expressed by the chairman of this committee in his address at Philadelphia a year ago.[1]

The committee does not feel called upon to make specific recommendations based upon the showing of the above table of analyses. It prefers for the present to let the table and the above-quoted remarks speak for themselves to each and every instructor. It believes that their consideration ought to lead to much good, and that the seed of improvement already germinating will in time produce good fruit if continuously and carefully cultivated.

W. F. HILLEBRAND, *Chairman.*
CHAS. B. DUDLEY,
CLIFFORD RICHARDSON,
H. N. STOKES.

REVIEW.

SOME ABSTRACTS FROM CURRENT LITERATURE UPON INDUSTRIAL CHEMISTRY.

BY FRANK H. THORP.

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This article being a continuation of the Review prepared by the writer last year, the same general scheme has been followed. As in the previous article, attention has been given mainly to papers published in the foreign journals during the year just closed, and which have not been included in the *Review of American Chemical Research.* A few abstracts from American journals and patents have been given. It has been desired to make the abstracts brief and to consider only those which seemed of most general interest.

Technical Education.—Technical training and educational methods continue to receive attention in society meetings and technical journals. Prof. Sir Alexander Kennedy, in an address before the Union Society of University College, London, referred to the Academic Side of Technical Training. He argued that the teaching of various branches should be carried much further than the point which may just suffice for the needs of the professional work of the engineer. A scientific branch cannot be mastered, even to an elementary degree, without some knowledge of the more advanced phases of the subject. He holds it essential that advanced work shall be done, but this should be so selected that it will make clear and certain the knowledge of the early work. It is necessary to broaden the mental grasp of a

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[1] This Journal, 27, 300.

subject so that the individual may be able to think beyond the limits of daily routine work. In this country, a paper by Prof. H. M. Howe before the Association of American Universities, dealing with the question of association of technical schools with large universities, has attracted much attention. The author inclines to the view that "wisely guided association" is beneficial to both the technical school and the community.

Acids.—Berl (*Z. angew. Chem.* **18**, 252 (1905)) has experimented with arsenic pentoxide as a catalyzer for the preparation of sulphur trioxide. He finds that arsenic pentoxide acts catalytically about as do ferric oxide and vanadium pentoxide, thus supporting the views of Lunge and Reinhardt (this Journal, **27**, 417). Sulphuric acid appears to be the best means of drying the gases, since better results were obtained with gases so dried than when more thoroughly dried or if more moisture were present. The speed of the reaction increases with greater concentration of either the sulphur dioxide or the oxygen, but more noticeably in the case of the sulphur dioxide. Any sulphur trioxide remaining in the apparatus diminishes the speed of the reaction and is supposed to crust over the surface of the contact material and hinder the diffusion of the gases. Owing to its greater density and slow diffusion, carbon dioxide is found to retard the reaction more than does nitrogen, thus supporting the view that the process is a diffusion reaction. It is also asserted that sulphur trioxide at high temperatures, 300° to 500° C., corrodes glass. Küster and Münch (*Z. anorg. Chem.* **43**, 350 (1905)) tried to make 100 per cent. nitric acid by crystallization in perfectly dry air, but the highest concentration they could get was 99.4 per cent. By excluding the air they succeeded in raising the concentration to 99.79 per cent. On standing in dry air, the acid lost strength until a concentration of 98.67 per cent. of HNO_3 was reached. The authors conclude that absolute nitric acid only exists as crystals and at temperatures below —41° C. The crystals decompose when melted and the resulting nitrogen pentoxide and water dissolve in the acid. This is supported by the observation that the crystallized acid of melting-point —41.3° was pure white, but the melted acid at even —41° C. had a yellow tinge. On passing perfectly dry air through the yellow liquid, the nitrogen pentoxide was driven off and a colorless acid of 98.67 per cent. strength remained. This could be distilled unchanged. Lüty (*Z. angew. Chem.* **18**, 1253 (1905)) reviews the present progress and economies in the chamber process for sulphuric acid. A short abstract of the paper can only be unsatisfactory, owing to the number of details discussed. The yield of acid has been increased, by means of improvements in the process, to 6 or 7 kilos chamber acid per cubic meter chamber capacity per day. About 12 to 14 cubic feet of chamber space per pound of sulphur burned per day is now customary. Raschig

(*Ibid.* p. 1281) has another long paper on the theory of the chamber process. The reactions taking place in each part of the system are discussed separately and the causes of loss in several instances are pointed out. Lunge (*Z. angew. Chem.* **18,** 60 (1905)) disputes certain contentions of Raschig (this Journal, **27,** 417) that nitrosylsulphuric acid causes the nitrous character of chamber acid, and that the small percentage of nitrogen trioxide in chamber acid is equivalent to only 0.1 per cent. nitrosylsulphuric acid. But this amounts to 2,000 kilos in a production of 2,000 tons of acid. The author found in the chamber acid and "drips acid" in a works in Zurich, 0.085 and 0.24 per cent. of nitrosylsulphuric acid. The fact that nitric oxide yields nitric acid and nitrous acid, when shaken with air and water, is claimed to have no bearing on the chamber process, since there is almost no nitric acid formed. But in Raschig's experiments, having a great excess of water vapor, he changed the entire nature of the reaction and converted nearly all the nitric oxide into nitric acid. Haber and Oordt (*Z. anorg. Chem.* **43,** 111 (1905)) have produced ammonia directly from nitrogen and hydrogen, by passing the mixed gases over powdered iron, supported on asbestos and heated to above 1000° C., in a tube. A few experiments were made with nickel powder produced by reducing the nitrate with hydrogen. This was less effective than the iron. The mixture of gases was prepared by decomposing ammonia in a similar apparatus by passing it over the iron at 1000° C.; the undecomposed ammonia was absorbed in standard acid and the purified gases again conducted over the heated iron to reform ammonia. An equilibrium was soon reached in both cases. Lunge and Berl (*Chem. Ztg.* **28,** 1243 (1904)) have studied the reaction between nitric oxide and oxygen or air, by passing measured amounts of the gases into a flask with varying quantities of water. After definite times, concentrated sulphuric acid was added to absorb the nitrous gases. The total nitrogen was then determined in measured portions of the acid by means of the nitrometer and the nitroso compound by use of permanganate. It was found that (1) the amount of water was the chief factor in influencing the formation of nitric acid from the nitric oxide. The conversion was complete with a certain proportion, but excess of water beyond this point resulted in a larger yield of nitrous acid. (2) The presence of free nitrogen with the oxygen (as in air) had no effect on the formation of nitric acid, the amount of water being the important factor. (3) The reaction is not instantaneous but requires some time. (4) Concentrated sulphuric acid is better than alkali hydroxides for absorbing nitrogen oxides, since it forms stable compounds, while the latter form bodies capable of further reaction, and thus affect the value for total nitrogen. Carpenter and Linder have continued their study of the reactions in the Claus kiln (*J. Chem. Ind.* **24,** 63

(1905). Compare this Journal **27,** 415 (1905)). They give their observations of the influence of various contact substances on the interaction of steam and hydrocyanic acid (for the formation of ammonia), both in the presence of hydrogen sulphide and air, and in their absence. The apparatus is first described, with an account of the methods of analysis and of calculation. Experiments were carried on using broken brick, oxide of iron and Weldon mud, in the absence of hydrogen sulphide and air. It was found that the reactions, (1) $HCN + H_2O = NH_3 + CO$ and (2) $CO + H_2O = CO_2 + H_2$, occur simultaneously but with lower temperature than 530°, as had been stated (*J. Gas Light.* (1902) p. 1417) *viz.*, between 465° and 625°, about 80 per cent. of the hydrocyanic acid is converted to ammonia, but some of the acid escapes undecomposed, the amount increasing with increased rate of flow. Carbon monoxide and hydrogen are constant products of the reaction, the hydrogen being in excess. No pronounced decomposition to free nitrogen was observed, even at 625°. With oxide of iron, under the same conditions, the yield of ammonia reaches a maximum (96.5 per cent.) at about 280°, and then falls rapidly. No undecomposed acid was found. Below 350° hydrogen and carbon monoxide were formed; at higher temperatures (500°), these were oxidized by interaction with the contact material. Below 350° the oxidation of the ammonia or the hydrocyanic acid was not marked, but above 500° it was very pronounced. These experiments show that the reactions (1) and (2) above both occur within the temperature range 200° to 350°; at 500° the only products were nitrogen, carbon dioxide and ammonia. With Weldon mud the yield of ammonia never exceeds 75 per cent.; hydrocyanic acid escapes undecomposed under 150° C. and above 200° C. free nitrogen appears in the products. These results show Weldon mud to exercise a much more powerful oxidizing action upon the reaction products than does iron oxide, since no carbon monoxide nor hydrogen are found in the products. In the presence of hydrogen sulphide and air, with the same apparatus and contact substances, a similar series of tests was carried on. The proportion of air was in moderate excess of that needed for the decomposition of sulphur and water. This introduction of air vitiated, to a great extent, the importance of the figures for nitrogen. With brick contact, the hydrogen sulphide and air favored a high yield of ammonia, but did not sensibly affect the character of the products. The most favorable proportion of air for maximum yield is 3.2 air to 1 hydrogen sulphide. Nitrogen and undecomposed hydrocyanic acid were absent from the product, but both carbon monoxide and hydrogen were found when the air did not exceed the above proportion. With higher proportion of air, only free nitrogen, ammonia and carbon disulphide were in the product. With oxide of iron it was again found that air and hydrogen sulphide favored a high yield of ammonia, and there was absence of undecomposed hydrocyanic acid, carbon monoxide and hydrogen. With Weldon mud, the presence of air and hydrogen sulphide again favored high yield of ammonia and also modified the nature of the products. For maximum yield of ammonia, the best proportion of air to hydrogen sulphide was found to be 2.7: $1H_2S$, with a temperature of 380°. Carbon monoxide and hydrogen were present and nitrogen absent between the temperatures 220° to 380°. As to the distribution of ammonia, it is present in the exit flue gases of the kilns as ammonium sulphate mainly, but to a less extent as ammonium sulphite, or more probably thiosulphate. Special attention was given to the estimation of the various oxidized sulphur compounds of ammonia in the residual gases, resulting from the interaction of steam and hydrocyanic acid in the presence of hydrogen sulphide under the conditions existing in the Claus kiln. By filtering the gases through asbestos at 100° to 200° C., before passing them to the acid catch for ammonia absorption, the large dilution and decomposition by secondary reaction with the half-normal acid was avoided. The asbestos was then extracted with cold water and the extract examined. With Weldon mud (sulphided) and the temperature not above 380°, the results showed the presence of traces of oxidized sulphur compounds in the asbestos and the absence of sulphate, most of the ammonia appearing as carbonate. With oxide of iron (sulphided), at temperatures of 480° to 520°, one experiment showed the presence of oxidized sulphur compounds of ammonia in the asbestos and an absence of sulphate in the acid catch. With broken brick at 565° to 580°, there was absence of pentathionate, sulphate and thiosulphate in both the asbestos and acid catch, and a large proportion of ammonium carbonate. Tabulated results of the experiments, and curves of the most important features of the tables, are included in the paper. Eyde and Birkland's process for nitric acid from air by electric discharges (*French Pat.* No. 335,692, 1903) is described in *Z. Elektrochem.* 1905. Winteler (*Chem. Ztg.* **29**, 820 (1905)) discusses nitric acid making to meet the modern demands for explosives, and the production of nitrated cellulose for celluloid and artificial silk. Freedom from nitrous acid is desired for these purposes. Analyses of two American-made mixed acids for nitrating, are given. The best conditions for manufacturing are (1) keeping the temperature as low as possible in the retort and carrying on the process very slowly to avoid overheating. (2) The niter should be dry, and the best strength for the sulphuric acid is 92 per cent. (3) The yield is better if air be introduced into the retort. (4) Rapid condensation of the vapors is essential. The utilization of the acid sulphate for hydrochloric acid making is considered, and also the effects of impurities, such as nitrate, nitrite, sulphuric acid, chlorides, iodine compounds, arsenic and selenium.

The latter passes into the hydrochloric acid and colors it red or yellow and causes it to dissolve copper. Guttmann (*Loc. cit.* p. 934) comments on the above paper and replies to certain criticisms of Winteler upon data given by himself. Saposchnikow (*Z. physik. Chem.* **51,** 609 (1905)) has examined mixtures of concentrated nitric (sp. gr. 1.467) and concentrated sulphuric acids, with respect to the vapor-pressures. The percentages used ranged from 100 of nitric acid and no sulphuric, to 5.29 per cent. nitric and 94.71 per cent. sulphuric acid; in all, 12 mixtures were examined. The vapor-pressure (in millimeters of Hg) ranged from 16.64 for 100 per cent. nitric acid to 34.12 mm. for a mixture of 59.91 nitric to 40.09 of sulphuric acid. The pressure then decreased to 8.40 mm. for a mixture of 20.07 per cent. nitric to 79.93 sulphuric acid. The highest vapor-pressure is found with a mixture of 65 per cent. nitric acid (sp. gr. 1.48) and 35 per cent. sulphuric acid, corresponding to $5HNO_3 + 2H_2SO_4 + 3H_2O$. In a later paper (*Loc. cit.* **53,** 225) the author continues his work with nitric acid (sp. gr. 1.40) containing 65.3 per cent. nitric acid and pure 100 per cent. sulphuric acid. The results show similar effects by the addition of the sulphuric acid; the mixture of acids is less active in nitration work but still admits of highly nitrated products being prepared. Bodenstein and Pohl (*Z. Elektrochem.* **11,** 373 (1905)) have studied the contact process for sulphuric acid, with reference to the law of mass action, to ascertain if the formula,

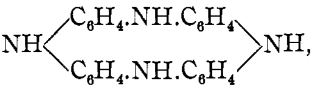
$$\frac{C^2_{SO_2}\, C_{O_2}}{C^2_{SO_3}} = K,$$

(a constant) applies where C is the concentration. A steady current of sulphur dioxide and air was passed over a platinum contact mass in a quartz tube, heated uniformly in an electric furnace, and the composition of the resulting gas mixture compared with that entering the tube. Fourteen experiments were carried on at about 727° (= 1,000° abs.), and the results corrected to equalize the variations of temperature, pressure, rate of passage through the apparatus, and quantity of sulphur dioxide per volume of oxygen. The sulphur trioxide produced ranged from 20.8 to 59.6 per cent. of the amount of sulphur dioxide originally present. The value of K was found to vary from 3.43×10^{-3} to 3.67×10^{-3} and averaged 3.54×10^{-3}. The results of other experiments at different temperatures agreed with these, and it was further found that the heat evolved in the reaction $2SO_2 + O_2 = 2SO_3$, as calculated from these results, agreed with the observed values. The authors hold that the reaction obeys the law of mass action closely. Lunge (*Chem. Ztg.* **29,** 933 (1905)) defends the work of Rey and himself in determining the specific gravity and strength of nitric acid (*Z. angew. Chem.* (1891) p. 165) against the criticism by Winteler, and shows that curves of their results plotted along with those from the work of Kolb, Veley and Manley, and of Ferguson agree reasonably well and throw doubt on the correctness of Winteler's figures. Winteler (*Chem. Ztg.* **29**, 689 (1905)), finding that the specific gravity tables for nitric acid of high concentration were inaccurate owing to the presence of nitrous acid, has made redeterminations of the gravity and concentration on especially purified acid of various strengths, ranging from 47.0° to 49.4° Bé., corresponding to percentages of HNO_3, 86.3 to 99.7 respectively. Ferguson (*J. Chem. Ind.* **24**, 781 (1905)) describes the method employed by himself and his assistants in preparing the tables of specific gravity of sulphuric acid, nitric acid, hydrochloric acid and ammonia, which have been adopted by the Manufacturing Chemists' Association of the U. S. The tables also are published in full. Nagel (*Electrochem. Metal. Ind.* **3**, 16 (1905)) suggests the conversion of electrolytic chlorine into hydrochloric acid by passing it with steam through incandescent coke at 1000° C., thus: $Cl_2 + 2H_2O + 2C = CO_2 + CO + 2H_2 + 2HCl$. This he asserts would be more profitable than the manufacture of bleaching-powder. The gases are passed through absorbing towers and the unabsorbed mixture of carbon monoxide and hydrogen may be utilized for fuel purposes. Deussen (*Z. anorg. Chem.* 44, 300 (1905)) has determined the conductivity and strength of solutions of hydrofluoric acid, and its influence on the rate of inversion of cane-sugar. In this latter case, it appears to come between monobasic and dibasic acids. It is a little weaker than phosphoric acid of equal concentration. Dubosc (*Rev. Gén. Mat. Col.* **9**, 99 (1905)) proposes to make hydrosulphites by heating the acetone-sodium bisulphite compound with ammonium formate solution. A sesquicarbonate of ammonia distils off and the solution of hydrosulphite is evaporated *in vacuo*. Ammonium formate is preferred as it is volatile at 60°, and the reaction with the sodium bisulphite compound goes on at 84°. Lead, zinc or manganese formate can, however, be used instead. Tarugi (*Chem. Centr.* **1**, 584 (1905)) has found that bleaching-powder or hypochlorite which becomes pink on exposure to carbon dioxide, contains iron, probably in the form of calcium ferrate. Manganese does not appear to be present, contrary to the generally accepted view as to the cause of the color. Wegschneider and Walter (*Monatsh.* **26**, 685 (1905)) have prepared a table of densities and percentages at 60° C., and 80° C., for sodium carbonate and sodium hydroxide. Interpolation formulae for calculating densities of these solutions at all temperatures between 0° and 100° C., for concentrations up to 8 N, are given.

Salts.—Winteler (*Electrochem. Metal. Ind.* **3**, 16 (1905)) has examined samples of electrolytic caustic potash for strength and finds the content to vary from 73.3 to 81.8 per cent. of potassium hydroxide, while the carbonate ranges from 2.4 to 18.4 per cent. As no carbonate is formed in electrolysis, this impurity comes from contamination during the evaporation and casting of the caustic. By shaking hot solutions of 1.5 sp. gr. with solid potassium carbonate, and then cooling down to 20° C., the amount of carbonate remaining in the solutions ranged from 37 to 55 grams per liter, while the hydroxide amounted to 700 to 760 grams per liter. This is considered the limit which may be produced by absorption of carbon dioxide, hence any quantity in excess of this found in solid caustic has been formed in the casting operation. Fused hydroxide, on standing, deposits most of its content of carbonate, and the clear portion should not contain over 3 to 5 per cent. of carbonate. Geffekin (*Z. anorg. Chem.* **93,** 197 (1905)) has determined the solubility of lithium carbonate in various alkali salt solutions, and prepared curves of the solubilities. It appears that alkali sulphates, especially ammonium sulphate, have very considerable solvent power on lithium carbonate. Frasch (*J. Chem. Ind.* (1905) p. 17) describes his method for making caustic soda (U. S. Patent, 688,463, 697,465) in which ammoniacal salt brine is treated with nickel hydroxide, forming nickel-ammonium chloride ($Ni(NH_3)_2Cl_2.4NH_3$), and caustic soda. The nickel-ammonium chloride is insoluble in the caustic liquor, and is filtered off and distilled to recover the ammonia and the nickel hydroxide, both being returned to the process. The amount of nickel hydroxide is about 80 per cent. of the salt converted, but is affected by the amount of water in the hydroxide. If the hydroxide recovered in the process contains 60 per cent. of nickel hydroxide, 200 grams per liter of ammoniacal brine yield 10 per cent. caustic soda solution, and 73 per cent. of the salt in the brine is converted. The reaction takes about an hour. The nickel-ammonium chloride is easily decomposed by water to nickel hydroxide and ammonium chloride, so for high conversion and strong caustic liquor any excess of water is avoided, and rather an excess of salt is used to keep the brine saturated as the ammonia is abstracted. The salt also serves as filtering material to separate nickel-ammonium chloride from the caustic liquor, this being done in the same vessel as the conversion. The nickel oxide and ammonia are recovered by distillation in a calcium chloride solution of 1.250 sp. gr., which is saturated with salt. The nickel-ammonium chloride is suspended in the calcium chloride solution in the proportion of 400–500 grams to the liter, and distilled. The ammonia in excess of that in the form of chloride is driven off, and the nickel hydroxide is precipitated and removed by decanting or filtering. If the calcium chloride is allowed to concentrate to its practical limit before drawing off, not over 600 gallons of waste liquor are produced per ton of caustic soda. The time required for distilling the ammonia and separating the nickel is four hours to a charge of 10,000 gallons, which produces about four tons of caustic soda. If the conversion and distillation be conducted in the same apparatus to prevent loss of nickel and ammonia, an additional four hours is needed for conversion, filtration and washing; or, about 10 tons of caustic soda per day is the output. Hempel (*Z. angew. Chem.* **18,** 132 (1905)) has studied the production of phosphorus by the Pelletier process, in which tricalcium phosphate is converted to the monocalcium phosphate with sulphuric acid and this is then reduced with charcoal. An excess of sulphuric acid over the calculated amount is needed to render the phosphate soluble, and when the liquors are evaporated to a specific gravity of 1.28, the sulphuric acid is 4.2 per cent. At this point the crystallization of the phosphates begins, so the concentration is stopped. It proved difficult to make an apparatus for the reduction of the phosphorus; the vapors passed through the walls of fire-clay retorts, and porcelain vessels became clogged. Collection of the phosphorus by scrubbing with liquid was not entirely successful, but filtration through a layer of garnet sand worked well. The reduction was accomplished in a porcelain tube wound with a coil of nickel wire through which a current was passed for heating. This tube was jacketed with another of fire-clay which in turn was surrounded by diatomaceous earth. Temperatures were taken with a thermo-electric pyrometer inserted into the tube. A wide delivery pipe conducted the vapors to a washing vessel from which they passed to the garnet filter, and then to a final wash-bottle. Lastly, the gases passed through a meter before escaping into the air. Between 300° and 600°, the sulphuric acid present is reduced and passes off as sulphur dioxide. At 700°, the gas contains carbon dioxide, carbon monoxide and hydrogen and becomes combustible. At 74° distillation of phosphorus begins, being most active above 960°; at 1170° practically all the phosphorus was over. About 92.5 per cent. of the phosphorus was recovered in the condenser, but some of it refused to melt together (probably due to a little hydrogen phosphide as solid or liquid) and had to be determined by oxidation and weighing as pyrophosphate. Metaphosphoric acid did not afford a good yield of phosphorus, as it did not reduce with the charcoal. The old reaction $Ca_3P_2O_8 + 3SiO_2 + 5C = 3CaSiO_3 + 5CO + 2P$, proposed by Wöhler, which could not be carried on technically because of the high temperature necessary, becomes possible here. The reaction begins at 700°, and phosphorus is evolved at 1150°, but only between 1200° and 1450° is the evolution brisk; above 1450° the process ceases. A yield of 92 per cent. was obtained, which was not improved by higher heating. In Germany the process is worked in electrically heated sheet-iron cylinders lined with fire-clay. The slag is run off continually. For high yield, the materials must be perfectly dry. Bauer (*Chem. Ztg.* **29,** 1 (1905)) describes a method for making lead acetate on a large scale. To avoid loss in evaporation, acetic acid of 60 per cent.

concentration is used. Pure litharge, free from iron and alumina, is added in 100 kg. portions to the total quantity of acid in a vat provided with a reflux condenser and a wooden stirrer. In about an hour the litharge is dissolved, the temperature not being allowed to exceed 65°. The liquor should then stand at 70° to 72° Bé. at 65°. It is settled in covered vats in which sufficient mother-liquor from previous crystallizations has been mixed with the fresh liquor to bring the gravity down to 50° Bé. By hanging metallic lead plates in these vats, any copper is precipitated; after standing about six hours, at a temperature slightly above 60°, the solution is filter-pressed and goes to the crystallizing vats where it stands a week or ten days. The vats are covered and provided with steam coils, so the cooling can be controlled, and about 3° per twenty-four hours is the rate of cooling desired. The crystals are freed from mother-liquor in centrifugal machines and dried in vacuum driers at 30°. The mother-liquors have a density of about 35° Bé. and are returned to the vats with the next liquors. All residues are extracted with water and the wash-waters evaporated. Lumière and Seyewetz (*Rev. Gén. Mat. Col.* **9**, 250 (1905)) show that sodium hydrosulphite may be kept unoxidized indefinitely in dry air, but in moist air oxidation proceeds rapidly. In distilled water which has been boiled, the salt is oxidized slowly if the solution be dilute (3 per cent. solutions in sixteen days and more rapidly as the concentration is higher, a 10 per cent. solution in eleven days and a 25 per cent. solution in three days). In the presence of air, the oxidation is greatly accelerated. Certain substances appear to retard the oxidation; *viz.*, trisodium phosphate, acetaldehyde, benzaldehyde and trioxymethylene in connection with sodium sulphite; the first has no deleterious effect on the indigo-reducing power in cold solutions; the others retard reduction until the temperature is near 100°. Naumann (*Ber.* **37,** 4328, 4609 (1904)) has determined the solubility and certain reactions of a large number of inorganic salts in acetone and pyridine. The work is a continuation of an investigation published in 1903 (see *J. Chem. Ind.* (1904) p. 1088). Frank and Voigt have patented processes for cyanide and ammonia from cyanamide (*U. S. Patents*, Nos. 775,953 and 776,314). For cyanide, a metallic cyanamide is fused under pressure with flux, carbonaceous matter and a base whose cyanide is to be formed. For ammonia the cyanamide is heated under pressure with carbon dioxide gas and water in proportions of at least three molecules to each two atoms of nitrogen in the cyanamide, the temperature being at least 100°. At about 300°, under the above conditions, ammonia and a formate are produced.

Dyes.—Barbier (*Bull. Soc. Indust. Mulhouse* (1905), p. 153) describes a new group of direct (azo) dyes obtained from diphenyl in combination with tetrazo-derivatives from benzidine, toluidine, dianisidine, *p,p′*-diaminophenyltolyl and similar diamines. The colors yielded by these products range from red through orange, yellow, blue to violet. They are direct cotton dyes, fast to acids. Prud'homme (*Ibid.* p. 155) describes new hydrazine sulphonate dyestuffs obtained from basic dyes, such as magenta, safranine *p*-nitraniline, etc. These are acid dyes, coloring wool in acid baths. Shades of prune, red, green, blue and yellow are obtained. Vidal (*Monit. Scient.* **19**, 25 (1905)) discusses the presence and action of mercaptan groups in the direct sulphide dyestuffs. He holds that the solubility of these dyes in alkali sulphide solutions is not due to the presence of the mercaptan groups, but that they appear to modify the shades of the color in some cases, but are not necessary to the formation of the dye. Certain reactions are proposed to represent the formation of sulphide dyes from *p*-aminophenol. The same author (*Z. Farben. Textil. Ind.* 4, 458 (1905)), by heating quinol with *p*-phenylenediamine to 180° C., in sealed tubes, produced a leuco-base of emeraldine and azuline, which, on further oxidation of the dyes, yielded aniline black. Goppelsroeder's formula for aniline black,



$$NH\left\langle \begin{matrix} C_6H_4.NH.C_6H_4 \\ C_6H_4.NH.C_6H_4 \end{matrix} \right\rangle NH,$$

seems to be supported by this.

Bleaching.—Störmer (*Centr. Bl. Bakter. Parasitenk.* **13**, 35, 171, 306 (1904); *Chem. Centr.* **1**, 41 (1905)) has studied the retting of flax under water. The process is a fermentation induced by organisms, mainly of the anaerobic *Plectridium* genus, which attack the pectin bodies of the material enclosing the fibres. Absence of oxygen is essential for the process, and this is secured by the action of certain oxygen-consuming bacteria; hydrogen, carbon dioxide and organic acids, such as acetic, butyric, and lactic, are then produced. Since butyric acid is injurious, it is proposed to add lime to the liquid during the retting and to use pure cultures of *Plectridium*. Knecht (*J. Soc. Dyers Colorists*, **21**, 189 (1905)) has found that human saliva has action on bleached cotton, whereby the fibre is made to take up more dyestuff. Probably the ptyaline is the active agent. It is suggested that this action may account for some of the spots on piece goods which occasionally appear in the finished product. Trotman (*J. Chem. Ind.* **24**, 267 (1905)) discusses the damage caused by magnesium soaps in bleaching. He classifies the brown discolorations on bleached goods as due (1) to iron, (2) overbleaching, (3) mildew, (4) grease, (5) use of unsuitable soaps and water. The last is held to be of very common occurrence, while overbleaching is not very frequent. Damage, showing after a considerable length of time, particularly in a hot climate, has frequently proved to be due to resinate of lime or magnesia. Waters used in bleaching often carry lime and magnesia and are used without purifying, while many soaps contain considerable resin. The lime and magnesia resinates are insoluble in water and when dried, slowly become brown, partly because of dehydration. Magnesia soap is distinctly darker than the lime soap.

Dyeing.—Hurst (*J. Soc. Dyers Colorists*, **21**, 130 (1905)) has studied the mordanting of silk with regard to the diminution of lustre if the temperature is high. The mordant oxides appear to deposit on the surface of the fibre as minute excrescences at about 140° to 150° F. and at higher temperatures the oxides penetrate further into the fibre and dull the lustre. Between 70° and 120° F., there was no loss of lustre by the mordanting, but the process is very slow. Above 150° F., only chromium bisulphite could be used safely and this gave good results when heated to 180–190° F., the loss of lustre being very slight. Green, Yeoman and Jones (*Ibid.* **21**, 236 (1905)) have prepared quantitative analytical tables for detecting dyestuffs in animal fibres. The scheme is based principally on the stripping effect of various reagents, combined with reduction tests with sodium hydrosulphite and reoxidation tests with a persulphate. Seven tables for the various colors are given. Suida (*Monatsh.* **26**, 413 (1905)) has examined the relation between the chemical composition and the dyeing properties of cotton, wool and silk. Regarding cellulose as an alcohol body containing hydroxyl groups, its chemical activity is attributed to these groups probably having a slightly acid nature. Purified cotton was heated with acetyl and benzoyl chlorides, dimethyl sulphate and caustic soda, and alcohol and sulphuric acid. The two chlorides were found to introduce one acyl radical into each cellulose molecule. The reaction products were washed and dyed with samples of the original cotton and of nitrated cotton (12.1 per cent. nitrogen) in magenta and crystal violet (basic dyes), Bordeaux extra (a direct dye) and azofuchsine B (acid dye). The cellulose and its acyl and alkyl derivatives took the basic and direct dyes readily and to an equal degree, but the acid dye was not absorbed. This showed that the introduction of these groups into the cellulose molecule had not affected the activity of the hydroxyl groups, which is evidently very slight in any case. Purified wool was treated with acetyl chloride, acetic anhydride, ethyl bromide and alcohol and sulphuric acid. The samples were washed with alcohol and water and dyed, together with the original wool at 80° to 90°, with the same basic and acid dyes as before. Only a slight tint appeared in the alkylated and acetylated samples with the basic dyes, but the original wool took the color deeply; but with the acid dye these conditions were reversed, the treated wool taking the color well. Wool, boiled in weak sulphuric acid and washed, takes acid and basic dyes about equally well. The treated wool, when heated with ammonium carbonate, regained its original properties, thus showing that an anhydride is not produced by the reagents. These appear to act on the carboxyl group in the first instance and then on the amino-group, in the latter case producing a salt. Silk is not affected as to its dyeing properties by these reagents except the alcoholic sulphuric acid, which alters its character on heating. Such treated silk takes acid dyes well from a neutral bath, but is merely stained by basic dyes. Wool and silk dyeing with these dyestuffs thus appears to be a simple chemical action. Sedlaczek (*Färber-Ztg.* **16,** 17 (1905)) describes a method for dyeing leather with sulphide dyes, in which tannin or glucose is added to the dye-bath to prevent injury to the leather by the sodium sulphide. The author also reviews the methods of producing yellow and brown shades on tanned leather by soaking in solutions of titanium salts; these salts also serve as mordants for certain dyewoods. Alcoholic or aqueous solutions of *p*-phenylenediamine, *p*-aminophenol or *p*-diaminodiphenylamine are said to be satisfactory hair dyes. By oxidation through exposure to air or by hydrogen peroxide, various shades of brown are obtained. Kapff (*Färber-Ztg.* **15,** 357 (1904)) discusses the use of formic acid in dyeing and printing. By adding it to the bath for wool dyeing, uneven deposition of color, such as occurs with sulphuric or acetic acid, is largely avoided and the fibre takes up a larger amount of dye. In dyeing mixed silk and wool, formic acid is recommended in place of acetic or oxalic acids, as it causes fuller shades on the silk. It is most largely used with potassium bichromate for mordanting wool; 1.5 per cent. of formic acid (85 per cent.) liberates the chromic acid of the bichrome and entirely reduces it, fixing the chromic oxide on the fibre after about two and a half hours boiling. The acid also counteracts any lime in the water used for dyeing. It is also proposed for use with bichrome for "after-chroming" dyed goods. For printing methylene blue, magenta and auramine, lighter and more brilliant shades are obtained than with acetic acid. Five per cent. of the acid will keep a starch paste in good condition much longer than when no acid is present. It may also be used to impart a "scroop" feel to mercerized cotton, and is better for this than acetic or sulphuric acid and less expensive than citric or tartaric acids. Mettner (*Z. Farb. Textil-Chem.* **4,** 171 (1905)) contributes an article upon the use of formic acid in wool-dyeing. With this assistant, there is more complete absorption of the chromium by the wool fibre, and it is claimed that the dyeing can be carried out in the same bath in which the mordanting has been done. Such dyeings are reported to be very fast to milling and better than when mordanted and dyed in separate baths. The wool is mordanted with 1.5 per cent. of its weight of potassium bichromate, with 2 per cent. of formic acid (80 per cent. strength), and heated to gentle boiling for an hour and a half to two hours. Cold water is then added to the bath to reduce the temperature, and the color solution added in small portions; finally about 2 per cent. of formic acid is added and the dyeing completed by boiling for two hours. Dreaper (*J. Chem. Ind.* (1905) p. 233) publishes a contribution to the theory of dyeing, basing his conclusions largely upon experiments made with colloidal solutions of arsenious sulphide. From the experimental results, he advances the following laws: (1) "Within certain limits of concentration, and when once an equilibrium has been established, and in the case of a solution where this action is a reversible one, the aggregates in any solution system are of equal size." (2) "The aggregates in a stronger pseudo-solution are larger in direct relation to the number of molecules present, and that, when once a certain point is reached, they increase in size rather than in number." The author rejects any chemical theory of dyeing and holds to the purely mechanical theory of the process. There is no evidence in favor of solid solution in any of his results. Lamb (*J. Chem. Ind.* **24,** 187 (1905)) confirms the analysis of sumac ash, communicated by Trotman (*Ibid.* **23,** 1137 (1904)). A sample of pure sumac was found to contain leaf substance, 72.5 per cent.; stems (mid-rib, etc.), 6.6 per cent.; stalks, 20.9 per cent. The ash determinations showed from leaf substance 6.3 per cent.; stems, 8.1 per cent.; stalks, 3.9 per cent.; average of whole sample, 5.89 per cent. Common adulterants of sumac, *Pistacia Lentiscus* and *Tamarix Africana* showed very high ash, *viz.*, 6.8 per cent. in the former and 10 per cent. in the latter. Knecht (*J. Soc. Dyers Colorists,* **21,** 3 (1905)) explains his method for determining certain dyestuffs when dyed on cotton fibre, by direct titration with titanous chloride. A piece of the fabric is boiled in hydrochloric acid (1 : 3) for five minutes to remove any chlorine; then carbon dioxide is passed into the solution, a measured amount of titanous chloride added, and the solution heated until the color is destroyed. Then it is cooled and the excess of titanous chloride is titrated with a ferric alum solution and potassium thiocyanate indicator. The carbon dioxide is passed in during the whole operation. The method gave good results with benzopurpurine 4B, chrysophenine, erika B, and brilliant yellow and methylene blue. With mixed colors a selective action appeared, the yellow being entirely destroyed before the blue was attacked. In the determination of methylene blue, the disappearance of the color gives a sharp end-point. Assuming that one molecule of dyestuff requires two atoms of hydrogen for reduction, accurate results are obtained by this method. Davidis (*Färber-Ztg.* **15,** 373 (1904)) proposes a new test for fastness of dyed cloth to perspiration, to replace the common test with acetic acid. Perspiration is usually of alkaline reaction and the test proposed is as follows: Prepare a solution of 5 grams Marseillès soap and 3 cc. ammonia in one litre of water; steep the dyed fabric in this for ten minutes, then squeeze and wrap tightly around a glass rod with an interwound piece of cotton cloth. On drying at 50° the amount of "bleeding" of the color is taken as a measure of the fastness. The author recommends the use of formic acid instead of sulphuric for dyeing mixed goods with acid dyes, where the quantity of acid in the bath may tender the cotton. Lambrecht and Weil (*Ber.* **37,** 4326 (1904)) describes a colorless rosaniline hydrochloride, soluble in cold water with a very pale pink coloration. Williams (*J. Chem. Ind.* (1905) p. 877)) contributes a paper on the valuation of tannic acid from the standpoint of the dyer and calico printer. The author outlines the more important methods of tannin estimation, but considers Hunt's modification of the permanganate process (*Loc. cit.* (1885) p. 263) the most satisfactory. For rapid comparison of values, he uses a dye test on cloth printed with the tannins in question, and with a standard sample. The patches are then all dyed together in a bath of methylene blue, and the mordanting value and clearness of hue determined by comparison. Results nearer than 5 per cent. cannot be expected by the matching test, but it shows the colorist the relative value of the samples at a glance. Precipitation methods, using gelatin or hide powder, are not found satisfactory.

Cement.—Seger and Cramer (*Thonind. Ztg.* **28,** 1662 (1905)) have made tests upon bricks of Portland cement to which ground sand, iron, etc., had been added to increase their resistance to wear and crushing. Addition of ground ore increased the resistance to crushing somewhat, and also to attrition, but ground sand had a more marked effect and raised the figures considerably. The same authors (*Loc. cit.* p. 1687) have found that blast-furnace slag, used for Portland cements, varied a good deal, especially in the proportion of soluble silica and of alumina. A high percentage of sulphide was also found in the samples examined. There has been published a resumé of the standard requirements for Portland cement in Russia (*Chem. Ztg.* **28,** Rep. 391 (1904)).

Clays, Etc.—Heraeus (*Z. angew. Chem.* **18,** 49 (1905)) has determined the melting-points of various refractory clays, by heating in an iridium tube, 200 mm. long by 40 mm. diameter, heated by an electric current of 1200 amperes at 5 volts. The tube was jacketed in fused magnesia and cased in a fire-clay cylinder. A thermo-element of iridium and iridium-ruthenium calibrated to 1600° by a standard platinum-platinum-rhodium couple, and at 1780° in melting platinum, was used. (Recent determinations give the melting-point of platinum as 1710°.—Editor.) Calculations were made to give temperatures to 2000°. It appears that pure clays have a definite melting-point which is not changed by remelting the test piece. Determinations of the rate at which a weighted iridium rod settled into the test piece at various temperatures furnish a means of estimating the rate of softening as the temperature rises. Some clays show a steady progression of softening until complete fusion is reached; others soften somewhat at low temperatures and then exhibit no marked change until just before complete fusion occurs.

Cyanides.—Hand (*Z. angew. Chem.* **18,** 1098 (1905)), in a study of the cyanide mud obtained by Bueb's method of cyanogen recovery, obtains results which vary considerably from those of Feld (this Journal, **27,** 420 (1905)). The mud is a dark brown mass, consisting of soluble bodies, ammonium ferrocyanide, ammonium sulphate, ammonium carbonate, small amounts of ammonium sulphide and about 0.13 per cent. ammonium thiocyanate; of insoluble bodies, iron-ammonium cyanide, ferrous sulphide, tar, sand, ferric oxide, etc. Cyanogen is present to about 8 to 15 per cent. as Prussian blue; the insoluble iron-ammonium cyanide appears to be a double ferrous and ammonium cyanide, $2NH_4(CN).Fe(CN)_2$. On boiling the mud or adding acid to it, the double cyanide is converted into white insoluble $(NH_4)_2Fe_2(CN)_6$ and ammonia is evolved. The difference between the authors' results and those of Feld (*Loc. cit.*) is claimed to lie in the different methods used for determining soluble ferrocyanide and ammonia.

Distillation.—Schidrowitz (*J. Inst. Brew.* **11,** 125 (1905)) contributes an article on brandy, with special reference to those produced in France. Cognac, the best grade, is double distilled in pot-stills at a very slow rate. Usually three fractions are separated; the first runnings, amounting to about 5 per cent., are added to the next charge; the middle portion, beginning at about 85 per cent. alcoholic strength, is collected until the spirit content falls to 56 per cent., thus averaging 66 to 70 per cent. of alcohol in the total portion. The third fraction averages 20 to 25 per cent. alcohol and is rectified by itself or is added to the next charge of wine. Newer forms of rectifying stills, by which the brandy is produced in one operation, are displacing the pot-stills. The author restricts the name "brandy" to a "spirit distilled in France, and the volatile constituents of which are all derived from the grape, and to which only water, sugar and a little coloring-matter may have been added." The analysis of brandy as a basis of determining the genuineness of a sample is to be employed with caution and any attempt to base judgment on the proportion of esters present is declared misleading. Schidrowitz and Kaye (*J. Chem. Ind.* **24,** 585 (1905)) contribute an article on the chemistry of whiskey, with special reference to the product made in the pot-still. The authors were at first inclined to attribute much of the flavor of such whiskey to a kind of dry distillation of the solid matters in the still, consisting of certain woody or cellulose matter from the grain, and of the yeast. They tried destructive distillation of the yeast and obtained products similar to those derived from the distillation of bones; *i. e.*, amines, bodies of the pyridine and pyrrol class, phenols, nitriles, sulphur compounds, ammonium salts and gases—such as carbon dioxide, sulphur dioxide and hydrogen sulphide. Tests of new pot-whiskey showed evidence of the presence of pyrrol, phenols, hydrogen sulphide, sulphurous acid and an alkaline body, probably ammonia. Attention is directed to the fact that bodies such as these would tend to become altered in time by exposure to air and damp. Thus an explanation of the effect produced by ageing on the crude spirit may be deduced and the elimination of the raw and unpleasant flavor of new pot-still spirit be accounted for. These substances were, however, detected in a whiskey distilled by steam, a fact which led the authors to decide that the bodies were formed in drying out the malt in the kiln and did not have their origin in the still. The results of analyses of malts and grain whiskey are tabulated.

Electric Furnace Products.—Harboard, in the report of the Canadian Commission appointed to examine electrical processes for making iron and steel (*Electrochem. Ind.* 1904, p. 479), states that steel equal to the highest grade of Sheffield crucible steel can be produced at a lower cost by the processes of Kjellin, Keller and Héroult, but that these cannot compete with the Siemens or Bessemer processes for ordinary grades of steel. The reactions in the electric smelting of iron are similar to those in the blast-furnace, and any grade of gray or white iron can be made by suitable changes in the charge and temperature; further, these changes can be made more quickly than in the blast-furnace. But only under the exceptional conditions of cheap electrical power and costly fuel can pig-iron be made electrically to compete with blast-furnace pig. Haanel, in the same report, has a more favorable opinion of the future development of the electric furnace for smelting. Improved forms of furnace with lower cost of electrical energy, and possibly the use of coke from peat, or charcoal briquettes from saw-mill refuse, may reduce the cost materially. The electric furnace, owing to its high temperature and easy regulation, should also be made useful for smelting other ores than iron.

Electro-Chemistry.—Raschen and Clayton (*Eng. Pat.* No. 2152 of 1904) have devised a cell for making metallic sodium by the electrolysis of fused caustic soda. The anode is a sodium-lead alloy; the cathode is a hollow cylinder of nickel and has suspended from its top an iron or nickel annular diaphragm, forming an annular space between them which is closed at the top. The sodium collects in the annular space and overflows through suitable openings into a space at the bottom of the hollow cathode, from which it can be dipped out without admitting air to the interior of the cell. Petit has taken a French patent (No. 353,467) for the electrolytic reduction of the lead oxide produced in the manufacture of nitrites by reduction of the nitrate with metallic lead. The oxide, suspended in sodium carbonate solution as a thin paste, is spread upon the metal cathode in a closed vessel. The anode is of sheet iron, perforated and arranged to permit the oxygen gas to pass into a receiver. The metallic lead thus reduced is returned to the nitrite process. LeBlanc and Cantoni (*Z. Elektrochem.* **11**, 609 (1905)) have devised an experimental cell of the Castner alkali type, suitable for laboratory work. With a current density on the (mercury) cathode of 0.1 ampere per square centimeter, and the mercury kept in motion, and a highly concentrated potassium chloride solution, the current yield at 40° C. may be above 90 per cent. Gilchrist (*J. Physic. Chem.* **8**, 539 (1904)) found that aniline black was produced at the anode when aniline was electrolyzed in either hydrochloric or sulphuric acid solution. The decomposition potential of aniline was the same (0.95 volt) in both acids, and less than that of either acid alone; thus the oxidation yields the same product in both cases. But hydrobromic acid requires only 0.75 volt for decomposition, hence when dissolved in this acid, bromine derivatives of aniline are produced, notably *s*-tribromaniline. Müller and Spitzer (*Ber.* **38**, 778 (1905)) have repeated the experiments of Traube and Biltz (*Ibid.* **37**, 3130 (1904)) upon the electrolytic oxidation of ammonia to nitrite. Although better yields of nitrite were obtained than by the previous experimenters, the cost appears still too great for industrial application of the process. Traube (*Ibid.* p. 828) replies to the statement of the authors and calls attention to his own prediction that better yields of nitrite could be obtained by adding alkali during the process. An ammoniacal copper solution containing fixed alkali absorbs oxygen from the air more rapidly than when alkali is omitted. Stavenhagen (*Ibid.* p. 2171) has experimented on the oxidation of nitrogen by the high tension spark discharge in a porcelain tube, through which the air is passing. Indications of certain nitrogen oxides formed, which were not caught by the absorbing media, were several times observed. Perkin and Low, in a paper before the Faraday Society, have continued their work upon the electrolytic oxidation of organic compounds of the benzene series, this time having experimented upon ethylbenzene, cumene and cymene. Alcohols and some aldehydes were produced in each case and the authors incline to the view that the hydroxyl ion is the oxidizing agent.

Electro-Metallurgy.—Burgess (*Electrochem. Metal. Ind.* **3**, 17 (1905)) reports investigations on zinc coatings upon iron. Comparative tests between galvanized and electrolytically coated plates were made with $^2/_3$ N sulphuric acid as corroding agent. The resistance of the electrolytically deposited zinc to this acid was much greater than that of zinc applied in the fused bath;

12 grams per square foot of electrically deposited zinc proved equal to 28 grams per square foot deposited from the fused bath. Electrical galvanizing is rather slow and the best coating results with a current of 14.4 amperes per square foot. If the coating exceeds 30 grams per square foot, the surface layers are crystalline and rough. The solutions should be nearly neutral for good deposits, as free acid affects the current efficiency and the quality of the deposit. It is further found that no alloy forms between the iron and zinc in either process; the two metals remain separate. Edison (*Eng. Pat.* No. 26,947, 1904) proposes to clean the surface of metal articles by making them the cathode in a bath with a carbon anode. The hydrogen generated on the metal surface carries away mechanically any dirt, scale or other matter, leaving a clean surface upon which a metallic coating may then be deposited. The process is designed particularly to prepare long strips of sheet iron for nickel-plating. A 10 per cent. solution of potassium cyanide is the electrolyte. Engelhardt (*Stahl u. Eisen*, **25**, 148 (1905)) gives a description of the Kjellin furnace for the electrical production of steel, and compares this method with other steel-making processes. Basing his figures on a cost of 2 pfennigs per kilowatt hour, for electrical energy, the author estimates the cost of fine special steel at 18 to 22 marks per ton by this process, as against 20 to 40 marks per ton by the crucible process. For Martin steel the cost is figured in detail at 68.06 to 71.42 marks per ton, against 75 to 80 marks by the basic process and 85 to 88 marks by the acid process.

Explosives.—Thomson (*Report of Chief Inspector of Explosives*, 1905) describes an explosion of 400 pounds of dry collodion due to collodion dust on the brass runs and guides in the dry room, being fired by friction of the zinc tray on the runs. The collodion contained only 10.61 per cent. of nitrogen, yet the explosion was violent. As a preventive of future trouble in this way, it is suggested that the sliding trays be abolished in the dry room, and that the use of apparatus be avoided in which there are corners where the collodion dust can accumulate. Further, in a report on an accident at Newcastle, Emlyn, Thomsen attributes the explosion to the fall of some iron or steel article on the concrete floor of the storage vault, by which a few grains of powder, accidentally spilled on the floor, were ignited. A lead or linoleum floor covering is recommended. Hake (*J. Chem. Ind.* **23**, 915 (1905)), from an examination of the parchment paper used for wrapping nitroglycerol explosives, through which the nitroglycerol had exuded, concludes that the porosity of the paper was due to an admixture of ground wood, which became charred in the acid of the parchmentizing bath and thus left minute holes in the paper. Lignocellulose was found in the paper. A report upon an explosion in a fireworks factory near Manchester, England, by Major A. Cooper-Key, Inspector of Explosives, gives the results of certain experiments with a mixture of potassium chlorate, copper oxychloride, arsenic sulphide, potassium nitrate, and rosin. This mixture can be fired by friction between wooden surfaces and is sensitive to blows. It is supposed that two copper funnels, used in filling the mixture into the cardboard cylinders, may have been struck together, or possibly a little grit was present. The inspector recommends that the workmen should wear uninflammable clothing and should not turn up the sleeves while at work. Also that the buildings should have ample means of egress and escape in event of danger. Hake and Lewis (*J. Chem. Ind.* **24,** 374 (1905)) have studied the formation of sulphuric esters in the nitration of cellulose and also their influence on the stability. Two samples of cotton, one suitable for making guncotton, and the other for making blasting gelatin, were nitrated with acids as used in a factory for making nitroglycerol. The temperature of nitration was 73° F.; the samples were soaked one hour in the acid with regular stirring, then the acid squeezed out and the samples washed twice a day for fourteen days in rain-water; after saturating with water, the samples were put into bottles. After several days, the water was tested for sulphuric acid with barium chloride. After again washing for four hours, in running water, the cotton was bottled, kept standing two days more and the water again tested. No sulphuric acid could be detected. After two months the tests were repeated and in nearly every case free acid was found, which was quantitatively determined, and ranged from 0.79 to 0.22 per cent. sulphuric acid in the cellulose. Various solvents were tried with a view to remove the sulphur compounds, and the guncotton then subjected to heat tests (*i. e.*, exposure to a temperature of 170° F., with potassium iodide paper) and to stability tests (heating to 130° C.). The results proved that the sulphuric esters were present in all cases and these decompose slowly during the washing and storage of the wet samples. This free acid then causes erratic behavior in the apparently stable guncotton. It is suggested that this may explain some of the mysterious explosions of guncotton in storage, *e. g.*, that at Stowmarket in 1871. A lengthy discussion of the paper is included. Nauckhoff (*Z. angew. Chem.* **18,** 11, 53 (1905)) has studied the conditions governing the freezing of nitroglycerol and explosives of which it forms a component. A pure nitroglycerol can be chilled much below its normal freezing-point without solidifying, but the true freezing-point is 12.3° C.; commercial nitroglycerol contains some dinitroglycerol which lowers the freezing-point to 10.5° C. This lowering of the freezing-point is expressed by Raoult by the formula $\Delta = E. \frac{m}{M}$, where 100 grams of the solvent (nitroglycerol) contain m grams of the impurity, M is the molecular weight, and E, a constant, which, for nitroglycerol, is 70.5. Additions of benzene, mono-, di- and trinitrobenzene, *o*- and *p*-nitrotoluene, dinitrotoluene, naphthalene and nitronaphthalenes, ethyl acetate and nitrate and methyl alcohol, to nitroglycerol, were found to lower the freezing-point in accordance with the amount calculated by the formula, except that methyl alcohol caused less depression of the congealing point than the formula would require. This is supposed to be due to the formation of more complex molecules in the solution. In general, the effect of a substance in lowering the freezing-point depends on its molecular weight and not on its composition or freezing-point. Tests with dynamite samples showed that the effect of cold is influenced by the amount of cooling below its true freezing-point which the nitroglycerol permits without congealing. This property is affected by the plasticity of the explosive, which, in turn, depends on the proportion of nitrocellulose present and on its gelatinizing properties. Dynamite which has once been frozen and thawed will not withstand chilling to so great a degree as in the first instance. Whatever is added to nitroglycerol to lower the freezing-point must not reduce the explosive power or stability of the explosive, must not be volatile at high atmospheric temperatures, should have a relatively low molecular weight and not affect the gelatinizing of the nitrocellulose.

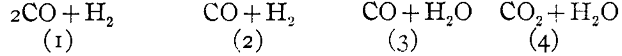
Brewing.—Windisch and Röttgen (*Z. Untersuch. Nahr. Genussmittel*, **9**, 129 (1905)) have examined the effects of "fining" agents, like isinglass, gelatin, egg-albumen and "Spanish earth" (a China clay) on wines. The ash, extract, and total acidity were not affected; the tannin of red wines was diminished but in one white wine it was increased, for no apparent reason. Spanish earth containing calcium carbonate may reduce the acidity. Keil (*Woch. Brau.* **22**, 432 (1905)) publishes the average alcohol content for certain German beers tested during two years past. Of 476 samples of bottom fermentation, 79.7 per cent. of the pale beers and 71.6 per cent. of the dark beers ranged from 3 to 4 per cent. by weight; the average for the pale beers was 3.55 per cent. and for the dark was 3.70. Top fermentation beers showed much more variation but 112 samples ranged, for the most part, from 1 to 3 per cent. Rogers (*J. Inst. Brew.* **10**, 528 (1904)) considers the proper standard of hard water for pale ale to have the following composition (grains per gallon): Calcium sulphate 60; magnesium sulphate 10; calcium and magnesium carbonates 20; sodium chloride 4; total salts 94. An excess of magnesium sulphate may be compensated by adding calcium chloride. If nitrates are present in the water, it is recommended to add sulphurous acid and boil. Gypsum and potassium salts, as kainite, are desirable for mild ales. Lindet and Marsais (*C. R.* **139**, 1223 (1904)) have fermented equal volumes of sterilized must with equal quantities of the same yeast, and have determined the quantities of alcohol and carbon dioxide formed at different periods. During the early stages of the fermentation the amount of alcohol is larger than that of carbon dioxide, but later they are practically the same. It is believed that the excess of the alcohol over the carbon dioxide is due to the growth of the yeast itself and the formation of new cells, this taking place chiefly during the early stages of the fermentation.

Fermentation.—Jensen (*Centr. Bakt. Parasitenk.* **13,** 161, 291, 428, 514, 604, 687, 753 (1904)) contributes a long series of articles upon the volatile acids in cheese and the biology of cheese ferments. In some cheeses, volatile acids not produced by hydrolysis were found. Acetic acid was present every time and also formic acid, though only in traces. In cheeses ripened by mold action, small quantities of acetic and formic acids are present along with the acids from the hydrolysis of the cheese fat. The molds cause hydrolysis but not fermentation. In others, propionic acid is found. The acids produced from the cheese fat by hydrolysis influence the aroma, the more so the greater the weight of the acid; thus capric, caprylic and caproic acids have greater influence than valeric and butyric acids. Ammonia is generally found in cheese where hydrolysis of the fat occurs. The peculiar aroma of certain cheeses is due to special constituents: amino-acids in Emmenthaler; butyric esters in Roquefort; putrefactive products in Limburger. Stoklasa (*Chem. Centr.* **1,** 265 (1905)), in a study of anaerobic respiration, found a greater amount of sugar decomposed than was required by the amounts of alcohol and carbon dioxide produced, but an increase of acidity, due to lactic acid, resulted. An enzyme causing this was isolated, and it appeared that when the fermentation continued more than twenty-four hours there was an evolution of hydrogen. The alcohol is oxidized by certain enzymes to acetic acid, while formic acid is also made, and this splits off carbon dioxide and hydrogen. It is thought that this nascent hydrogen has some part in the assimilation of carbon dioxide in the cells having chlorophyll. Ehrlich (*Z. Ver. deutsch. Zucker-Ind.* (1905) p. 539) has investigated the origin of fusel oil in fermentation of saccharine solutions and concludes that it is derived from albuminoid matter in the wort by the action of yeast. This view was advanced by Müller in 1857. The fermentation amyl alcohols are produced from leucine and isoleucine or other amino-acids, as was demonstrated by adding these substances to a pure sugar solution and fermenting; the control test showed only a trace of fusel oil, but that produced in the direct experiments was about equivalent to the quantity of amino-acid destroyed. Leucine produced inactive amyl alcohol and isoleucine formed *d*-amyl alcohol. The small quantities of amino-acid bodies present in yeast account for the production of a little fusel oil when fermenting pure sugar. It is supposed that the amino-acid unites with the water and then, under the action of the enzymes in the yeast, ammonia is produced and a hydroxyl acid which splits into amyl alcohol and carbon dioxide. Possibly isobutyl alcohol comes from α-aminoisovaleric acid, and *n*-propyl alcohol from glutamic acid. Dawson (*J. Inst. Brewing*, **11**, 288 (1905)) discusses the mechanism of enzyme and ferment action; the action of enzymes is essentially like that of catalytic substances, but their functions are not simply a contact. The enzyme combines with the body on which it exerts its action and the intermediate body formed then breaks up. The law of mass action really controls each of the changes. Hydrolysis by enzymes is due to hydrogen ions to which the compound of the enzyme and original substance is very sensitive. Lange (*Z. Spiritus-Ind.* **28**, 341 (1905)) advocates the addition of formic acid to distillery mashes already sour with lactic acid. This stimulates the fermentation, keeps the diastase active during fermentation, and prevents the action of acid-forming bacteria. Thus the yield of alcohol is increased. The fermentation in the presence of formic acid is quiet and uniform; the secondary fermentation is usually vigorous. The uniform intensity of the fermentation permits filling the vats to a higher level. To 3000 litres of mash about 50–60 cc. of formic acid are used, the strong acid being diluted 1:8 with water. The yeast and mash are prepared in the ordinary way and when cooled to 37–38° C. the diluted formic acid is added, 100 cc. to each 100 litres of mash. After three fermentations with yeast, the amount of formic acid is raised to 200 cc. per hectolitre and kept there for six more fermentations; finally 300 cc. acid to each 100 litres of mash are used for continuous work. Emmerling (*Ber.* **38**, 953 (1905)), in further investigation of fermentation of molasses (this Journal, **27**, 434) by the bacteria in potato skins, found the total quantity of alcohols produced was 4.3 per cent. of the molasses (equal to 8.9 per cent. of the sugar). The alcohols consisted largely of ethyl alcohol with *n*-propyl alcohol in small part; *n*-butyl alcohol formed the larger part while little or no amyl alcohol was produced. Exclusion of air furnished the best condition for the fermentation, but this is not absolutely necessary. The bacteria cause liquefaction of gelatine and ferment cane-sugar solution, producing the same alcohols and evolving carbon dioxide and hydrogen. But if calcium carbonate is present, most of the sugar forms fatty acids, especially butyric and a little acetic. The bacteria also ferment maltose, glucose and glycerol, but not lactose. Buchner and Meisenheimer (*Ber.* **38**, 620 (1905)) have continued their investigation of alcoholic fermentation by expressed yeast cell-juice (this Journal, **27**, 432) and confirm their former conclusions that the change of the sugar takes place in two stages, with lactic acid as an intermediate product. They propose to restrict the name zymase to that enzyme which converts the sugar to the lactic acid, and to give the term "*lactacidase*" to that which changes the lactic acid to alcohol and carbon dioxide. Addition of excess of sugar or of lactic acid seems to disturb the process and destroy the lactic acid produced. Cell-juice of low fermentative power seems to favor the destruction of lactic acid; strong and active juice shows an increase of lactic acid after the fermentation. The inactive form of lactic acid was always produced. Acetic acid is always found in small quantities in the products of cell-juice fermentation of sugar. Warcollier (*C. R.* **141,** 405 (1905)) finds that bruised spots in unripe apples contain starch which remains unsaccharified even after the fruit has become wholly ripe. The tannin which exudes from the damaged cells exerts a paralyzing action on the diastase, thus preventing conversion of the starch to sugar in the ripening process. It was found that 0.2 per cent. of tannin from galls, or 0.075 per cent. of the apple tannin, would prevent the conversion of a 1 per cent. starch paste to sugar, when treated with a 10 per cent. malt extract, at 62° C. Pringsheim (*Ber.* **38,** 486 (1905)) has confirmed Emmerling in regard to a bacillus infecting potatoes and causing the formation of fusel oil in fermentations (this Journal, **27,** 434). Schönfeld (*Woch. Brau.* **22,** 79 (1905)) has continued his study of the effect of metals in causing turbidity in beer, and finds that aluminum in contact with copper causes beer to become turbid by precipitation of albuminoid matter.

Fine Chemicals.—Askenasy and Mugdan have patented (*Eng. Pat.* No. 18,602 of 1904) a method for making acetylene tetrachloride by passing acetylene and chlorine into antimony pentachloride which is well cooled. The gases are passed successively or simultaneously into the pentachloride, which in the latter case is contained in two connecting vessels. The first product is $SbCl_5.C_2H_2$, which then absorbs four atoms of chlorine to form the tetrachlorethane or acetylene tetrachloride. The product is separated by fractional distillation, or in some cases by decomposing the antimony pentachloride with water or acid. The acetylene tetrachloride is a good solvent for fats, oils, etc. Knoevenagel (*Eng. Pat.* No. 23,578 of 1904) makes perfumes by treating condensation products of citral and acetone, acetylacetone, etc., with hydrogen halogen acids, as hydrobromic, in glacial acetic acid; the addition products so formed are boiled with dilute alkali solution to cause the halogen acid to split off, forming odoriferous substances. Hooven and Endemann (*U. S. Pat.* No. 783,524) propose to make cream of tartar by extracting grape pomace with oxalic acid solution. The conversion of calcium tartrate into cream of tartar by boiling with oxalic acid solution and a potassium salt, is included in the claim. Morel (*J. Pharm. Chim.* **21,** 177 (1905)) has an illustrated article upon the commercial manufacture of formaldehyde by passing wood alcohol vapors mixed with air, over copper at a red heat. The mixture of methyl alcohol, water and formaldehyde is rectified in a column still and a 40 per cent. formaldehyde solution is produced. Reuter (*Pharm. Jour.* **74**, 787 (1905)) proposes to use sulphur dioxide to counteract the tendency of crystallized carbolic acid to turn red in color. Liquid phenol with 10 per cent. water is treated with sulphur dioxide until the phenol has absorbed about 10 per cent. of its weight of the gas. Then a small proportion of this solution (averaging about 50 cc.) is added to 200 kilos of melted phenol. This is said to preserve the phenol from the oxidizing action of the air for a very long time. But as the red color has no injurious effect on the phenol for medicinal use, the author calls attention to this color as tending to prevent mistakes and even suggests adding some dyestuff to the carbolic acid intended for retail trade, and deprecates any use of decolorizing agents. Moissan (*C. R.* **140**, 1209 (1905)) has found that carbon dioxide (dry) and potassium hydride reacting at 54° yield only potassium formate; but if the reaction starts at a temperature between 80° and 200°, a mixture of formate and oxalate of potassium results; thus $2KH + 2CO_2 = K_2C_2O_4 + H_2$.

Foods.—Just (*U. S. Pat.* 789,858, also *Scient. Am. Sup'l.* 1905) prepares milk powder by rapidly evaporating a partially pepsinized milk at 100°, upon the surface of steam-heated rolls, the dry film being automatically scraped off from the rolls by a knife blade. The bleaching of flour by ozone has received further investigation by Brahm (*Z. Untersuch. Nahr. Genussm.* **8**, 669 (1904)) who finds the quality of the flour for bread-making much injured, thus supporting the views of Balland (see review in this Journal, **27**, 429). Roberts (*Eng. Pat.* 23,576 of 1904) restores certain ingredients to flour which have been lost in the milling process, by adding small quantities of potassium, sodium, calcium, and magnesium phosphates and a little soluble proteid as powdered milk proteid. Thorpe (*J. Chem. Soc.* **87**, 206 (1905)) has investigated the effect of souring of milk on the results of the analysis for determination of quality in connection with control under the Food and Drug Acts, in England. Since nearly all the samples sent in for test are sour by the time they reach the laboratory, it becomes necessary to determine the effect of such change. The fat content does not appear to alter to any appreciable degree; nor does the proteid content suffer any considerable loss, beyond the formation of ammonia to a small extent. But the formation of each molecule of butryic acid from the lactic acid causes two molecules of carbon dioxide and of hydrogen to escape as gases. As the lactic acid is oxidized, acetic acid is formed and one molecule each of water and carbon dioxide are evolved. Any ethyl alcohol produced is also accompanied by loss of carbon dioxide which may amount to $^{90}/_{46}$ of the weight of the alcohol so formed. A scheme of analysis as followed in the Government laboratories is given. Bodner (*Analyst*, **30,** 264 (1905)) warns against the use of zinc sulphate and potassium ferrocyanide in clarifying wines, owing to the danger in adding either in slight excess. Certain Moselle wines were found thus contaminated.

Gas.—Le Sueur has patented a process (*U. S. Pat.* No. 781,009) for treating acetylene by refrigeration at atmospheric pressure, whereby it is liquefied or solidified, thus facilitating its transportation and storage. Bone and Andrew (*J. Chem. Soc.* **87,** 1232 (1905)) have continued their researches upon combustion, extending their work to acetylene. The combustion of this gas seems to be essentially similar to that of ethylene, ethane and methane. Oxygen appears to combine with the hydrocarbons, forming an unstable molecule which then rapidly decomposes into simpler bodies. Mixtures of acetylene and oxygen filled into glass retorts and sealed under atmospheric pressure, when heated, begin to react at about 250, °and the process advances rapidly at 300°. With mixtures of one to two molecules of acetylene to one molecule of oxygen, explosions take place at 350° and at 375°, when the proportion is two of acetylene to three of oxygen. Excess of oxygen over the equimolecular proportion retards the rate of combustion both below and above the ignition point. The formation of carbon monoxide and hydrogen when the equimolecular mixture is exploded, is attributed to the secondary decomposition of the hydroxyacetylene first produced. In the slow combustion of acetylene, carbon monoxide and formaldehyde are produced at a very early stage, owing to the breaking up of the unstable hydroxyl compound. The following stages of the process are proposed:



$$\begin{array}{ccccccccc} \mathrm{HC{:}HC} & \rightarrow & \mathrm{(HO)C{:}C(OH)} & \rightarrow & \mathrm{CO+H.CHO} & \rightarrow & \mathrm{H.COOH} & \rightarrow & \mathrm{HO.COOH} \\ & & \mathrm{2CO+H_2} & & \mathrm{CO+H_2} & & \mathrm{CO+H_2O} & & \mathrm{CO_2+H_2O} \\ & & (1) & & (2) & & (3) & & (4) \end{array}$$

Below the ignition point in stages (3) and (4) the formic and carbonic acids are split into steam and carbon oxides; and above this point in stage (2) the formaldehyde breaks down to carbon monoxide and hydrogen. This may also happen in stage (1) where the dihydroxyacetylene is formed as an unstable body. Separation of carbon in the explosion of mixtures of acetylene and oxygen does not take place unless an excess of acetylene is present. Contact with a hot catalyzing surface (as porcelain) causes acetylene to unite with water vapor to form acetaldehyde

$$\mathrm{HC{:}CH+HOH=CH_2{:}CH(OH)=CH_3.CHO}.$$

Nothing to indicate the formation of benzene was noted in the experiments. Lewes (*J. Gas Lighting*, **89,** 161 (1905)) discusses the theory of the incandescent mantle and inclines to the catalytic theory. The fact that a mantle once brought to incandescence can be kept there by the action of a cold stream of coal-gas with air, shows catalytic action on the part of the ceria of the mantle. The author regards Buntes' experiments with a Bunsen flame and with a mantle as misleading, since the temperatures in various parts of the flame are changed when a mantle is placed over it. The non-conductivity, low specific heat and low radiation of thoria cause it to take on the temperature of the flame and it may rise a little above this, owing to the catalytic action of the mixed gases. Ceria has greater catalytic power, and in quantities up to 1.5 per cent., tends to localize the combustion on the mantle surface, and thus the ceria particles themselves become much hotter than the mantle. More ceria than this cools the mantle and flame by greater heat radiation, and there is a resulting fall in illumination power. 'King (*J. Gas Lighting*, **88**, 839 (1904)) compared the results obtained at Cleethorpes, Rushden and Higham Ferrers Gas works, with the water-gas produced by the Dellwik process. The "blue" water-gas is passed through retorts during the carbonization of the coal. The results of eighteen months working at Cleethorpes fix the cost per 1000 cubic foot of water-gas at 3.50d. Water-gas constitutes about 22 per cent. of the mixed gas produced. The quantity of benzene used for enrichment has decreased from 0.38 gallon per 1000 cubic foot, in July, August and September, 1903, to 0.0066 gallon during the same months in 1904. In 1903, the water-gas formed 12.6 per cent. of the mixed gas, which had a candle-power of 16.4 and a calorific value 625 B. T. U. Later, the candle-power was 15.9 and the proportion of water gas 21.3 per cent., with a calorific value of 595 B. T. U. The coal gas furnishes all the enrichment now, and about 400 cubic feet per ton increase of yield is noted. The tar is of slightly lower value. At Rushden, the results agree closely with the above; the yield of coal-gas is about 11600 cubic feet per ton, and the benzene consumption is 0.292 gallon per 1000 cubic foot of water-gas. The mixed gas is 16 candle-power. An extended review upon gas as a source of power appears in *J. Chem. Ind.* **24**, 592 (1905) under the heads: Generation of Producer, Mond and Blast-Furnace Gases (W. I. Case), Utilization of Gas from Suction Producers (Oskar Nagel), Coke Oven Gas (C. G. Atwater), and the Mond Producer (J. D. Pennock). Douglas (*Inst. Mining Metal.*, 1905) considers the use of wood-gas for power, basing his paper upon data obtained from the plant of the Montezuma Copper Co., Sonora, Mexico. The gas produced in modified Loomis-Pettibone apparatus has a calorific value of 135.6 B. T. U. at 62° F. Its composition is hydrogen, 19.5; carbon monoxide, 13.45; methane, 2.48; olefines, 0.34; carbon dioxide, 15.45; oxygen, 0.25; nitrogen, 48.5 per cent. (this Journal, R. 573 (1905)).

Illumination.—von Bolton, at the meeting of the Bunsen Society for Applied Physical Chemistry at Karlsruhe in June, presented a paper on the Siemens-Halske tantalum lamp, which is reported in *Electrochem. Metal. Ind.* **3**, 328 (1905). The preparation and properties of pure tantalum were described in *Z. Elektrochem.* 1905, p. 45. The lamp with tantalum filament is said to have a useful life of 400 to 600 hours, during which it loses 20 per cent. of its candle-power, and consumes 1.5 watts per candle-power; the total life of the lamp may reach 1,000 to 1,500 hours. The consumption of energy is less than half that of the carbon filament lamp for the same useful life. Steinmetz has patented (*Eng. Pat.* No. 26,916 of 1904) the addition of 2 to 3 per cent. of titanium or its oxide or carbide to the ordinary carbon electrode for arc lamps. The vaporized titanium imparts an intense whiteness to the light. Associated with him, Demster and Härden have taken patents for producing titanium-bearing electrodes. (*Eng. Pat.* Nos. 26,915, 26,918 and 26,919 of 1904).

Health and Sanitation.—T. M. Legge, Medical Inspector of Factories, reports on the "Manufacture of Paints and Colors Containing Lead, as Affecting the Health of the Operatives" (Abstract in *J. Chem. Ind.* **24**, 742 (1905). Inspection of nearly 100 factories shows that the wet process causes about 18 per cent. of the cases of lead poisoning while dry operations, causing dust, produce 72.9 per cent. Boiling of solutions in certain wet methods has made some trouble, owing to the spray projected into the air acting similarly to the dry dust. Processes employing white lead appear to be much more dangerous than those involving red lead, vermilionettes, chrome greens or yellows. Respirators worn by the operatives have numerous objectionable features, and strong exhaust draught away from the workmen appears more satisfactory. Trillat (*C. R.* **141**, 215 (1905)) finds that formaldehyde is present in the fumes of burning sugar, ranging from 0.2 to 5.7 per cent.; there were also 1.0 to 3.0 per cent. phenols; 1 to 3 per cent. of acetic acid; 0.1 to 5 per cent. acetone; 0.1 to 0.5 per cent. of methyl alcohol, and 0.5 to 1.4 per cent. of benzaldehyde. The gases are of an antiseptic character, for by burning 4 to 6 kilos of sugar in a room of 100 cubic meters volume, very resistant germs are killed. Grossmann (*J. Chem. Ind.* **24**, 655 (1905)) describes his method of treating sewage sludge for its disposal and recovery of products, as applied at Bradford, where 16 tons of sludge are handled daily. Sulphuric acid is added to the sewage to precipitate the sludge and the mass filter-pressed, hot; the cake contains about 24 per cent. grease. This cake is distilled in retorts at temperatures from 200° to 900°, steam being introduced during the distillation. The fatty acids and ammonia distilled off are collected in suitable condensers; the residue of free carbon contains 2 per cent. nitrogen and 1 per cent. phosphoric acid and is used for fertilizer. About 25 pounds of butyric acid and an equal amount of other organic fatty acid are obtained each twenty-four hours.

Moore (*Amer. J. Pharm.* **76,** 553 (1904)) advocates his method for destroying algae (green scum) which grows in ponds and reservoirs by the use of copper sulphate, in the proportion of 1 part to 5,000,000. This was found effective in destroying the odor and taste in a reservoir at Winchester, Kentucky, purifying the water in three days. It also prevented the growth of algae in water-cress beds in the Southern States, without injury to the cress. One treatment per annum was sufficient. It is also claimed that 95 per cent. of the micro-organisms in sewage were destroyed by one treatment with copper sulphate. Kraemer (*Ibid.* p. 574) explains the action of copper sulphate in minute quantities in killing algae on the theory that the plants, being unicellular, are entirely surrounded by the copper and the cell functions are thus all affected. Using copper salt in the proportion of 1 part to 100,000 and 1 part to 1,000,000, after forty-eight hours at ordinary temperature, 99 per cent. of micro-organisms were destroyed in the first series and 90 per cent. in the second. Colon and typhoid bacilli were destroyed in four hours at ordinary temperatures when clean copper foil was suspended in the contaminated water. It is proposed to suspend small strips of copper in the water for domestic uses.

Metallurgy.—Burgess (*Electrochem. and Metal. Ind.* **3,** 332 (1905)) considers the action of acids on iron and the use of acid pickle. Although much investigation of the corrosion of iron by acids has been carried on, information on the subject is still deficient, and among the numerous published articles, so many conflicting statements and faulty and incomplete observations appear, that little of real value can be found. Quantitative tests seem to have been much neglected. Information relative to the effect of impurities in the acid on the corrosion is very much desired. The factors which determine why one grade of iron is better than another for a given use, or whether any certain grade of iron should be employed, should be considered. Concerning the use of acid pickles, the author first gives some interesting statistics as to the importance of the industry. Seventy square miles, or 40,000 acres of sheet metal and 60,000 tons of zinc are used annually for galvanizing in this country, and all of this surface must be pickled; even a larger surface of wire is pickled, while stamping, cold rolling, preparation of enameled ware and electroplated surfaces for painting, varnishing, etc., all involve acid pickling as a preliminary. No uniformity of working has been adopted, each operator having his own method. The ideal pickle is defined as one that removes rust and scale, without attacking the underlying metal. For this, acids having maximum solvent action on oxide and a minimum action on iron, are desired. A table is given showing the variety in practice in the operation of pickling solutions for iron, the composition of the pickles and the time required. Extended citations from published articles and books on the methods of pickling, the composition of the baths, the effect on the iron of "overpickling," the costs of the process and much other information, are included in the article. Shepherd and Upton (*J. Physic. Chem.* **9,** 441 (1905)) have tested the tensile strength of certain alloys of copper and tin as affected by heat treatment. Bronze with 74.87 per cent. of copper was strengthened by heating above 510°, though there was loss of strength by continuing this heating; this increased the ductility. The maximum tensile strength was found in an alloy having 78.81 per cent. of copper and this contained both α- and β- crystals. Shepherd also examined certain aluminum and zinc alloys (*Ibid.* p. 504). The specific gravity of some of these alloys was determined and was found to be unaltered after heating for a week in boiling naphthalene. The curve obtained by plotting the specific volumes of the different alloys shows two branches which intersect near a point representing the alloy having equal proportions of the two metals. The two phases probably consist of solid solutions. When more than 50 per cent. aluminum is present, the alloys solidify above the eutectic point, 381°. An alloy with 40 per cent. of aluminum shows two phases when examined microscopically; the eutectic contains 5 per cent. of aluminum. Zinc can take up 4 per cent. of aluminum in solid solution, but aluminum can dissolve 50 per cent. of zinc. Goldschmidt (*Chem. Ztg.* **29,** 56 (1905)) states that metallic chromium may be precipitated from the solution of the nitrate by contact with metallic zinc for a day or two. The chromium hydroxide also thrown down can be separated from the crystalline chromium by treating the mass with caustic soda. Hutton (*J. Chem. Ind.* **24,** 589 (1905)) has a review of recent advances in the electro-metallurgy of iron and steel. The electro-thermic reduction of iron, electric steel-making and considerations of the Héroult and Kjellin, Keller, Stassano, Girod, Gin and the Schneider furnaces are included. Ward and Dongden (*Ibid.* p. 186) criticize a paper by Hudson (*Ibid.* **23,** 595 (1904)) in which the glazing of certain kinds of silicious irons is attributed to an increase in the percentage of sulphur. They added sulphur as iron sulphide to the melted iron, but glazed iron was not produced; hence they hold that if high sulphur always does appear in the glazed iron, its presence must be due to the same cause as the glazing. Glazed iron is made when the temperature of the blast is high, with an excess of fuel, and when the furnace is running on an acid slag. The authors think the glazing probably due to the silicide of iron produced by high temperature, but under these conditions there may be a tendency for the sulphur to combine with the melted iron. In discussing the paper, Hudson doubted the presence of free silicide of iron in glazed pig-iron, but admitted that silicon plays an important part in giving a glazed fracture which was only observed when

3.5 per cent. silicon was present; iron containing nearly 4 per cent. silicon in solid solution was easily broken and the fractured crystals present shining surfaces. He maintained that the increased percentage of sulphur might account for the glazing. MacArthur (*Ibid.* p. 311) gives a review of the progress of gold extraction by cyanide solution during the past fifteen years. The early experiments and results of the researches by the author with the Messrs. Forrest upon the action of various solvents upon gold, which led up to the discovery of the action of dilute cyanide solution, are most interestingly set forth; also, the influence which the process has had in the gold-producing districts of the world and in chemical manufacture and research with a view to the production of the necessary cyanide. Barnett (*Ibid.* **24,** 832 (1905)) discusses magnalium and other light alloys. Wöhler prepared two magnesium-aluminum alloys in 1866, *viz.*, Al_2Mg and $AlMg_2$, but neither had any practical use, being brittle and easily oxidized. Three of these alloys are now in use: X used for forging and casting where strength is important; Y used for ordinary casting; Z used for rolling and drawing. Care is necessary with all these to avoid oxidation by overheating or agitation of the fused metal, and the working temperatures range from 300° to 360°, the treatment being, in general, similar to that of aluminum. Magnalium has higher tensile strength and works better in the lathe than aluminum, and is less susceptible to dry, atmospheric corrosion than aluminum, copper, zinc or brass. All the alloys contain over 94 per cent. aluminum with small amounts of copper, nickel, antimony, iron and sometimes lead and tin. "Zisium" and "ziskon" are silver-white alloys and very light, *viz.*, specific gravity 2.95 and 3.35 respectively. Ziskon has much the higher tensile strength. Zisium is chiefly aluminum with zinc, tin, and copper and traces of antimony and bismuth. Ziskon is a zinc-aluminum alloy containing about 25 per cent. zinc. Dewar and Hadfield (*Proc. Roy. Soc.* **74,** 326 (1905)) have found the effect of liquid air temperatures on iron and iron alloys generally to increase the maximum hardness and decrease the ductility to nothing. Soft Swedish iron, after chilling in liquid air, became very brittle and broke readily when hammered. But its hardness, which was 90 by the Brinell hardness test, was raised to 266 at — 182°. But nickel showed an increased tensile strength and ductility when chilled; thus the addition of nickel prevents the iron becoming brittle. Manganese, on the contrary, makes the iron still more brittle. Hofman (*Trans. Am. Inst. Min. Eng.* (1905) p. 811) has studied the decomposition of zinc sulphate by roasting in an electrically heated tube. Using a thermo-electric pyrometer, the lowest temperature of dehydration of the crystals was 263°, but even after forty hours' heating of 2 grams of the salt, 0.24 per cent. of water remained. The last of the water was not given off until the temperature had risen to 528° where decomposition of the sulphate began. This decomposition became complete at 739° but required considerable time. Basic sulphate was formed to some extent in all trials. The percentage of sulphur eliminated in a given time, with a uniform increase of temperature in several experiments with various depths of charge, is shown by curves. When carbon is mixed with the zinc sulphate, it assists in the elimination of sulphur, with increasing effect until the temperature reaches 528°, at which point reduction to the sulphide becomes noticeable; but the elimination of sulphur by carbon was not complete, some sulphate remaining after the most favorable trials. Attempts to roast blende to form sulphate directly, showed a small yield in every case; only 9 per cent. of the total zinc in raw blende was converted and 16 per cent. in a mixture of blende and pyrites. The temperature necessary for roasting is too high, resulting in decomposition of the sulphate, while much of the sulphur escapes as sulphur dioxide upon oxidation. High temperatures increase the proportion of basic sulphate formed. Hofman and Magnuson (*Trans. Am. Inst. Min. Eng.* (1905) p. 948) have examined the effect of silver on the chlorination and bromination of gold. Alloys of the two metals were exposed to the action of chlorine and bromine waters. The results show a greater extraction of gold from the alloys when the solution of chlorine was supersaturated, containing 2.8 grams chlorine per liter. With less than 2.1 grams chlorine per liter and more than 10 per cent. silver in the alloy, there was marked decrease in the amount of gold dissolved. Bromine water appeared to be somewhat more efficient; with 20 per cent. silver in the alloy, the gold dissolved was only about 1 per cent. under that taken into solution from pure gold. But again, the quantity dissolved decreased rapidly as the amount of bromine in the water was less. From an alloy carrying 30 per cent. silver, bromine water containing 8.97 grams bromine per liter dissolved 97.7 per cent. of the gold, whereas a saturated chlorine water with 2.8 grams chlorine per liter, dissolved only 40.3 per cent. of the gold. Curve diagrams for both solvents are included in the article. Boudouard (*Iron and Steel Inst.* May, 1905) publishes the results of his study of the fusibility of calcium and aluminum silicates and double silicates and calcium aluminates. Various curve diagrams and tables of analyses are included. Szirmay (*Z. Elektrochem.* **11,** 335 (1905)) has made tests of the galvanized coating on iron and steel, produced by both the hot method and by electro-deposition. The latter requires less zinc, has better adhesion to the iron and withstands corrosion much better. Neil (*J. Chem. Ind.* (1905) p. 121) reviews the principal methods of recovering tin from waste tin scrap of the tin can industry. Neuhardt's electrolytic process, the caustic soda electrolytic process, the stannic chloride process and the Browne-Neil electrolytic process, are all considered. The results shown by Gayley in experimenting with the dry air blast (*J. Chem. Ind.* (1904) p. 1148) have led Boudouard to study the effect of water vapor on the reduction of iron oxides by carbon monoxide and dioxide (*C. R.* **140,** 40 (1905)). By passing the gas obtained by decomposing oxalic acid over ferric oxide, the gas being dry in one case and saturated in the other with moisture at atmospheric temperature, he found that the dry gas has the greater reducing power at temperatures of 400° to 500°, but as the temperature rises, the effect becomes less marked and finally ceases at about 1050°. Thus it is only in the cooler parts of the furnace that more complete reduction of the iron oxide would be expected with dry air blast. Also the reduction of the carbon dioxide by the coke is less marked at this temperature (500°), which may save fuel. Near the tuyeres the water is decomposed into hydrogen and oxygen and there is nothing certain known as to the action of the hydrogen. Gayley (*Trans. Am. Inst. Min. Eng.*, July, 1905) has contributed another valuable article upon the dry-air blast. The data obtained in running the Isabella furnaces from November 1904 to March 1905, are given and support the views held by the author in his earlier paper. (See *U. S. Pat.* No. 779,037, *Eng. Pat.* No. 13,892, of 1904). von Maximowitsch (*Elektrochem. Ztg.* **11,** 165 (1904)) explains a method for electroplating with copper in which heating or stirring the bath is avoided. The anode is placed above the cathode, both being horizontal, and the copper sulphate solution flows from the former to the latter. The solution contains 220 grams copper sulphate crystals and 25 grams sulphuric acid per liter; the current density was 6 to 10 amperes per square decimeter, and the electromotive force 0.8 volt per ampere, with the electrodes 8 cm. apart. By separating the anode from the cathode by silk gauze, the mud is retained in the anode compartment. The copper deposit is said to be bright, smooth and tough.

Oils.—Petrie (*J. Chem. Ind.* **24,** 996 (1905)) contributes the results of a thorough investigation of the mineral torbanite of New South Wales and of the oils obtained from it. The special characteristic of torbanite is the presence of gelatinous algal substances constituting 90 per cent. of the whole organic matter. Thus there is a high ratio of volatile to fixed carbon. The microscopic structure shows the presence of algal cells. The composition of New South Wales torbanite is C, 75.32; H, 12.05; O, 5.49; N, 0.28; S, 0.31; ash, 6.55 per cent. The sulphur is probably derived from pyrites. The ash contains SiO_2, 77.12; Al_2O_3, 20.14; Fe_2O_3, 0.76; CaO, 0.30; MgO, 0.45; P_2O_5, 0.65 per cent. Extraction of the mineral with benzene yielded a liquid which was fractionated into eight groups, from 79–170°, and tests showed these constituents to be saturated hydrocarbons of high boiling-points, mixed with a small amount of other substances having high specific gravity and refractive index. High-grade torbanite is exported for gas-making; lower grades are destructively distilled for oils, paraffin and ammonia. A crude green oil is obtained which fractionates into naphtha 3 per cent., solar oil 60 per cent., heavy oil 17 per cent. and a residue 20 per cent. These fractions were carefully examined in detail. The crude oil is composed of paraffins and olefins; the latter distills off under 280°, and the paraffin continues to come over up to 400°. The naphtha forms 9 per cent. of the crude and consists of equal parts paraffins and olefines, with boiling-point ranging from 30° to 200°. Solar oil comes over between 200° and 270°, and contains 50 to 80 per cent. paraffins. The heavy oils come over between 270° and about 400°; they crystallize on cooling and in the portion distilling above 300°, the compounds from $C_{17}H_{36}$ to $C_{30}H_{62}$ make up the mass. At the end of the distillation, chrysene appears. Naphthenes are also present in considerable quantities. Weger (*Chem. Ind.* **28,** 24 (1905)) has examined various commercial burning oils and prepared curves showing percentages of the constituents of different boiling-points, of 14 samples of oil. Boiling-points were determined in the continuous distillation apparatus of Frank, the distillation being continued until about 90 per cent. had distilled over. Olefines were determined by the method of Kraemer and Böttcher; the candle-power showed the American oils at a disadvantage compared with several Russian, Galician and German oils. But for whiteness of flame they hold the first place, since the high content of olefins in the other oils reddens the flame. Rakusin (*Chem. Ztg.* **29,** 139 (1905)) has determined the specific gravity of cacao-butter as 0.9702 at 20°. It sinks in castor oil and must exceed the density of the oil at 0.9604 at 20°. Hoyer (*Seifensiederztg.* **32,** 509, 530, 546 (1905)) describes certain improvements in the process of hydrolyzing fats by the use of castor seed extract (this Journal, **27,** 426); this contains the ferment in more concentrated state than in the crushed seeds and, at the same time, reduces the amount of albuminoid matter introduced into the fat to about 10 per cent. of that in the seeds. Thus a purer glycerol solution is obtained. The temperature should be near 23° for oils and only 1° or 2° above the melting-point of the fats. Above 42° the ferment loses strength. The amount of ferment necessary is directly proportional to the saponification value of the fat, and the water present about 35 per cent. of the weight of the fat. An addition of 0.15 to 0.20 per cent. of the weight of the fat, of manganese sulphate solution, is claimed to be an advantage. The mixture is agitated by a current of air. On standing twenty-four hours, about 80 per cent. of the fat is hydrolyzed and after forty-eight hours, about 90 per cent. With the castor seed extract about 0.06 per cent. (on the weight of the fat) of acetic acid is added. On the completion of the hydrolysis, the temperature is raised to about 80°, and dilute sulphuric acid added to break the emulsion. After standing two or three hours, the clear glycerol solution is run off. A claim is made that 95 per cent. of a theoretical yield of glycerol can be obtained, while the fatty acids are practically anhydrous. After removal of the sulphuric acid, the glycerol is evaporated in vacuum stills.

Ozone.—Guarini (*Elec. Eng.*, 1905, April 14) gives a description of the plant for sterilizing water at the Saint-Maur water works of Paris. The de Frise ozonizer is used and 150 cubic meters of water are treated per hour; an output of 1,000 cubic meters per hour would require only 2 or 3 men and about 129 horse-power for generating and pumping. The ozonizers are worked at 2000 volts tension and they are artificially cooled. The cells are semi-cylindrical brass troughs placed horizontally and covered with a glass plate; each is water-jacketed. The trough is divided by transverse partitions of brass, semi-circular in shape with toothed edges, and 60 mm. less in diameter than the trough; they are suspended from the glass cover and are connected to the generators for high tension current, by liquid resistances which serve as regulators to prevent sparking or arcs. The trough is grounded. Silent discharges from the teeth of the brass partitions to the inner surface of the trough, are produced, and through this succession of discharge areas, the air is drawn to form the ozone. The sterilizers are vertical cylinders divided into segments by transverse diaphragms of celluloid, perforated with fine holes. The ozonized air and water flow up through these diaphragms and are mixed. Finally the water is sprayed into an atmosphere of the ozonized air.

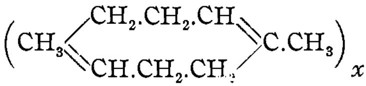
Paints.—Vanino and Gans (*J. pr. Chem.* **71**, 196 (1905)) describe phosphorescent sulphides (Bologna phosphorus), made by heating thiosulphates of barium or strontium to about 1300°. The luminosity is increased by adding a little nitrate of thorium, uranium or bismuth to the mass before heating. Formulae for preparing four different masses are given. Germain (*French Pat.* No. 339,180) proposes a suitable mixture of zinc sulphide, zinc oxide and barium silicate (or silicates of aluminum, magnesium or lead) as a base for paints. Morehead (*U. S. Pat.* No. 779,728) proposes to make lampblack by exploding a mixture of acetylene and air (or oxygen), under such conditions that the minimum pressure required for dissociation (about 60 pounds per square inch) is used. Toch (*J. Chem. Ind.* **24**, 527 (1905)) discusses the conditions affecting the painting of the iron work in the New York subway, with some observations on the progressive oxidation of iron under paint. The author holds that paints which are not moisture- and gas-proof should not be used for subterranean work. A dried film of linseed oil, when exposed to moisture forms with it a semi-solid solution similar to soap, and the moisture is carried through to the iron where it produces oxidation, especially in the presence of carbon dioxide. The hydrolysis of the oil seems to be hastened by the presence of lime, iron, lead and other bases in the paint, where they act similarly to a catalyzer. Tests of the rust beneath the paint showed it to be laminated in alternate red-brown and dark brown layers of constitution $Fe_2O_3.2H_2O$ and $Fe_3O_4.H_2O$ respectively. It is concluded that the rust formed in the subway is probably a mixture of these two, and further, that in places where there is vapor-pressure, condensation and abnormal humidity, a linseed oil pigment paint is useless. An examination of a steel pier at points covered at mean tide, disclosed oxide scales from $^1/_4$ to $^3/_8$ inches thick, produced by progressive oxidation in the salt water.

Paper, Pulp, Etc.—Beadle and Stevens (*Paper and Pulp,* **10,** 69, 105 (1905); *J. Chem. Ind.* **24,** 775 (1905)) have examined different gelatins with reference to their sizing qualities. Sheets of machine-made, laid paper containing one-third linen and two-thirds cotton, were sized in 5 per cent. solutions of the various gelatins at a temperature of 131°. Corrections for unequal absorption were made in proportion as the amount of gelatin in the paper varied from 5 per cent. and then the strength of test pieces was determined. The price of the gelatin was in no way an indication of its true value for sizing, nor was the stiffness of the jelly a sign of the strengthening properties of the size. Gelatines of the lowest grades (glues) gave greater strength to the paper, but the ink-resisting property is indicated to a considerable degree by the stiffness of the jelly formed. Müller-Jacobs (*Z. angew. Chem.* **18,** 1141 (1905)) proposes the use of amides of the higher fatty acids as substitutes for rosin soap in sizing paper. By heating ammonium stearate to 250° with pressure, stearamide is formed. This can be dissolved in soap solution containing a little sodium carbonate, by boiling. The solution becomes milky on dilution, owing to separation of the stearamide in fine suspended form. On adding alum or other metallic salt, the metallic soap precipitates, carrying down the stearamide with it. When thus precipitated in the hollander, on the paper pulp, and later passed through the callender, the stearamide is fused (melting-point 109°), and gives the paper a water-resistant character. Paper sized in this way is claimed to be more durable than ordinary rosin-sized paper. Richard and Jacquin (*French Pat.* No. 348,354) propose to coat paper or other tissues with an artificial silk layer. A film of nitrocellulose is produced on a polished plate of aluminum by dipping in alcohol-ether mixture; this film is denitrated and colored without detaching from the metal plate. The sheet of paper is then cemented to the film with gelatin and the whole then detached and stripped from the metal plate. Using a cotton cloth backing, a fabric is produced resembling goods woven with silk face and cotton back. Dietz (*Z. angew. Chem.* **28,** 648 (1905)) has worked out a method for utilizing straw for making cellulose pulp by the sulphite process. The high silica content of straw has prevented its use in this way. It is proposed to dissolve the silica with hydrofluoric acid by which the content is reduced from 1.5 per cent. or more, to less than 0.05 per cent. A bisulphite liquor carrying 3.6 per cent. of sulphur dioxide, of which 2.4 per cent. is free, is used in the proportion of 4½ times the weight of the straw. The boiling continues for three hours at 3½ atmospheres' pressure. A yield of 42 per cent. of cellulose is claimed, and this bleaches well with 13 per cent. of bleaching-powder. Sindall (*J. Chem. Ind.* **24,** 770 (1905)) describes the making and use of art papers such as have a very smooth surface for printing from half-tone blocks. The materials used, the qualities desired in the body paper, the defects common to such paper, the influence of the mineral filling on the print, and some suggestions relative to the production of such smooth papers, are the chief points considered. The surface is composed of glue or casein mixed with clay, *blanc fixe,* satin white or other mineral matter; the body paper consists of wood pulp or a mixture of this with esparto fibre. It is suggested, that, as these papers are not very durable, especially when exposed to dampness, the proper storage in a dry room of books made from it, is essential. A surface coating of cellulose in some soluble form is very desirable, but has not yet come into extended use.

Photography.—Morgan (*Eng. Pat.* 26,247 of 1904) prepares self-toning printing paper thus: For the emulsion, dissolve 6 drams sugar, 5 drams citric acid, 64 grains ammonium chloride and 4 drams Rochelle salt in 24 ounces water, to which has been added 1.5 ounces arrowroot starch. Then add 9 drams 36 grains silver nitrate in 8 ounces water; 11 grains gold chloride in 6 ounces water; 2 drams agar-agar in 18 ounces water. Coat the paper with this emulsion and finish as with a gelatin-coated paper. In this emulsion the gold is more easily reduced in the "hypo" bath. Lumière and Seyewetz (*Monit. Scient.* **19,** 104 (1905)) produced brilliant green tones in the silver image by bleaching in a solution of potassium ferricyanide 60 grams, lead nitrate 40 grams, water 1 liter. After washing, pass the plate into a solution of cobalt chloride 100 grams, hydrochloric acid 300 grams, and water 1 liter. The formation of a double silver-lead ferrocyanide in the first reaction is incomplete and the composition of the image is between $Pb_3Ag_2Fe_2(CN)_{12}$ and $Pb_2Fe(CN)_6$. Part of the lead is then substituted by the cobalt and the composition of the image finally lies between $Co_2Ag_2PbFe_2(CN)_{12}$ and $Co_2Fe(CN)_6$. These authors (*Brit. Jour. Phot.* **52,** 68 (1905)) have toned negatives with salts of uranium, copper and iron in conjunction with potassium ferricyanide, to obtain colored images. These images were of a very complex composition; thus with uranium the composition appeared to be intermediate between bodies having the formula $Fe.Ag_2UO_2(CN)_6$ and $(FeAgUO_2(CN)_6):UO_2$; the copper image was between $(Fe.Cu.Ag(CN)_6)_2:Cu$ and $FeCu_2(CN)_6$ and with iron it was between $Ag_2Fe_2''Fe_2'''(CN)_{12}$ and $Fe_3''Fe_2'''(CN)_{12}$. Kessler (*Ibid.* p. 28) describes a thiocarbamide toning bath made up of a 2 per cent. solution of thiourea added to 25 cc. of 1 per cent. gold chloride solution, until the precipitate formed at first is redissolved. (This requires about 15 cc.) Then 0.5 gram of citric acid is added and the whole diluted to 1 liter. Brownish red to violet tones are furnished by this bath. Namias (*Ibid.* p. 106) proposes to give a blue color to "bromide" prints by toning with molybdic acid. No silver salt is left in the toned image and it is probable that the silver merely aids the reduction of the molybdic acid. Pure whites cannot be obtained readily.

Pottery.—Edwards (*Trans. Engl. Ceramic. Soc.* 4, 32 (1903)) has experimented with pure precipitated tricalcium phosphate in the body for china. The ware was as translucent and showed no more fusibility, nor warp, than that containing bone-ash. Adding calcium fluoride to the phosphate appeared to have no effect. Commercial precipitated calcium phosphate in the ware caused it to soften and warp entirely out of shape when fired. This is supposed to be caused by the alkali left in the phosphate by incomplete washing. The view is advanced that in ordinary chinaware about 15 per cent. of the total calcium phosphate serves as a flux and the rest renders the ware white and more translucent. The phosphate, which is uncombined and in excess being infusible, gives the body greater stability at the high temperature of firing. Berdel (*Sprechsaal*, **38,** 345, 393, 438 (1905)) has experimented on the production of non-poisonous lead glazes, which should withstand the test of boiling in a 4 per cent. acetic acid solution for half an hour, and then passing hydrogen sulphide into the liquid, whereby no precipitate should form. Various formulae for colorless, salmon-red, purple, black, green and blue glazes are given, the products of which will stand the above test.

Rubber.—In the *Bull. Imp. Inst.* **3,** 146, 147 (1905) are reports upon the rubber from certain species of *Landolphia* (*L. ugandensis*) from East Africa Protectorate, and that from the *Ficus elastica* from Madras Presidency. The former contained caoutchouc, 78.3; resin, 9.1; moisture, 6.2; insoluble matter (dirt), 6.4; ash, 2.4; the latter contained caoutchouc, 85.2; resin, 7.8; albuminoid matter, 1.4; moisture, 3.7; insoluble (dirt), 1.9; ash, 0.5. Alexander (*Ber.* **38,** 181 (1905)) has attempted to make the dinitro-caoutchouc of Weber from crude rubber, but in no case could he get a product agreeing with Weber's formula, $C_{10}H_{16}N_2O_4$. The products generally corresponded to the "nitrosit C" of Harries, $(C_{10}H_{15}N_3O_7)_2$, though containing more carbon and less nitrogen than the formula implies. The products thus made from crude rubber are supposed to be mixtures of nitrosit C, with more or less oxidation products, since the lead nitrate on decomposing yields both oxygen and nitrogen peroxide. Harries (*Ber.* **38,** 87 (1905)) has also experimented with nitrogen peroxide upon caoutchouc but failed to form anything corresponding to Weber's dinitro-caoutchouc; the products were nearer the author's nitrosit C, produced when nitrous acid acts on rubber. Both reactions take a somewhat similar course, yielding products soluble in acetone and ethyl acetate, but nitrogen peroxide does not seem to yield a product of constant composition. This casts doubt upon the general accuracy of the "dinitro" method for determining caoutchouc. The author also contributes another article (*Ibid.* p. 1195) bearing on the constitution of caoutchouc. Experiments have been made with the *ozonide,* which, on decomposition with water, gives levulinic aldehyde or acid. This indicates that the caoutchouc molecule is a closed ring, and the molecular weight determinations with the ozonide indicate its formula to be $C_{10}H_{16}O_6$. A formula for paracaoutchouc is proposed, *viz.*:



$$\left(\mathrm{CH_3}\left<\begin{matrix}\mathrm{CH_2.CH_2.CH}\\\mathrm{CH.CH_2.CH_2}\end{matrix}\right>\mathrm{C.CH_3}\right)_x$$

Burgess (*Chem. and Drug.* **66,** 911) proposes to coagulate the latex of *Ficus elastica* by heating to 40° and adding a 2 per cent. solution of tannic acid. The method is much more rapid than the usual process of exposing to the sun and air.

Starch.—Roux (*C. R.* **140,** 440 (1905)) has succeeded in producing artificial starch by converting amylocellulose into simpler substances at temperatures near 150°. If an excess of water is present, amylocellulose liquefies at 150° and degradation sets in, producing various substances, which are colored blue by iodine but do not form a jelly with hot water. The changes are the reverse of those by which amylocellulose is made from starch-paste and cannot take place if the transformation has gone too far and produced amylodextrin or glucose. The author considers the artificial starches as identical with those from cereals under the same temperature conditions; they are all thought to be more or less condensed forms of the same nucleus. In a later paper (*Ibid.* p. 943) he explains the rapidity of reversion of solutions of these starches on standing at ordinary temperatures, and as compared with that of potato starch. In a 3.3 per cent. solution made by heating ten minutes at 100°, and four minutes at 150°, 43 per cent. reverted within one hour, but in a solution made at 100° only 1.8 per cent. reverted in that time. Acids and bases seemed to accelerate the reversion of the "artificial" starch; 1 per cent. of sulphuric acid caused reversion in five days at 0°. At 100° no reversion occurs in these solutions; the reverted product dissolves only at the temperature at which the original starch dissolved. Roux also finds (*Loc. cit.* p. 1259) that "artificial" starch yields 96 to 98 per cent. of maltose when saccharified with malt extract at 56°; ordinary starch under the same conditions yields an average of 82.3 per cent. At 67°, the artificial starch yielded 55.1 per cent. and the ordinary starch only 45 per cent. At 80° malt extract had no action on the artificial starch. In conjunction with Maquenne (*Loc. cit.* p. 1303) the author shows that ordinary starch by the iodine test and also by the saccharification test, contains 80 per cent. of amylocellulose, a body identical with "artificial" starch. The other 20 per cent. consists of mucilage-like substances called amylopectin and to which the gelatinizing of the starch paste is due; this is not present in "artificial" starch.

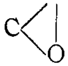
Sugar.—Ost (*Z. angew. Chem.* **30**, 1170 (1905)) has converted *r*-glucose into *δ-l*-fructose by treatment at ordinary temperature with fairly strong sulphuric acid. By dissolving 1.1 kilos of glucose in a cold mixture of 1 liter of concentrated sulphuric acid with 2 liters water and keeping at room temperature for four months, then neutralizing with chalk and evaporating at very low temperature and adding alcohol and ether, the residual liquors were levo-rotary. From 100 parts glucose, about 20 parts isomaltose, 5 to 10 of fructose and 60 parts unchanged glucose were obtained. From a 10 per cent. syrup the fructose was precipitated at 0° by adding dry slaked lime; the calcium fructosate was thus separated and decomposed with oxalic acid to reform the sugar. It was crystallized by cautious concentration of its syrup and addition of methyl alcohol and ether.

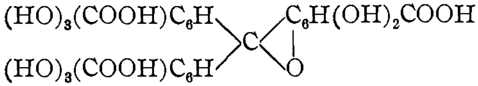
Tanning.—Nierenstein (*Collegium,* **21,** 197 (1905)) has investigated some tannins which cause "bloom" or an efflorescence on the leather. The author holds that this is produced by material present in the tannin substance, partly as a soluble glucoside and partly as ellagic acid, these also having tanning action on the skin. Tanning action is produced by bodies having "tannophor groups," *viz.*, CHO, CO and CO.O. The same writer (*Ibid.* p. 159) contributes some observations on the formation of leather, based on experiments with formaldehyde on skin. By boiling out the leather with water until all formaldehyde was removed and then boiling with dilute sulphuric acid, more formaldehyde was extracted from its chemical combination with the hide. The author proposes two formulae for the reaction of leather-making:

$$\underset{\text{Pelt.}}{RNH_2} + \underset{\text{Formaldehyde.}}{CH_2O} \rightarrow \underset{\text{Leather.}}{R.N{:}CH_2}.$$

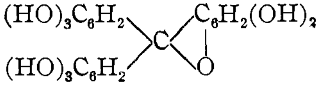
Using vegetable tannin, carrying the "tannophor" CO or CO.O,

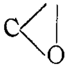
$$\underset{\text{Pelt.}}{RNH_2} + \underset{\text{Tannin body.}}{R^2C.O.O.R^3} = \underset{\text{Leather.}}{R.N{:}C(R^2).O.R^3}.$$

In a further communication (*Ibid.* p. 221) the author considers the "tannophor" , reviewing some work of von Baeyer (*Ber.* **25,** 280, 1096) who found that pyrogallol with formaldehyde gave a substance resembling tannin and which precipitated gelatin from solution. The author repeated these experiments and also tried formaldehyde with gallic acid, and got in both experiments soluble substances which precipitated gelatin. The formulae of these substances were established as



from gallic acid, and



from pyrogallol. Both contain the tannophor group: .

Eitner and Stiazny (*Der Gerber,* **31,** 125, 139 (1905)) have experimented with mixtures of salt and acids for pickling skins. Hydrochloric, acetic and lactic acids seem to have no advantage over sulphuric, the leather in all cases being essentially the same in quality. The concentration of the solution affects the quantity of salt taken up by the skins. Larger amounts of acid improved the quality of the leather. Absorbed sulphuric acid even to the amount of 3 per cent. is claimed to produce no tendering of the leather on drying.

Tar.—Loew-Beer (*Z. angew. Chem.* **18,** 8 (1905)) describes a continuous acting tar-still of the Lennard type (*Eng. Pat.* No. 844 of 1891) in an improved form. The still consists of two rows of cast-iron pipe coils, heated by gas or liquid fuel. The cold tar is itself used to chill the first two condensers in which the volatile products are condensed, and it is thus heated to a sufficient degree to expel the ammoniacal liquor and some naphtha. These are condensed in a special cooler. The heated tar enters the pipe coils at the top of the furnace and leaves through the bottom coil, which is at a higher temperature. This hot tar flowing out at near 300° is brought into contact with superheated steam at 300° in the "pitch scrubber," which drives out the volatile products, and the pitch passes on to a collecting tank. The vapors go first to the condensers cooled by the incoming tar and then to others cooled by water. The anthracene oil condenses in the first, creosote oil in the second, and in the water-cooled coils the light oils are collected. The apparatus is worked under a vacuum of 550 mm., with water and oil towers between the vacuum pump and the condensers, to prevent any loss of volatile substances.

Textiles.—Bernstein has patented a process for artificial silk (*U. S. Pat.* No. 754,027) in which the liquor boiled off from raw silk is mixed with a solution of cellulose in ammoniacal copper hydroxide. The mixture is heated slowly and spun into threads which pass through an acid bath. They may be further softened by passing into a solution of neutral alizarin assistant (Turkey-red oil). Holle (*Z. Farb. Textil-Chem.* 4, 144 (1905)) has found that cotton fibre is occasionally injured by a fungus, which resembles cellulose in appearance. The fibres attacked showed a darker shade on dyeing than did the normal cotton. The fungus appears to be present in the seed-cells and develops with the new plant.

Miscellaneous.—Griffin (*J. Chem. Ind.* 24, 183 (1905)) has a thoughtful review upon standard methods of drawing samples for analysis. He shows that, with the exception of a few papers on special cases, little or nothing of value has been published on the subject. Standard methods of analysis of certain classes of materials have been proposed and tested by committees of various societies and associations, but the drawing of the samples has been left to "boys and pensioners" in many cases. The author makes several suggestions looking to improvement in this work, and finally recommends that a few chemists working in similar lines should disclose directions how samples of the materials with which they are familiar, should be drawn. Gardner and Lloyd (*J. Chem. Ind.* (1905) p. 392) have published some "Notes on Water Softening." The subject is considered under several heads: The Effects of Neutral Salts; Influence of the Apparatus; Determination of Lime Factor and of Soda Factor. Neutral salts frequently interfere with complete softening, as the alkalinity then becomes too high. In this case, the use of barium hydroxide to remove sulphates may have some advantage. The time allowed for settling and the temperature at which the purification is carried on are affected by the kind of apparatus used. Agitation after mixing with reagent is an important factor; pressure also seems to assist the completion of the reactions. The formula proposed by Pfeiffer for determining the amount of lime needed to purify a water has been found unreliable for water containing neutral salts. The formula is $Ht + Hm - Hp =$ lime needed, when Ht is temporary hardness, Hp is permanent hardness and Hm is magnesium hardness. But with mixtures of calcium bicarbonate and magnesium sulphate, more lime is needed to remove all the magnesium salts as well as the calcium bicarbonate. Experiments with barium hydroxide lead to the conclusion that it is too expensive except for very special cases, and in the presence of sodium sulphate it is unsuitable since sodium hydroxide remains in the water. A report of the Departmental Committee on Industrial Alcohol, to the Chancellor of the Exchequer, appears in the *J. Chem. Ind.* **24,** 397 (1905). The uses of alcohol in the arts, the hindrances to the use of spirit for industrial purposes and certain suggestions looking to relief from present restrictions, are included. The entire report, sub-reports and five appendices are too extensive for a satisfactory short abstract. Zalackas (*C. R.* **140,** 741 (1905)) reports that the juice of *Nasturtium officinale* is a positive antidote for nicotine poisoning. The juice usually contains iron and iodine which are supposed to revivify the blood corpuscles that have been poisoned by nicotine. Perkin, *et al.* (*Eng. Pat.* No. 22,169, 1904) propose to render wood fire-proof by treating for six hours at 500 pounds pressure per square inch, with a sodium stannate solution at 32° Bé. or a mixture of sodium stannate and tungstate solutions. After drying by hot air, a solution of ammonium sulphate or zinc sulphate or acetate, or a mixture of zinc sulphate and tartar emetic is applied under pressure. After drying, the wood is washed and is ready for use. Ditz (*Chem. Ztg.* **29,** 581 (1905)) has tried the catalyzing action of rare earth compounds for the oxidation of naphthalene by sulphuric acid to form phthalic acid. The substances used were carbonates, oxalates and hydroxides of cerium, lanthanum, neodymium, praseodymium and yttrium, obtained as residues from the preparation of thorium nitrate. The oxidation began at about 220°, and was completed at 300° when the mass became viscous and decomposition took place. The distillate contained sulphuric acid and phthalic anhydride, but the yield was less and the process not so rapid as with mercury for the catalytic body. Perotti (*Chem. Centr.* **1,** 117 (1905)) shows that calcium cyanamide, when used as a fertilizer, may injure the germinating seeds and otherwise interfere with the growth of the plant. When used, it should be applied to the soil before the seed is sown. The Forty-first Annual Report of the Chief Inspector of Alkali Works in England was issued February 27, 1905. Statistics of the various manufactures coming under the supervision of the inspectors constitutes an important part of the publication. It appears that the new "Alkali Works Bill" introduced in Parliament last year, was subsequently withdrawn, but will be again introduced next session. It is estimated that one-half the world's production of bleaching-powder (260,000 tons) is made by electrolytic processes. In sulphuric acid making, artificial draught and the use of atomized water continue to find more extended acceptance. A plant using the tangential system of chambers, devised by Meyer, has been started. No further extension of contact methods has been noted. Kessler's system of concentration continues to work well. More attention is being given to the production of arsenic-free acid and an explosion of a hydrogen sulphide-air mixture used in this purification, is noted, the cause being given as contact with iron oxide scales on the inside of the pipe through which the mixture was passing. A lead pipe was later substituted. The evaporation of salt by means of Mond producer gas and the utilization of the vapor from the brine evaporation as the supply of aqueous vapor to the producer, is one of the newer ideas noted. For cement-making, the rotary kiln is finding more extended use. The Höpfner electrical method of extracting zinc from blende is in successful operation at one works. A large part of the report is comprised in a further contribution upon "Studies of the Claus Kiln Reaction," with reference to the "Influence of the Various Contact Substances on the Interaction of Steam and Hydrocyanic Acid."

NEW BOOKS.

The Study of Chemical Composition, an Account of Its Method and Historical Development, with Illustrative Quotations. By Ida Freund, Staff Lecturer and Associate of Newnham College, Cambridge. Cambridge: The University Press. 1904. 650 pp. Price, 18/ net.

The second part of the title gives a better idea of the scope of this work than the first. It is not so much a treatise on chemical composition, after the manner of the ordinary text-book, as "an account of its methods and historical development, with illustrative quotations." The author disclaims that it is a history of chemistry, yet, while it does not enter into detail as fully as do many histories, the development of the fundamental chemical conceptions of the present day is very fully traced, much more fully and logically than in most histories of chemistry properly so-called. The author quotes very freely from original sources, the experiments of the writers being described and their reasoning given in their own words wherever possible, and this gives to the book a peculiar freshness which will be appreciated by every reader who has felt the advantage of going to original sources rather than consulting reviews, abstracts and restatements. Probably there has never been collected within the same space so many quotations from the fathers of chemistry, perhaps 40 per cent. of the volume of 650 pages being quoted, yet it is by no means a compilation merely, the original matter supplied by the author being also of great interest and value.

In the introduction the author discusses the method of the inductive sciences, observations, generalization, law, theory and hypothesis, using as illustrations the classical experiments of