hydrogen molecules into atoms. The variation of the energy loss with the temperature and with the pressure agree quantitatively with this theory. Simple unforced theoretical considerations form the basis for a calculation of the heat of formation of hydrogen molecules and the percentage dissociation at various temperatures. The results are: Heat of formation of H_2, 125,000 cal. Percentage dissociation (1 atmo.): at 2500° K. 3.9; 2700°, 10.0; 2900°, 22.1; 3100°, 40.4; 3300°, 61.4. In the case of the monatomic gas, Hg vapor, the calculated energy loss does not show differences with the observed values similar to the above.

IRVING LANGMUIR: *A Chemically Active Modification of Hydrogen.*

When a tungsten wire is heated to a temperature between 1300° and 2500° K. in hydrogen at very low pressure (0.001–0.020 mm.) the hydrogen slowly disappears. With nitrogen or carbon monoxide such disappearance never occurs below about 2200° K. and seems to be an electrical effect, while with hydrogen it is purely thermal. There is a distinct fatigue effect, but the substitution of a new section of wire does not restore the action. The hydrogen is not absorbed by the wire, but is deposited on the glass, especially where the latter is cooled by liquid air. If the wire is allowed to cool and the liquid air is then removed, ordinary hydrogen is set free which will not recondense when the liquid air is replaced. If this gas is pumped out and oxygen is admitted the oxygen will disappear and in its place a small quantity of hydrogen will appear. With platinum and especially with palladium wires these effects are much more marked. These effects are not due to the presence of finely divided metal on the surface of the glass. When phosphorus is present on the inner surface of the bulb and hydrogen is introduced and the wire heated to a temperature of about 1900° K., the hydrogen disappears and phosphine is formed (apparently the first direct synthesis of phosphine). These effects are accounted for by the theory that the hydrogen dissolves in the material of the wire in the atomic condition and that some of these atoms leaving the wire, do not meet other atoms (because of the low pressure) but diffuse into the tube cooled by liquid air, or become adsorbed by the glass, and thus remain in the atomic condition, retaining all of the chemical activity of the atoms.

IRVING LANGMUIR: *Melting Point of Tungsten.*

The melting point was determined by heating pure ductile tungsten wires in pure hydrogen to gradually increasing temperatures until the wire melted through. The temperature was found from the candle power emitted per square mm. of surface, using a modified form of Rasch's equation. The advantages of an atmosphere of hydrogen are: (1) Vaporized metal is carried away by the hydrogen and does not blacken the tube and interfere with candle-power measurements. (2) The energy loss from small wires in hydrogen is nearly independent of the diameter of the wire, therefore if the wire becomes thin in one spot the tendency to burn out is much less than it would be with the wire run in vacuo. It is therefore possible to make reliable measurements of the candle power at a temperature much closer to the melting point than is possible in vacuo. The results were: in hydrogen 3250° K., 3345°, 3430° and one somewhat doubtful value of 3500°; in mercury vapor, 3450° K. and 3350°. As the method tends to give low results it is highly probable that the melting point of tungsten is at least 3500° K. or about 3250° C. This is in good agreement with the value given by Pirani 3300° C., but very different from that of von Wartenberg, who gave 2900° C.

JOEL H. HILDEBRAND: *The Thermal Dissociation of Barium Peroxide.*

This equilibrium has been investigated on account, not only of its scientific interest, but because of its practical application in the manufacture of oxygen and hydrogen peroxide.

The nature of the phases involved was determined by observing the effect upon pressure of removing successive portions of oxygen, the temperature being kept constant. It was shown that within certain limits the oxide and peroxide form solid solutions in each other, and that a barium hydroxide phase must also be present. Conditions for reversing the equilibrium were stated.

Accurate measurements of the dissociation pressures of the univariant system were made, and the thermodynamics of the system discussed.

S. C. LIND: *Chemical Combination and Disintegration under the Influence of Radium.*

Chemical action produced by radium is due almost entirely to the α-rays. For gas reactions both of combination and of disintegration the *number of molecules* affected in a given time is of the same order of magnitude as the *number of ions* formed by the α-rays in that time, as calculated from Bragg's experiment on the ionization of gases. Data of Ramsay and of the author verify this conclusion with respect to radium emanation. A method is proposed for calculating simply the mean path of α-rays in cylindrical and spherical vessels. The principle found true for gases may also be extended to liquid systems, data of Ramsay, of Debierne, and of the author being used for its establishment both for emanation and radium salt in solution.

EUGENE C. BINGHAM: *Fluidity and Vapor Pressure.*

E. C. BINGHAM and G. F. WHITE: *Fluidity and Hydration.*

E. C. BINGHAM and G. F. WHITE: *A New Viscosimeter.*

EDWARD C. FRANKLIN: *Potassium Ammono Thallate.*

When the ammono base, potassium amide, in solution in liquid ammonia is added to a solution of thallium nitrate in the same solvent a black precipitate of thallium nitride is formed in accordance with the equation,

$$3TlNO_3 + 3KNH_2 = Tl_3N + 3KNO_3 + 2NH_3.$$

Thallium nitride dissolves in a liquid ammonia solution of potassium amide to a clear yellow solution from which potassium ammono thallate of the composition represented by the formula, $TlNK_2 \cdot 4NH_3$, may be obtained in the form of beautiful yellow crystals. The action of potassium amide on thallium nitride is represented by the equation,

$$Tl_3N + 6KNH_2 = 3TlNK_2 \cdot 4NH_3 + 2NH_3.$$

WILLIAM BLUM: *The Hydrolysis of Sodium Oxalate and its Influence upon the Test for Neutrality.*

The testing of sodium oxalate for use as a primary standard in acidimetry and oxidimetry requires a knowledge of the normal alkalinity. Decimolar solutions of pure sodium oxalate were found to produce a pink color with phenolphthalein equivalent to 4 per cent. transformation of the indicator, instead of the calculated 8 per cent., showing discrepancies in the accepted constants or theories. Colorimetric comparisons were made with solutions calculated from Sörensen's E.M.F. measurements, indicating that for 0.1 *m* $Na_2C_2O_4$, $[H^+]_{18^\circ} = 2.5 \times 10^{-9}$; and that the salt is hydrolyzed to the extent of 0.0024 per cent. The error produced in a titration by neglecting this normal alkalinity is negligible.

R. C. WELLS: *The Fractional Precipitation of Hydroxides.*

By fractionally precipitating dilute solutions of various pairs of metallic salts with caustic soda the following series was obtained, such that the higher members are more precipitable: ferricum, aluminum copper, zinc, lead, nickel, silver, ferrosum, manganese, magnesium, calcium. The position of a metal in the series is probably determined by (1) the solubility of the hydroxide and (2) the extent of hydrolysis of the metallic salt. The series agrees well with the order of the heats of precipitation of the hydroxides.

C. W. EASLEY and B. F. BRANN: *The Atomic Weight of Mercury.*

By means of bringing an excess of pure bromine in contact with pure mercury at approximately 300°, mercuric bromide was sublimed into a convenient receiver, which in turn was heated almost to the point of sublimation of the material in a stream of nitrogen. On cooling, the nitrogen was displaced by dry air.

From this material, mercuric oxide was precipitated by the use of a slight excess over the calculated amount of sodium hydroxide. This action was brought about in a flask with well-guarded openings so that the subsequent reduction with hydrogen peroxide or with hydrazine gave rise to no loss of the solution in the form of spray. The solution being separated from the free mercury, the bromine was determined as silver bromide in the usual way. The value 200.63 was obtained as the result of eleven concordant determinations of the ratio $HgBr_2:2AgBr$, no determinations, of course, being rejected.

J. I. D. Hinds: *Precipitation of the Copper-Arsenic Group and the Separation of its Divisions.*

A definite acid concentration is secured. Arsenic is precipitated in 2 normal hydrochloric acid solution, the other metals in half normal hydrochloric acid solution. Tin is precipitated as stannic sulfid. The sulfids of arsenic, antimony and tin are dissolved in colorless ammonium sulfid, or in ammonium hydroxid and hydrogen sulfid.

To a portion of the solution add one ninth its volume of hydrochloric acid (making it normal in HCl since the laboratory acid is about 10 normal) and a few drops of nitric acid to oxidize stannous to stannic ion. Boil the mixture a little more than half away in an Erlenmeyer flask, making the residual liquid 2 normal, pass a rapid stream of hydrogen sulfid until precipitation is complete (5 to 10 minutes), add enough water to make the volume twice the original, making the solution one half normal in hydrochloric acid and continue to pass hydrogen sulfid until precipitation is complete (10 to 15 minutes). Filter and wash.

Transfer the precipitate to a beaker, cover it with ammonium hydroxid, pass hydrogen sulfid rapidly for a minute, warm, shake, filter and wash. The filtrate contains the thioanions of arsenic, antimony and tin; the residue contains the sulfids of the other metals of the group.

Treat filtrate and residue in the usual way.

Time required for the entire process 30 to 45 minutes.

William D. Harkins: *The Intermediate Ion Hypothesis.*

The values now used for the degrees of dissociation of unibivalent salts, such as K_2SO_4, $BaCl_2$ or $Cu(NO_3)_2$, do not represent the degrees of dissociation at all, but are only the values of the conductance ratio, if intermediate ions are present in the aqueous solutions of salts of this type. In recent papers[3] it has been shown that the solubility relations of such salts indicate that the ionization takes place in two steps as follows:

1. $K_2SO_4 = K^+ + KSO_4^-$.
2. $KSO_4^- = K^+ + SO_4^{--}$.

Potassium sulphate, according to the present values used, is 71 per cent. dissociated in its tenth normal solution at 25°. Approximate calculations made upon the basis of the intermediate ion hypothesis indicate that its actual *total* dissociation is about 95 per cent.

It seems probable that *all triionic salts, acids and bases, when dissolved in water, dissociate in two steps, and that intermediate ions are present in all such solutions.* If this is the case, it seems self-evident that intermediate ions must be present in *all* aqueous solutions containing salts, acids or bases of still higher types. The percentage of the salt present as the intermediate ion is zero at zero concentration and increases as the concentration of the salt in the solution increases.

The constant $k = (K^+ \times KSO_4^-/K_2SO_4)$ increases with the total ion concentration and is several times larger, in the case of salts, than the second constant $k = (K^+ \times SO_4^{--}/KSO_4^-)$.

Solutions of certain salts, such as lead chloride, contain an abnormally large percentage of the intermediate ion.

G. R. White and H. Eastwood: *Electrolytic Corrosion in Ammonium Salts.*

Test pieces of copper, nickel, zinc, tin, iron and cadmium were made anodes in solution of ammonium chloride, sulphate, nitrate, acetate and tartrate containing 75 g. of the salt per liter. The anodes were rotated to ensure thorough stirring. The electrolysis was carried on at room temperature for an hour with a current of .35 amp. The average current density was 2.8 amp. per sq. dm. The results, which are given as percentage efficiency of corrosion, show that corrosion is markedly different for different electrolytes and that it is affected by changing the current density and in some cases by changing the temperature.

J. W. Turrentine and Raymond L. Moore: *Contributions to the Electrochemistry of Hydro-*

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[3] *Jour. Am. Chem. Soc.*, 33, pp. 1807–73.

nitric Acid and its Salts. II. *The Action of Copper and of Cuprous Oxide on Hydronitric Acid.*

In order to test the plausibility of certain reactions proposed to account for the phenomena observed at magnesium, aluminium and zinc anodes in sodium trinitride solution, reactions analogous to those hypothesized were induced and the accompanying phenomena were examined. The action of cuprous oxide on hydronitric acid is that of a reducing agent, the acid being reduced to ammonia and free nitrogen and the cuprous oxide becoming cupric trinitride. The relations here existing may be represented qualitatively by the expression: $Cu_2O + 5HN_3 = 2CuN_6 + H_2O + NH_3 + N_2$. With metallic copper, cupric trinitride results, and ammonia and gaseous nitrogen again appear as the reduction products. To represent this reaction, the equation is given:

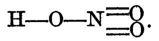
$$Cu + 4HN_3 = CuN_6 + NH_4N_3 + N_2.$$

J. W. TURRENTINE and LEONARD A. MAYNARD: *The Reduction of Hydronitric Acid by Cadmium.*

Hydronitric acid dissolves cadmium with effervescence. A neutral solution of cadmium trinitride and ammonium trinitride results. The gas evolved is nitrogen. The following equation is proposed to represent the course of the reaction:

$$Cd + 4HN_3 = CdN_6 + NH_4N_3 + N_2.$$

The products of the reaction have been measured. In the reactions with cuprous oxide, copper and cadmium (and with numerous other substances), hydronitric acid is found to be an oxidizing agent, an analogue of nitric acid, a fact which leads to an analogous structure. Accordingly, the structural formula for hydronitric acid, $H{-}N{=}N{\equiv}N$, is proposed, analogous to that of nitric acid,



$$H{-}O{-}N\begin{smallmatrix}=O\\=O\end{smallmatrix}.$$

This structure is supported by numerous reactions and considerations yet to be presented. Just as nitric acid is regarded as a hydrated oxide of nitrogen, hydronitric acid may be considered an ammoniated nitride of nitrogen.

E. H. ARCHIBALD: *The Hydrolysis of Potassium Chloroplatinate.*

The hydrolytic decomposition of solutions of potassium chloroplatinate at a temperature of 25° has been studied. The hydrolysis can be followed by titrating the hydrochloric acid formed with sodium hydroxide, using phenolphthalein as indicator.

The hydrolysis takes place very rapidly under the influence of light, apparently the ultra-violet rays only being concerned, as no action is caused by the strongest illumination from four Welsbach mantles. In bright sunlight at a temperature of 25° the reaction is complete in the case of a $N/50$ solution in 200 minutes when an amount of hydrochloric acid will have been formed equivalent to 36.5 per cent. of the chlorine present as platinum tetrachloride. A solution of this strength prepared in non-actinic light and kept in the dark has not attained equilibrium before several weeks. In the case of a hundredth normal solution the time required for equilibrium to be established in bright sunlight is 175 minutes and hydrochloric acid is formed corresponding to 50 per cent. of the chlorine present as platinum tetrachloride.

The reaction reverses to a small extent when the solution hydrolyzed by the bright sunlight is placed in the dark.

The reaction reverses much further, rapidly in the light but very slowly in the dark, when potassium chloride is added to the hydrolyzed solution.

E. H. ARCHIBALD and E. F. CONWAY: *The Hydrolysis of Potassium Bromoplatinate.*

The hydrolysis of potassium bromoplatinate has been studied after the manner of the previous investigation. The source of the ultra-violet rays was in this case an electric arc placed about 25 cm. from the solution to be studied. The temperature was kept constant at 25°. The hydrolysis is more complete than in the case of the chloroplatinate; the amount of hydrobromic acid formed in a $N/100$ solution corresponded to 78 per cent. of the bromine present as platinum tetrabromide. The reverse reaction also goes further when the hydrolyzed solution is placed in the dark.

A solution of the bromoplatinate prepared in the absence of actinic rays and kept in the dark showed no detectable hydrolysis after five days.

H. C. COOPER, E. H. KRAUS and A. A. KLEIN: *Lead Silicates.*

Having subjected the system $PbO{-}SiO_2$ to thermal analysis and optical analysis, the latter particularly difficult because the refractive indices of most of the lead compounds are higher than the index of any known immersion liquid, the authors conclude that $PbSiO_3$, Pb_2SiO_4 and $Pb_3Si_2O_7$ are well-defined compounds and that Pb_3SiO_5 is probably also an independent substance. The minerals barysilite, found in Sweden by Sjögren and Lundstrom and the mineral alamosite, recently described independently by Palache, correspond fully with the compounds $Pb_3Si_2O_7$ and $PbSiO_3$, respectively. It is interesting that the artificial alamosite was prepared and characterized before its counterpart was found in nature. The crystallized lead silicate formations found under dismantled smelters are rather miscellaneous in character, the largest crystals being of mixed composition.

H. S. Fry: *Some Application of the Electronic Conception of Positive and Negative Valencies: V. Dynamic Formulæ and Absorption Spectra of Chlor- and Brom-benzenes.*

F. D. Wilson: *A Further Study of the Action of Calcium Carbonate on Zinc Sulphate Solutions.*

When calcium carbonate and zinc sulphate solutions are brought into contact with one another in varying preparations, and at different temperatures, and for different periods of time, the basic carbonate is formed.

When the solution of zinc sulphate is changed into carbon dioxide, and calcium carbonate added, and carbon dioxide passed in for several days, the normal carbonate of zinc with from 0.8 to 1.5 per cent. of water is formed.

Robert B. Sosman: *The Nitrogen Scale from 300 to 600 Degrees.*

Charles Baskerville and Abraham Lusskin: *Chemical Tests for Lanthanum.*

As far as we are aware, there are no chemical tests for lanthanum which are so distinctly characteristic as to be used to prove the presence of that element when associated in mixtures with neodymium or praseodymium. Recourse must be had to photographic reproduction of the arc or spark spectrum, facilities for which do not constitute a part of the armamentarium of all analytical chemists, and at best this is not applicable upon a quantitatively qualitative basis.

Having exhausted the probabilities of analogous tests for other metals, recourse was had to the empiricism offered by a Kahlbaum catalogue. While much not recorded in the literature was observed as to the conduct of this subgroup of the so-called rare earths with many unusual reagents, the main object was to secure some one or more definitely distinctive tests for lanthanum alone or in mixtures. While it may be stated that results altogether satisfactory were not obtained, the following may be noted.

Conduct with Sodium Potassium Tartrate.—Solutions of lanthanum, neodymium and praseodymium salts, singly or mixed with each other, give precipitates with this reagent which dissolve in an excess of the precipitant. On adding oxalic acid to these solutions a precipitate is produced in each case, but with lanthanum the precipitate is soluble in excess. Filtration, evaporation and ignition yield lanthanum oxide. The delicacy of the reaction and all the determining factors have not been established.

Conduct with Cyanates.—Potassium cyanate gives a white gelatinous precipitate insoluble in excess. On standing the precipitate changes into beautiful silk-white crystals. Similar conduct was observed with neodymium and praseodymium salts, except that each of the latter exhibited the characteristic rose or light green tint. The solubility of these cyanates, the composition of which has not been determined, was investigated, using a great variety of solvents, some very unusual. A difference was noted in the solubility in bromine water, the lanthanum salt being more soluble. In acetic acid, however, the lanthanum salt dissolved much more slowly. The same was noted with lactic and phthalic acids and boiling sodium tartrate solutions. In the last the neodymium preparation is entirely soluble, whereas the lanthanum salt is only slightly, but appreciably, soluble.

Neither of the methods has so far shown itself suitable either for satisfactory qualitative purposes or for separating lanthanum from the didymium on a laboratory scale.

Suggestions as to rarely applied tests will be most acceptable.

Charles Baskerville: *On the Simplicity of Praseodymium.*

The results of twelve years' study of praseodymium with different assisting workers in an effort to show its complexity are given. All efforts to decompose praseodymium were unsuccessful. The investigations were carried out along the following lines: (1) fractional precipitation from salt solutions; (2) fractional solution of the black oxide in acids; (3) fractional decomposition of the nitrate by heat; (4) fractional crystallization of double nitrates, one being an isomorphous nitrate of another metal; (5) fractional oxidation of a soluble salt of praseodymium; (6) fractional oxidation of the oxide by fusion with an alkali peroxide, and (7) fractional electrolysis, with and without a porous cell. The absorption spectrum of the different fractions, several thousand all told, was taken as a criterion as to any disintegration. Solutions of a definite strength, acidity and thickness were compared.

J. E. MILLS: *Force.*

Elasticity is a property very similar to temperature, depending upon the motion of certain parts of larger elastic bodies. When these fundamental particles collide they simply exchange velocities instantaneously. Neither motion nor energy is for a fraction of a second lost.

The usual definition of force is: "A unit force is that force which, acting on a mass of one gram for one second, will give to it a velocity of one centimeter per second." In a medium when the particles exchange their velocities instantaneously this definition of force does not apply, as the words "for one second" have no meaning. More important is the fact that the kinetic energy of a moving body must then be measured by its mass (probably amount of matter) times its velocity, instead of by one half its mass times the square of its velocity.

The term "attractive force" has been applied to chemical, molecular, gravitational, electrical and magnetic attractions. Some in consequence of our definition of force have invested these phenomena with attributes which they do not possess.

W. E. HENDERSON: *A Jacket for a Victor Meyer Apparatus.*

The usual form of glass jacket is replaced by a beaker deep enough to contain the bulb of the inner tube. The beaker is covered with a copper sheet in the center of which is a circular hole large enough for the insertion of the bulb. Concentric with this hole is a deep groove in the cover in which the square end of a piece of large glass tubing rests in a water seal (a broken outer jacket cut square will serve). The beaker should have no lip.

W. E. HENDERSON and H. B. WEISER: *The Action of Sulphurous Acid upon the Sulphides of Iron and Manganese.*

When freshly prepared sulphides of iron or manganese are treated with sulphurous acid the primary action appears to be the production of the metallic sulphites and hydrosulphuric acid. The sulphites are held in solution as acid salts, and are precipitated as normal salts on warming the solution. The interaction of sulphur dioxide and hydrosulphuric acid produces free sulphur which converts a portion of the sulphites into thiosulphates. These have been isolated in pure form. Contrary to the statements in the literature, there is no dithionate or tetrathionate formed beyond possibly a mere trace.

R. F. BRUNEL: *The Equilibrium between Iso and Tertiary Butyl Bromides.*

CHAS. T. P. FENNEL: *A Strange Substance in Iodine.*

A. S. McDANIEL: *Chemistry of the Silver Voltameter.*

CHAS. A. KRAUS and WM. C. BRAY: *A General Law of Ionization of Binary Electrolytes.* (Presented by Wm. C. Bray.)

From a preliminary examination of the existing conductance data in various solvents the first named author four years ago suggested the relation

$$\frac{(C\gamma)^2}{C(1-\gamma)} = K + D(C\gamma)^m,$$

where C is the concentration, γ the degree of ionization calculated from the conductance ratio Λ/Λ_0, and K, D, m are constants. A more careful study, which is still in progress, has furnished striking confirmations of this law. The evidence that the law of mass action is obeyed in dilute solutions is based on the experimental results of Franklin and Kraus in liquid ammonia and of Dutoit and his coworkers in propyl, butyl and amylalcohols and in acetone, sulfur dioxide, pyridine, etc. There is a rough parallelism between the values of K for a typical salt (as NaI) and the di-electric constants of the pure solvents. The deviations from the law of mass action are in general appreciable when the ion concentration is greater than 0.0005 normal. The values of m usually lie between 0.4 and 0.6 in aqueous solution and between 0.9 and 1.2 in liquid ammonia and are still larger in solvents of lower di-electric constants. Whenever m is greater than 1, the values of the equivalent conductance pass through a minimum as the concentration increases and then increase with increasing concentration. D is the controlling factor in determining γ at high ion concentration, and usually lies between 0.1 and 5.0 for the different solvents. The above law ceases to hold in the neighborhood of normal concentration, and Λ then decreases with increasing concentration. There is evidence that this decrease is connected with the rapidly increasing viscosity of these concentrated solutions.

HARRY N. HOLMES: *The Detection of Ozone.*

The paper presented the various theories explaining the presence of ozone in nature and gave the results of six months' ozone tests in outdoor air. In June and July the quickest response to a starch potassium-iodide test was an hour and a quarter, except in the case of a thunder-storm, when the record was set at fifteen minutes. In the hottest days of July no test at all could be obtained and none at night in either month. This would seem to indicate that the ultra-violet rays of sunlight have a great deal to do with the formation of ozone.

In the bracing days of late November the weather was cold and snappy. A test resulted in less than twenty-five minutes on November 13. During the following three weeks several tests were secured in thirty or forty minutes. At this time the silent electric discharge between earth and clouds must have been quite instrumental in forming the ozone. The greater stability of ozone in cold weather allowed it to accumulate.

Probably after a cyclonic disturbance of the upper air we on the surface get a supply of ozone manufactured in the upper laboratories. On the occasion of some of the above tests air was drawn over crystals of chromic acid to eliminate the effect of hydrogen peroxide. Furthermore, delicate reagents for hydrogen peroxide and nitrites failed to yield a test. The inference is that all the above tests were due to ozone alone.

JAMES M. BELL and MELVILLE L. BUCKLEY: *The Solubility of Bromine and Iodine in Aqueous Solutions of Alkali Bromides and Iodides.*

C. W. FOULK: *A Modified Burette Calibrating Pipette.*

W. M. BLANCHARD: *A Simple Lecture Apparatus for Illustrating the Relative Ionizations of Salts.*

ARTHUR B. LAMB and JOHN W. MARDEN: *The Quantitative Determination of Perchlorates.*

The determination of perchlorates by fusion has, in spite of its great simplicity, been generally abandoned in favor of some method of reduction in solution. This has been due to the fact that during ignition or fusion there have been small but apparently unavoidable mechanical losses, presumably of potassium chloride. The authors have shown that by merely carrying on the fusion in a test tube, suitably plugged with asbestos wool, instead of in a crucible, these losses could be prevented, and by precipitation of the chloride as silver chloride a very simple but accurate determination of the perchlorate obtained.

G. N. LEWIS and F. G. KEYES: *The Potential of the Potassium Electrode.*

G. N. LEWIS and PAUL FARRAGHER: *Potentials between Liquids.*

J. E. SIEBEL: *The Molecular and Intermolecular Energy.*

In this paper the author attempts to show that, "*PxV*" being practically equal to "*RxT*" for permanent gases, no notable portion of the kinetic energy can be present therein as rotary or intermolecular motion, since neither of these motions could contribute to the pressure and volume energy, of which a full equivalent appears for every amount of heat or kinetic energy imparted to a gas, and that therefore all kinetic or heat energy of gases must be almost exclusively due to the translatory motions of the molecules, while other internal molecular motions must be confined to chemical, radiant and other energies. Confirmatory of this the author also finds that the translatory molecular velocity in gases calculated on above basis, after different independent methods, is uniformly almost exactly double that of the velocity of sound in the respective gases, thereby indicating another mode of propagation of sound in addition to that by aerial resonance, in which new mode of propagation the molecular vibrations act as vehicle for the sound impulses, which new mode of propagation would fully explain all acoustic phenomena, including also such (audibility of very feeble sounds for miles, etc.) not explainable by aerial resonance only.

A. A. NOYES: *A Proposed System of Notation of Physico-chemical Quantities.*

JOHN JOHNSTON: *A New Form of Mechanical Vacuum Pump.*

This pump—known as the May Nelson Rotary Pump—consists essentially of two plates of metal, one fixed, the other movable; no valve, packing or fluid is required, though a little lubrication is desirable for mechanical reasons. A somewhat defective pump of this type has given a vacuum of 0.01 mm. when connected to the gauge by rubber tubing. It has exhausted 6 liters to 0.1 mm. in 2 minutes. After pouring in 1 c.c. of water, the pressure was reduced to 0.5 mm. in 4 minutes, without drawing any air through the pump. The exact mode of working is difficult to show without a diagram, but the principle may perhaps be made sufficiently clear by what follows:

In each of the metal plates are cut a series of concentric grooves, which are so situated that the projections on each plate will lie in the grooves on the other plate. Through the center of the fixed plate passes a shaft, on which is an eccentric carrying the movable plate. Rotation of the shaft thus produces an eccentric motion—but no rotation—of the movable plate; as a result there is, between each adjacent pair of curved surfaces, a rolling contact which sweeps out the air ahead of it. The pump above mentioned has an inner diameter of 13 cm., a depth of 4 cm., and consists of three rings which pump in series; the speed of rotation of the shaft was 800 r. per minute; ¼ H.P. suffices to operate it.

The effectiveness of this form of pump appears to be due to two things: (1) A very slight travel of the metal parts produces a relatively rapid motion of the crescent-shaped spaces between the rings on the two plates; (2) the contacts, since they occur between curved surfaces of nearly the same radius, are relatively long; hence the viscosity of the air is sufficient to prevent appreciable leakage backwards.

This pump may also be operated as a blower, or, with slight modifications, can be used as a water motor; indeed, since the rings may be made independent of one another, one can drive the pump by supplying water to one ring and obtain vacuum or blast from the other rings.

SECTION OF INDIA RUBBER CHEMISTRY

D. A. Cutler, *chairman*

F. J. Maywald, *secretary*

W. A. DUCCA: *Testing Methods of Rubber Contents in Raw and Vulcanized Rubber.*

The paper deals with modern methods of rubber analysis by nitrosate and tetrabromide methods. Mostly a historical review of the work done along these lines. In accordance with his own experiences the author concludes that the nitrosate method is not suitable for the determination of rubber in either raw or vulcanized samples, but yields apparently satisfactory results for sulfur of vulcanization. Budde's tetrabromide method gives a fair idea of the percentage of actual rubber in samples of raw material, but is not applicable for vulcanized goods. Huebner's method, bromination under water, based on the Weber-Ditmar theory of vulcanization, is very unreliable in its present form. Until now only a way has been opened towards the development of methods to determine rubber directly.

S. P. THACHER: *On Mineral Compounds Used in Rubber.*

VICTOR HANZLIK: *A Few Notes on Rubber Goods Used in Beet Sugar Factories.*

FRANCIS R. PEABODY: *The Treatment of Crude Rubbers.*

DAVID BLOOM: *Does the Acidity of Crude Rubber Resin Indicate Its Botanical Origin?*

Rubber resins obtained by extraction with acetone, carefully dried and redissolved in warm alcohol, were titrated with standard alkali. The acidity of the resin (expressed as the number of cubic centimeters of alkali used) is referred to a standard quantity of the resin (one hundred milligrams) and this ratio is called the "acidity number."

In the course of the analyses of about one hundred and fifty varied samples of washed and unwashed crude rubbers, the acidity numbers of the resins seem to be a constant for all rubbers of the same class, regardless of their age or mechanical treatment.

CHARLES FOX: *Apocynum Rubber.*

CHARLES KNIGHT (chairman): *Report of Committee on Rubber Analysis.*

CHARLES L. PARSONS,
Secretary

SOCIETIES AND ACADEMIES

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-ninth regular meeting of the Chicago Section of the American Mathematical Society was held at the University of Chicago on Friday and Saturday, December 29–30, 1911, extending through three half-day sessions. The total attendance was fifty-seven, including forty-three members of the society.

Professor L. E. Dickson, chairman of the section, presided at the opening session on Friday morning. Professor E. B. Van Vleck presided at the session on Friday afternoon while Professor Dickson was delivering his address on the "History of the representation of numbers as the sum of squares," and Professor E. J. Townsend presided at the session on Saturday morning.

At the business meeting on Saturday morning the following officers of the section for the year 1912 were elected: Professor D. R. Curtiss, chairman; H. E. Slaught, secretary, and A. L. Underhill, third member of the program committee.

On Friday noon the members lunched together at the Quadrangle Club, and in the evening they dined together at the same place and spent one of the most enjoyable social occasions in the history of the section.

The following papers were read at this meeting:

Professor Arnold Emch: "Involutoric circular transformations as a particular case of the Steinerian transformation and their invariant net of cubics."