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The Chemical Society, the Society of Chemical Industry, the Association of British Chemical Manufacturers, the Institute of Chemistry, the Society of Public Analysts, the Faraday Society, the Institute of Brewing, the Society of Dyers and Colourists, the Society of Glass Technology, the Iron and Steel Institute, the Ceramic Society, the Institution of Gas Engineers, the Society of Leather Trade Chemists, the Royal Photographic Society, the Mineralogical Society, the Biochemical Society, the Oil and Colour Chemists' Association, the Institute of Metals and the Royal Agricultural Society.

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EDITORIAL

A Century of Factory Inspection

THE Home Department is concerned with many problems; to its already numerous activities there was added a hundred years ago the duty of inspecting factories and workshops primarily with a view to the protection of the children and young persons employed in them. Now this inspection is concerned *on the main with the health of the young and old, male* and female, workers in factories and workshops. The first inspectors appointed seem to have worked firmly *and tactfully in co-operation with the employers, coaxing* the lazy ones after the fashion of Father O'Flynn, but preserving a certain measure of mutual trust that has prevailed through the whole century of the work of the inspectorate. Partly owing to the encouragement of the Home Office, ignorance, prejudice, and apathy on the part of employers have largely gone in this country and a standard of factory conditions has been set up which was long in advance of, and is still equal to, that of any other country. Nearly fifty years elapsed before industrial diseases became sufficiently important to require special attention but about the year 1880 it was realized that workers in compounds of lead, phosphorus, and arsenic were liable to special diseases characteristic of their occupations. Special legislation and improved knowledge have rendered these diseases, as well as anthrax, relatively infrequent and attention is now directed to some of the newer occupational diseases to be found in the manufacture of asbestos, the construction of buildings, the manufacture of cinema films, and the use of silica in pottery. Those who have been interested in the problems of industrial hygiene should take a note of the historical résumé contained in the latest Report of the Chief Inspector of Factories *and Workshops, a notice of which appears elsewhere* in this number. The account given of our industries in general is that shipbuilding has had the worst year on record; depression has remained acute in the iron and steel industries, engineering and cotton have shown little signs of recovery, and the herring fishery has been very bad, but indications of better prospects are not wanting; hosiery manufacture has been much more active, the canning of fruit and vegetables has greatly expanded, and the beet sugar factories have had a successful season: moreover two hundred and fifteen foreign-owned factories have been established here during 1932, particularly in the southern part of the country. On the whole the outlook is now more encouraging than it has been for a long time and we hope that it will remain so. The cost of administering the various Factory Acts has increased from £65,000 in 1902, to £98,000 in 1912, and £174,000 in 1932; there has been a noticeable decline in the diseases of occupation and the fatal accidents during the same period.

THE DISTILLATION OF COAL UNDER VERY LOW PRESSURES

By V. STONE, B.Sc., and PROF. M. W. TRAVERS, F.R.S.

The following account of some experiments on the distillation of coal under pressures of between 0·01 and 0·001 millimetre of mercury are published with the hope that someone else may continue the investigation. The authors have come to the conclusion that if further work in the same direction is to prove really useful the study of the process of distillation will involve a more extensive study of the products of distillation than they are prepared to undertake. It would also necessitate the purchase of apparatus not available in this laboratory. Any information which any other investigator desires to obtain, and which is available, will be placed at his disposal.

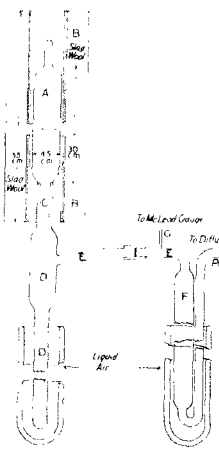


FIG. 1

A search in the literature of the subject has led to the discovery of no previous work of exactly the same character. In 1914, Wheeler carried out an investigation on the distillation of coal in an apparatus in which a pressure of at least a few millimetres of mercury was maintained by means of a Geryk oil pump. The coal was distilled at temperatures between 100° and 430° C., and at the highest temperature he obtained 6·7% of solid and liquid distillate.

The apparatus used in our experiments is shown in Fig. 1. It can be made wholly of soda-lime glass if the distillation temperature does not reach 400°, and Pyrex glass can be used for the retort for temperatures slightly exceeding 500° C. The upper part of the distillation apparatus, A, called the retort, was 30 cm. long and 4·5 cm. diameter, and was sealed to a stem at the top, which was drawn off in the blowpipe flame after filling, and was renewed for each experiment by sealing on a new piece of glass tubing. This part of the apparatus was enclosed in the electrically heated furnace which was made by winding No. 14 Standard W gauge nichrome wire on a piece of 2 in. steam bar 55 cm. long, first covered with wetted asbestos sh the spacing of the winding being about 0·5 cm. bottom of the retort was formed by sealing into i inner glass tube, C, projecting downwards through neck which was formed at this point. The coal res on a pad of asbestos fibre above a disc of iron wire gau The formation of the neck allowed of packing asbes wool into the lower opening of the furnace. Since a h vacuum was maintained in the apparatus, heat travel very slowly from the inner tube through which the p ducts of distillation passed, with the result that distillate condensed in it. The stream of vapour issu from the mouth of the inner tube struck the walls of glass apparatus, D, about 3 cm. lower down, formin deposit the upper limit of which was very shar defined. Study of the mode of condensation mi throw some light on the molecular weights of the s formed in this process.

The lower part of the apparatus, called the first c denser, D, had a side tube, E, 1·5 cm. diameter sea to it near the top, and this was slightly inclined upwa This side tube was sealed to the second condenser when the whole apparatus was made of soda-lime gla but when Pyrex glass was used the junction was m with a piece of rubber tube, wired on and varnis over. The lower part of D was, in the first experim cooled with water, but afterwards with liquid oxy The second condenser was filled with glass wool, and cooled with liquid oxygen, and as no liquid air trap used between the apparatus and the mercury pump also served for this purpose, some mercury vapour c densing in it.

Between D and F a side tube, G, sealed into the c necting tube, E, led to a McLeod gauge, by which pressures were measured. The connexions between second condenser and the mercury diffusion pu which is not shown in the figure, were of 1·5 cm. tubi all connexions being sealed. The diffusion pump backed by a Hyvac oil pump, a large pentoxide phosphorus tube being interposed between them.

The coal used in the experiments is described Washed Staveley Nuts, supplied by the Bristol Company, who also furnished the following analy for which we thank them: Moisture 2·7%, volat 36·8%, fixed carbon 54·8%, ash 5·7%. The c was dried at 110° C. It was ground roughly to p through a 1/10-in. mesh sieve, and then passed ove 1/90-mesh sieve, the fines being rejected. In two exp ments the coarse coal was used without further grindi in one experiment the coal was ground to pass a 1/ mesh sieve; and in one, in which a small apparatus used, the coal was ground to pass a 1/120-mesh sie The distillation process was continued during six da the liquid oxygen in the cooling vessels being renew as required.

When the first condenser was cooled with water or it contained at the end of the experiment a soft, reddi brown pitch, which was almost completely soluble benzene, the small insoluble residue being complet soluble in absolute alcohol. The second conden contained the more volatile oil, together with

considerable quantity of carbon dioxide, sulphuretted hydrogen, and hydrocarbon gas, consisting of ethane, possibly with ethylene, and some propane. The butanes seemed to be absent from the distillate. A separate small-scale test showed that at 350° C. the quantity of carbon monoxide, hydrogen, and methane given off was negligible.

TABLE I

Coal	1	2	3	4
Temp. of distillation	365°	350°	350°	350°
Period, days	1	6	6	5
Fineness of coal	Through 1/10	Through 1/10	Through 1/90	Through 1/120
Weight taken, g.	218·0	229·3	218·1	26·72
Final weight, g.	189·0	208·3	195·1	23·86
Loss of weight, g.	29·0	21·5	23·0	2·86
Loss of weight, %	13·2	9·4	10·6	10·7
Average pressure	Not measured	Not measured	10^{-3} cm.	10^{-4} cm.
Wt. of dry benzene extract of pitch	14·9	11·8	10·63	—
Wt. of dry alcohol extract of pitch	0·6	1·0	0·30	—
Wt. of liquid hydrocarbons	—	3·5	5·0	—
Wt. of water	—	2·4	3·0	—
Loss including CO_2, H_2S, C_nH_n, C_nH_{2n}, etc.	—	2·8	4·07	—

The experiments show that the quantity of distillate increases rather rapidly with rise of temperature above 350°. Fine grinding has very little effect on the

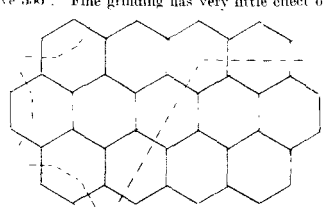


FIG. 2

FIG. 2.—DOTTED LINES ON LEFT SHOW HOW 2-CARBON ATOM COMPOUNDS MAY BE FORMED. DOTTED LINES ON RIGHT SHOW HOW 6-CARBON RING COMPOUNDS MAY BE FORMED BY THE BREAKDOWN OF THE COAL

yield, and though the process was continued for several days the bulk of the condensate was collected during the first two or three days. Yet the process had not actually come to an end in five or six days.

The yield of distillate at 350° is approaching the quantity of the product obtained by Bone on extracting with benzene under pressure. The process of pressure extraction has been referred to as one involving no change in the coal of a chemical character. This may possibly be the case; but the process of distillation at very low pressures at 350° certainly involves some chemical change, in evidence of which there is the formation of carbon dioxide, sulphuretted hydrogen, and hydrocarbon gases. It would be interesting to compare the products of the two processes.

Supposing that Bone's view that coal consists of very large molecules, which may be described as having a continuous hexamethylene structure, is correct, one may imagine that decomposition by destructive distillation involves the migration of hydrogen atoms towards the edges of the structure, and the subsequent breaking away of ethylene, ethane, and of larger fragments which are tar molecules. It is easy to see how this happens without the formation of hydrocarbons of intermediate molecular weight in any large quantity, if one regards the decomposition of the coal as taking place as indicated in Fig. 2.

The change indicated is analogous to that which takes place when tetrahydro-naphthalene breaks down, to which reference has been made elsewhere (J. Inst. Fuel, April, 1933).

In order to make any investigation at higher temperatures complete, it would be necessary to use a backing pump for the mercury diffusion pump so constructed that the gas delivered from it could be collected. This would not involve any particular mechanical difficulty.

THE INDUSTRIAL APPLICATIONS OF THALLIUM AND ITS COMPOUNDS

SOURCES AND PRICE

Until very recent years the main source of thallium and its compounds was the flue dust from the treatment of pyrites in sulphuric acid manufacture, and its price has necessarily been high and its industrial development consequently retarded. The large-scale production of thallium compounds from zinc blende as a by-product of lead and zinc manufacture has, however, been recently undertaken by the Vieille Montagne Zinc Co. of Belgium, and a substance which in spite of its comparative rarity has developed a surprising number of uses and potential applications will now be more readily available for industrial purposes.

The price of thallium sulphate, in 100-lb. lots, was quoted by the Foote Mineral Co., of Philadelphia, at $15 per lb. in 1928 and at $7·5 per lb. in 1932, and it is probable that in large quantities the price will now be much lower.

INDUSTRIAL APPLICATIONS

Apart from a number of minor applications and possible uses, which will be briefly considered later, the industrial uses of thallium and its compounds which appear most promising are in the manufacture of certain special alloys, as a rat poison, an insecticide, for medical purposes, in the manufacture of photoelectric cells, for treating fabrics etc. to render them water and insect proof, and in the preparation of a non-knocking motor fuel.

These uses and potentialities will be briefly considered in order.

(1) *Use of thallium in alloys.*—Alloys of thallium and silver have been found to have high lustre and to remain untarnished on exposure to air, and alloys with aluminium and silver are extremely resistant to chemical reagents, including hydrochloric acid and sulphuretted hydrogen. The most satisfactory of the latter alloys contained 10% thallium, 10% aluminium, and 80% silver.

Bearing metals with a lead base have been improved in their resistance to deformation by the incorporation of thallium, but the cost of the metal has naturally prevented any extensive application of such alloys.

Alloys of thallium and lead are, however, used in special types of electrical fuses. They have melting points higher than those of either of the component metals.

Messrs. Siemens & Halske found that alloys of iron and nickel with 0·1% to 5% of thallium were suitable for "powder cores," the effect of the thallium being to give greater brittleness to the magnetic material, and high initial permeability to the finished core.

Electrodes composed of an alloy of 10% thallium, 20% tin, and 70% lead have been found to be much more resistant than ordinary lead electrodes in the electrolytic deposition of copper from acid solutions.

Amalgams of thallium and mercury containing 8·5% of the former can be used in thermometers for measuring very low temperatures.

(2) *Thallium compounds as rat poison.*—Thallium sulphate, which is tasteless and odourless, is used for this purpose. It is cumulative and slow in its action, but no evidence of tolerance or immunity in animals appears to have been recorded. It is necessary to exercise care in its employment, however, as it is poisonous to human beings and domestic animals. It is effective in its results, as it is readily taken by vermin which refuse to eat baits containing strychnine or phosphorus.

The following mixture is suggested by the United States Department of Agriculture as a poison bait for field mice:

Whole wheat	125 lb.
Thallium sulphate	1½ lb
Hot water	6 quarts
Starch, dry	¼ lb.
Glycerin	½ pint

The thallium sulphate is dissolved in the hot water, and to this is added the starch, previously mixed with a little cold water. The clear starch paste thus made is boiled for 2 to 3 minutes, the glycerin is added and the mixture boiled for *a short time and then incorporated* with the wheat.

A simple rat poison consists of a tapioca flour paste, containing 2½% of thallium sulphate, and spread on slices of bread. Another bait which has been used successfully is made as follows: ¼ oz. of thallium sulphate is dissolved in a large tea cup of boiling water and half a cupful of corn syrup, and 12 oz. of peanut butter are added. Thin slices of bread from two loaves are well covered with this mixture and cut into small squares. Tablespoonful doses of these squares are placed in the tracks of the vermin.

(3) *Use as insecticide.*—Thallium sulphate has been found effective in exterminating in 3 or 4 weeks small red ants in houses, where arsenic compounds had previously failed. The following mixture was used:

Water	1 pint
Sugar	1 lb.
Thallium sulphate	27 grains
Honey	3 oz.

The whole is brought to the boil and well stirred.

Fire ants in Texas were exterminated by the use of a syrup containing 2 oz. of thallium sulphate in 4½ pints of water, 5 lb. of sugar and ½ lb. of honey being added, and when dissolved the whole made up to a gallon with water. At least four teaspoonfuls of this syrup are poured on a moistened sponge placed in a box near the ants' nest.

(4) *Medical uses of thallium compounds.*—Thallium acetate is used in the treatment of certain diseases of the scalp. In Mexico during the world war, several hundred children were treated with this compound, no bad effects being observed. There appears, however, *to be some small risk attached to its use, since out of* 8006 recorded cases, 8 fatalities occurred.

(5) *Use in photoelectric cells.*—The "thalofide" cell, which contains thallium oxysulphide, is superior in its sensitivity to light of low intensity and long-wave *length to the selenium cell*, and in consequence of its response to infra-red wave-length its use has been considered for "dark signalling." Its electrical resistance drops 50% on exposure to a quarter-foot candle.

(6) *For treatment of fabrics.*—A process has been patented (U.S. Patent No. 1,739,840, of December 17, 1929) for the treatment of such materials as fabrics, furs, leather, wood, etc., with compounds of thallium *and higher organic acids, which may include oleic*, linoleic, abietic, and others. It is claimed that this treatment renders the materials impervious to the attack of insects, and to the development of mildew and other fungoid growths.

Another somewhat allied process has been patented (U.S. Patent No. 1,799,047, of March 31, 1931) for the treatment of fabrics with thallium salts in such a way *as to render them water, moth, mould, and insect-proof.* The process is said to be suitable for the treatment of textiles such as tent canvas, and in addition to imparting the properties mentioned above, is claimed to render *the materials more* durable.

It may be of interest to describe this process in some detail in view of the fact that another substance, bentonite, many new uses for which are now developing, *is employed as well as the thallium compound.*

Two solutions are required, A and B. An example of A is as follows:

	Parts
Soap	15
Casein	10
Carrageen	5
Bentonite	30
Petrolatum	500
Water	2400

Solution B consists of a solution of a thallium or certain other metallic salt, one part of the salt being dissolved in about 40 parts of water.

The soap, casein, carrageen, and water are beaten together, a small amount of borax having been added to render the casein soluble. The temperature should be from 140° to 200° F. Into the emulsion which is formed, the bentonite is slowly sifted with constant stirring, and when incorporated, the melted petrolatum is added, the liquid being continuously beaten during the operation.

The canvas to be treated is immersed in and thoroughly wetted with A, wrung out and passed into B, washed in water to remove excess of metallic salts, again wrung, and dried. The finished goods are said to be entirely without any greasiness, and to be of a good colour.

(*a*) *As an anti-knock addition to motor fuel.*—English and American patents have been taken out by the Asiatic Petroleum Co., which claim that pinking or knocking is mitigated or reduced by the presence of a thallium vapour in the vapour of a thallium compound in the engine cylinder. It is stated that metallic thallium or an insoluble compound of thallium may be suspended in the fuel, or that a thallium compound may be dissolved in the fuel. Compounds claimed to be particularly suitable for the purpose are thallium benzylate, phenyl acetate, oleate, amyl alcoholate, ethyl, and acetoacetate. About 2 grams per litre is stated to be a suitable proportion of thallium compound to add to the fuel.

(*b*) *Minor possibilities of thallium compounds.*—(*a*) *In photography.* In 1929 Lüppo-Cramer showed that in making an iodide-free emulsion the addition to silver nitrate of one-tenth of its equivalent of thallous nitrate greatly increased contrast without fog for development with hydroquinone.

The same worker has recently found that the association of thallium iodide with silver iodide in an emulsion very greatly increases the general sensitivity and the colour sensitivity. Its further application in this direction seems possible.

(*b*) In glass manufacture, for the production of blacks or bronzes, or, in lead glass, greenish-yellows. It also increases the refractive index of lead glass, and renders it more suitable for making artificial gems.

(*c*) As a catalyst in the hydrogenation of lignite.

(*d*) For the production of orange and yellow pigments.

(*e*) As a "getter" in tungsten lamps, to prolong the life of the filament.

(*f*) For the preparation of heavy liquids for mineralogical laboratory use.

The writer is indebted for much of the foregoing information to articles by Dr. James Munch and Ernest C. Enck in "Mineral Foote Prints," 1933, vol. vi, and 1929, vol. ii, and to Information Circular No. 6453, U.S. Bureau of Mines. In the first and third of these publications extensive bibliographies will be found.

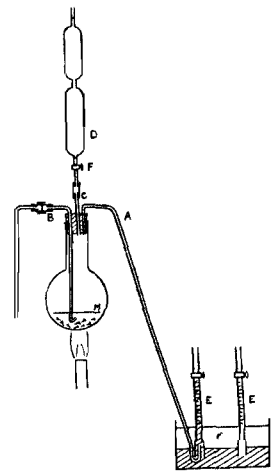
AN APPARATUS FOR THE RAPID ESTIMATION OF OXYGEN OR OTHER GASES DISSOLVED IN WATER

By R. C. HOATHER

The apparatus to be described provides a rapid means of expelling gases from a sample of water by boiling under slightly reduced pressure, followed by collection, measurement, and treatment of the gases with absorbents. The method has been in use for eighteen months for the estimation of dissolved oxygen and nitrogen, and has been found to be accurate and convenient. It is not affected by the presence of other substances, including oxidizing agents such as iron salts and iodine. Using a solution of oxygen in pure water, some comparisons were made with the Winkler method, and agreement obtained within 1%.

The apparatus consists of a 500-c.c. Pyrex flask, heated directly by a bunsen flame, and fitted with a rubber stopper which carries a side tube (B) with a rubber joint and screw clip, a delivery tube (A), and a short tube (C) with a connexion of pressure tubing into which is inserted one of the sample pipettes (D). The delivery tube ends in a trough of mercury covered with water, and discharges the gas into a micro-burette (E). The bottom of the flask is covered with a non-porous material to prevent bumping and facilitate removal of gases from the water, for which purpose a layer of brass screws has been found very effective.

The first operation in using the apparatus is to admit water *into the flask through the side tube (B), and boil* for about 15 minutes. Water is then withdrawn through this tube until the volume is about 50 c.c., as indicated by the mark (M), and the clip is closed. The pipette (D) containing the sample for analysis, is inserted into the rubber connexion while steam is issuing, and to ensure that all air has been expelled from the apparatus



some condensed steam is collected in the micro-burette which was previously filled with mercury by the application of a vacuum above its tap. By opening the tap (F), the sample of water is now admitted until the level falls to the lower graduation mark in the pipette. The admission of the sample occupies less than a minute, but should not be so rapid as to draw mercury over the top of the delivery tube by reducing the temperature too far. After the sample has been admitted, the bunsen is lowered and when the temperature reaches 100° the gases are driven over together with some condensed steam. *Collection is continued carefully for about two* minutes or as long as is necessary with the size of apparatus and type of solution being used. The heating is finally increased a little until the bottom of the delivery tube is swept through with uncondensed steam and the micro-burette is moved from above the tube so that the apparatus can be allowed to cool or used immediately for another analysis. The volume of gas can be read after cooling, and again after the introduction through the tap of an absorbent (*e.g.*, strong pyrogallol for oxygen);

or if desired, the gas can be drawn off into another apparatus for analysis.

The sample for analysis is collected by allowing the solution to flow through the pipette so that the specimen obtained has not been in contact with the air, and a reagent can be added immediately to prevent the progress of a reaction before the analysis is made. An example of this is the addition of a small volume of a strong solution of iodine (in KI) or bromine (in HBr), to a sample which is to be analysed for dissolved oxygen when sulphite or iron salts are also present. For the purpose of influencing the evolution of certain gases it is more convenient to add a reagent to the water in the flask. The slow evolution of CO_2 for example, from compounds in a sample of tap water, can be prevented by the addition of caustic soda in this manner, so that the estimation of oxygen and nitrogen is facilitated.

A few points in the design of the apparatus should be mentioned in greater detail than was given when describing its operation. The best position for the level of mercury in the trough is just below the end of the delivery tube, as shown in the diagram. The constriction in the centre of the sample pipette is not always essential, but allows a pause at this point during the admission of the sample into the flask, and so permits rapid movement through the wider part of the pipette without too great a reduction of pressure in the flask. Any interchange of gas with the atmosphere is thus minimized and has been found inappreciable. When estimating slightly soluble gases, such as oxygen, no correction need be made for gas dissolving in the water in the micro-burette, provided that measurement is made fairly soon after collection of the gas.

The height of the delivery tube is a matter of convenience, but in the present apparatus it is 45 cm., so that the temperature can be reduced to about 77°. The sample pipettes are of 70 c.c., and the micro-burettes of 2·5 c.c. capacity. The latter should be at least 5 mm. in diameter so that bubbles of gas will rise in it through water. The dimensions should, however, be adapted for the type of solution that is to be analysed.

I should like to thank Mr. C. F. Goodeve for his helpful interest in the development of this apparatus.

The Sir William Ramsay Laboratories of Physical and Inorganic Chemistry,
University College, London

ANNUAL REPORT OF THE CHIEF INSPECTOR OF FACTORIES AND WORKSHOPS FOR 1932*

The present year is the hundredth anniversary of the appointment of the first Government Inspectors of Factories, and much space in this annual report has been devoted to historical reviews of the functions and responsibilities imposed on the department by progressive legislation. These reviews deal with employment, safety, health, welfare, "truck," piecework, homework, the Government Wool Disinfecting Station, and the Home Office Industrial Museum. All of them are of much interest, and although no doubt they are not intended to be regarded as works of reference, they will probably be used as such by many who wish to find quickly concise particulars of factory development during the last century.

A review of particular interest to the chemist is that which deals with health. Looking back over 100 years it is striking to find that so many years elapsed before the science of medicine was used as an aid to improve working conditions in industry. The review shows the progressive steps by which lead, arsenical, and phosphorous poisoning, anthrax and other diseases were brought under control, and mentions the work now proceeding to reduce the incidence of fibrosis of the lung, cancer, chrome ulceration, etc.

Although the report of industrial development during 1932 recorded acute depression in several staple industries, it is stated that indications of better prospect were not wanting and there were some remarkable recoveries. The canning of fruit and vegetables, and the cinematograph film industry, greatly expanded and other "bright spots" were the sugar beet factories, hosiery manufacture in the Midlands, the spinning of yarn, and the electrical supply industry.

Legislation.—The Pottery (Silicosis) Regulations came into force during the year, amending the 1913 regulations, requiring efficient exhaust draught and other precautions during exposure to silica dust.

Registered works.—There were 157,891 factories and 90,859 workshops registered during the year, an increase of 2537 factories and a decrease of 4855 workshops.

Special inquiries.—The Department of Scientific and Industrial Research has arranged for research to be conducted by the Chemical Defence Research Department of the War Office on "breathing apparatus" intended for protective use in dusty and toxic atmospheres. Simultaneously, the best methods of detecting and estimating traces of toxic substances in the atmosphere are being studied.

Accidents.—The total number of accidents again shows a decrease from 113,249 to 106,164, and the fatalities from 755 to 602. Buildings under construction accounted for 95 of the fatalities, and the metal industry (melting, conversion, rolling, founding, etc.) was next on the list with 72, whilst there were 30 fatalities in the chemical industry.

Explosions.—Two explosions are reported in water gas plant, and others occurred owing to the break out of blast furnaces, the incandescence of the iron sulphite coating inside a tar still, and incandescence from the same cause in a vulcanizing plant.

Health.—There were slight increases in the numbers of cases of lead poisoning and chrome ulceration. Aniline poisoning showed a decrease, and the number of cases of anthrax (16, with one death) was the lowest on record. There were 125 cases of gassing reported and amongst the rarer forms, ethylene dichloride, ethylene chlorhydrin, and hydrogen iodide were each responsible for one case. Special attention has been given to the effects of trichlorethylene, which has come into extended use in the last year or two, but although a few cases of partial anæsthesia were met with no instance of chronic intoxication was observed. Inquiries into the effects of exposure to cellulose lacquer have demonstrated the need for vigilance in maintaining good ventilation and a reasonable temperature.

* H.M.S.O., pp. 134, 2s.

INSTITUTION OF CHEMICAL ENGINEERS

EXAMINATION FOR ASSOCIATE MEMBERSHIP

The following is a reprint of the papers set for the 1933 Associate-Membership examination of the Institution of Chemical Engineers, held during January—March and July.

Home Paper, January—March, 1933

The candidate may attempt one question only under *Section A*, and one question under *Section B*.

SECTION A

(1). Prepare a detailed scheme for the manufacture of 3 tons of 98% acetic acid per day of 24 hours from grey acetate of lime, assuming a market to be available for a reasonable quantity of 30% technical acetic acid.

Submit detailed flow-sheets showing balances of materials, heat and other forms of energy, and time.

Calculate as far as possible from first principles, the main dimensions of all essential parts of the installation, specifying the materials to be used. Give an approximate estimate of the capital outlay and of the cost of production.

Prepare a general arrangement drawing of the whole plant, and a working drawing, technical specification and detailed cost estimate for one of the reaction vessels employed.

(2). Discuss briefly and critically the methods which have been proposed for the removal of tar and phenol from ammonia liquor.

Prepare a detailed scheme for the treatment of the liquor from a coke-oven plant carbonizing 700 tons of coal per day of 24 hours.

Submit detailed flow sheets showing balances of materials, heat and other forms of energy, and time.

Calculate, as far as possible from first principles, the main dimensions of the installation.

Give an approximate estimate of the capital outlay and cost of operation.

Prepare a general arrangement drawing of the whole plant, and a working drawing, specification and detailed cost estimate for one of the special vessels you would use.

(3). Prepare a detailed scheme for the manufacture of 4 tons per day of 8 working hours of mononitrotoluene from toluene, nitric acid and sulphuric acid.

Submit detailed flow sheets showing balances of materials, heat and other forms of energy, and time.

Calculate, as far as possible from first principles, the main dimensions of all essential parts of the installation. Give an approximate estimate of the capital outlay and of the cost of production, assuming a value for the waste acid of 25s. per ton.

Prepare a general arrangement drawing of the whole plant, showing clearly any special precautions you would take in handling the various materials, and give a working drawing, technical specification, and detailed cost estimate for the nitration vessel and its accessories which you would employ.

(4). Prepare a detailed scheme for the manufacture of metallic magnesium from anhydrous magnesium chloride suitable for an output of 5 tons per day of 24 hours. Submit detailed flow sheets, showing balances of materials, heat and other forms of energy, and time.

Calculate, as far as possible from first principles, the main dimensions of all essential parts of the installation. Give an approximate estimate of the capital outlay and of the cost of production.

Prepare a general arrangement drawing of the entire plant and a working drawing, technical specification and detailed cost estimate of the type of reaction vessel you would employ.

SECTION B

(1). A mixture containing 30% by weight of methyl alcohol and 70% by weight of ethyl alcohol is to be separated by continuous distillation into methyl alcohol and ethyl alcohol, each of 95% purity (by weight). Plot a curve showing the relationship between the number of ideal plates required and the heat consumption, assuming the feed to be at boiling point. Mixtures of methyl alcohol and ethyl alcohol may be assumed to follow Raoult's Law.

Indicate approximately the limits between which you would expect the reflux ratio to be in practice.

(2). Write a critical essay on "Temperature Measurement," indicating the range of application of instruments of different types, the accuracy obtainable and the precautions necessary in practice to ensure accurate results.

(3). Describe the methods that are employed in industry for removing suspended dust or mist from large volumes of gas.

(4). Prepare a scheme for the complete treatment of boiler-feed water to render it non-scaling and non-corrosive, for use in a water-tube boiler generating 40,000 lb. of steam per hour at a working pressure of 250 lb. per sq. in. gauge. 90% of the steam is condensed and returned to the hot well at a temperature of 40° C.; the remaining 10% is used in process work and not returned.

The hot well is open to the atmosphere.

The "make up" water is at an initial temperature of 10° C.

Analysis of "make up" water is:

	Grains per gal.
Total dissolved solids	111·3
Alkalinity (calculated as calcium carbonate):	
as bicarbonate	12·39
as carbonate	nil
as caustic	*nil*
Total	12·39
Chlorine	21·04
Sulphuric anhydride	33·41
Nitric anhydride	1·77
Silica	0·84
Lime	1·6
Magnesia	8·42
Ammonia	0·28

Estimate the probable combinations and give the nature and weight of chemicals you would propose for its treatment, and give sufficient details of a suitable softening plant to enable a draughtsman to prepare working drawings.

Indicate clearly how you would propose to remove the dissolved oxygen from the water, assuming that the O_2 content of the "make up" water is 7 c.c. per litre.

Thursday, July 13, 1933

10 *a.m.*—1 *p.m.*

The candidate may use the reference books provided.

Four questions only may be attempted, two to be taken from each part of the paper.

SECTION C—PART I

(1). Water is flowing through a vertical pipe, of 5 in. internal diameter, at the rate of 200 gal. per min. The pipe contains a plate having a 3-in. diameter centrally situated sharp-edged orifice.

Calculate the pressure drop shown by a manometer, connected to the pipe on opposite sides of the plate at points 1 ft. vertically apart.

(2) Give the equation of Bernoulli's Theorem in a form applicable to the flow of compressible fluids, and derive therefrom expressions from which the velocity of flow and the mass velocity can be calculated for air, assuming that the approximate adiabatic equation

$$pv^{\frac{1}{3}} = \text{constant}$$

will apply.

Show that the mass velocity through an orifice will have a maximum value when the pressure on the exit side is approximately 0·54 of that on the entry side, and compute the linear velocity under these conditions when the pressure on the entry side is 1 kg. per sq. cm. abs. and the density of air is 1·17 kg. per cb. m.

(3). A cooling coil consisting of 10 m. of pipe 25 mm. bore is placed in a tank of liquid, the heat losses from which may be neglected. Water is passed through the coil at constant velocity of 2 *m. per sec.*, and it may be assumed that the overall coefficient of heat transfer is 1000 kg. cal./sq. m./hr./°C. throughout.

Assuming that the liquid in the tank is uniformly at 100° C. and that the water enters the cooling coil at 20° C., calculate the outlet temperature of the water and the efficiency of the coil.

Calculate approximately what changes in efficiency would be produced by lengthening the coil to 40 m. length and 100 m. length.

(4). Calculate the theoretical h.p. required for compressing 200 cb. ft. per min. of free air to pressures (gauge) of 70 and 200 lb. per sq. in. respectively.

Indicate briefly any differences in the equipment you would employ in the two cases, and estimate the power required in practice.

(5). Producer gas is used as fuel for an internally-heated kiln calcining a product which gives off carbon dioxide and water during calcination. The analyses of the exit gases and the producer gas are given below. Calculate the percentage of excess air used for combustion.

Composition of producer gas	%	Composition of exit gases	%
CO_2	6·5	CO_2	25·1
CO	27·0	O_2	3·3
H_2	12·0	N_2	69·6
CH_4	0·5		
N_2	54·0		

SECTION C—PART II

(6). Oil is pumped through a straight pipe 6 cm. inter diameter 100 m. long at the rate of 32,400 kilos per ho The net power consumption for overcoming friction resistances alone is 7·5 h.p. Given that the den of the oil is 0·9, calculate the average coefficient viscosity.

1 h.p. = 746×10^7 ergs per sec.

(7). The following liquids are to be elevated to height of 50 ft. at the rate of 800 gal. per hour :

(*a*) Water containing sand in suspension.

(*b*) 90% acetic acid (cold)—S.G. 1·07.

(*c*) Molasses—S.G. 1·45.

(*d*) 15% sodium carbonate solution (hot)—S.G. 1·1

State what type of apparatus and materials of co struction you would employ in each case, giving t reasons for your choice. What, approximately, wou be the h.p. required in each case ?

(8). Calculate the dimensions of cross section of bare copper conductor to carry a current of 10,0 amps. subject to the condition that the temperature the conductor shall not rise above 35° C. when t surrounding temperature is 20° C. Calculate the voltag drop per 100 ft. run.

Loss of heat from a copper surface

$$= 0{\cdot}2\,(T_s^4 - T_a^4)10^{-8} + 3\,(T_s - T_a)^{1{\cdot}25}.$$

kg. cals./sq. m./hr.

Where T_s = abs. temp. °C. of surface.

T_a = " " surroundings.

Resistance of copper at 20° C = $\frac{1}{58}$ ohm for 1 m. length, 1 sq. mm. section.

Temperature coefficient of resistance = 0·004 per °C.

1 kwh. = 860 kg. cals.

(9). The compressor of a refrigerating plant tak 20 b.h.p. The evaporator and condenser temperatur are 15° F. and 70° F. respectively. The efficiency the compressor is 70%. Assuming a reversed Carn cycle as an approximation, calculate the volume of bri that can be cooled per hour from 35° F. to 22° F.

S.G. of brine = 1·18.

Sp. heat of brine = 0·74.

1 h.p.-hr. = 2546 B.Th.U.

(10). Describe briefly the main types of instrumen used for checking the efficiency of combustion in boiler plant by the composition of the flue gases. Sta what you consider to be their relative advantages disadvantages.

Thursday, July 13, 1933

2 *p.m.*—5 *p.m.*

The candidate may use the reference books provide

Four questions only may be attempted, two to taken *from each part of the paper.*

SECTION D—PART I

(1). How would you determine the filtering characte istics of a given slurry ?

Discuss briefly the advantages and disadvantag of :

(*a*) A filter press.

(*b*) A leaf filter.

(*c*) A rotary filter.

State what type of filter you would propose in each of the following cases :

(i) To clarify a vegetable oil after neutralizing the free fatty acids.

(ii) To separate precipitated calcium sulphate from a concentrated solution of phosphoric acid.

(iii) To separate fine salt crystals from a hot mother liquor.

(2). Describe briefly with rough sketches the equipment required for :

(a) The evaporation of a saturated solution in double effect.

(b) The evaporation of a dilute solution in triple effect with forced circulation.

State the effect upon evaporative capacity and economy of :

(i) Boiling-point rise.

(ii) Multiple effect working.

(iii) Vapour recompression.

(3). Write a short technical report, describing the essential features of some industrial process in which you are particularly interested.

(4). Discuss the physico-chemical principles involved in either :

(i) The manufacture of synthetic methanol ; or

(ii) The hydrogenation of coal tar.

How are these principles applied in industrial practice? Illustrate your answer by a diagrammatic flow sheet of the plant.

(5). Describe a ball mill, indicating in particular the steps that can be taken :

(a) To obtain a uniform product.

(b) To prevent contamination.

(c) To obtain the maximum grinding efficiency.

How would you calculate the critical speed of the ball mill and approximately the h.p. reqnired ?

Section D—Part II

(6). What factors would have to be considered in designing a plant for producing 2000 cb. ft. of electrolytic hydrogen per hour with a maximum of economy ?

(7). Describe the mechanism of the drying of a wet solid, illnstrating your answer by reference to the drying of :

(a) Loose salt crystals.

(b) Lumps of whiting.

(c) Slabs of soap.

(8). In the rectification of a mixture of alcohol and water, what factors determine :

(a) The capacity of the still and column ?

(b) The degree of rectification that can be obtained ?

(c) The amount of steam that is consumed ?

(9). Describe, with sketches, giving the principles of operation, the type of plant which you would recommend for *any three* of the following operations on a commercial scale :

(a) The absorption of chlorine gas by NaOH to produce a concentrated hypochlorite liquor.

(b) The emulsification of bitumen in water.

(c) The separation of tar fog from producer gas.

(d) The extraction of magnesium as bicarbonate from a mixed precipitate of magnesium hydroxide and calcium carbonate.

(e) The production of commercial sodium chloride from sea water.

(10). Give an account of the two-film theory of gas absorption. How can the theory be applied to the design of an absorber :

(a) for ammonia :

(b) for sulphur dioxide ?

Friday, July 14, 1933

10 *a.m.*—1 *p.m.*

The candidate may use the reference books provided. Four questions only may be attempted, two to be taken from each part of the paper.

Section E—Part I

(1). *Compulsory question.*

Indicate in six only of the following cases :

(i) Generally and briefly the type of apparatus you would employ under normal conditions in large scale practice.

(ii) In detail, the materials of construction, and, generally, the type of fabrication of the plant (*i.e.*, riveted, welded, cast, forged, etc.).

(iii) Roughly, the length of life of the particular portion subjected to severe corrosion.

(a) Base-exchange type water softener and tank for the regenerating brine.

(b) Pickling tank and baskets for treatment of mild steel articles with warm dilute H_2SO_4.

(c) Storage tank for cold 70% acetic acid.

(d) Agitator vessel for a solution containing 30% H_2SO_4 at temperature of 100° C.

(e) Crystallisation of copper sulphate.

(f) Pumping cold 65% nitric acid to a height of 30 ft.

(g) Screening a hard gritty non-corrosive material through 8 mesh.

(h) Tube mill for pulverizing chromite for production of chromates.

(i) Transporting strong nitric acid in large quantities by rail.

(j) Denitrating waste acid from manufacture of aromatic dinitro compound.

(k) Removing arsenic from sulphuric acid.

(l) Decomposing NaCl with H_2SO_4.

(m) Evaporating oxalic acid.

(n) Saturation of sulphuric acid with ammonia in the production of ammonium sulphate.

(o) Washing crude benzol with sulphuric acid.

(2). Write out a specification such as you would send out to a manufacturer with an inquiry for a lead-lined steel plate montejus or acid egg for elevating sulphuric acid of 60% strength, to be suitable for a maximum working pressure of 45 lb./sq. in., capacity 7·8 cb. ft.

State what fittings you would require for use with this and give a rough sketch showing how you would install the arrangement

(3) Describe briefly the most important welding methods employed in the construction of chemical plant, and describe clearly the operations which would be involved in constructing a simple benzene storage tank of, say, 9 ft. diameter by 30 ft. long.

(4). Describe an air-compressing installation suitable for producing a steady supply with a maximum pressure of 80 lb. per sq. in. at a maximum rate of 250 cb. ft. of free air per min. What arrangements would you provide for driving the compressor?

(5). State what inquiries you would make before purchasing electric motors for a works obtaining power from a supply company.

Describe what arrangements you would specify for driving a vacuum pump with a 15-h.p. motor, assuming a 3-phase alternating current supply, and give particulars of control and starting gear required.

SECTION E. PART II

(6). Write a short essay on profit-sharing schemes in industry.

(7). Discuss the uses of rubber-lined vessels in the chemical industry.

(8). What are the main differences between conducting a business as a partnership and as a limited liability company?

(9). A single-effect evaporator for evaporating 5000 lb. of water per hour from a solution of a salt costs £1260. The cost of steam is 1s. 6d. per 1000 lb. If 1 lb. of steam can evaporate 0·75 lb. of water per effect, what number of effects should be installed to give the lowest operating cost and what would be the annual saving in this case compared with using a single effect? Neglecting variations in the cost of auxiliary plant, the capital cost of the evaporator may be taken as proportional to the number of effects. Allow 15% on the capital cost for depreciation and repairs, 6% for interest and 20% for other overhead charges. The cost of labour may be taken as the same for any number of effects. Assume 300 working days of 24 hr. in the year.

(10). Explain the meaning of the following terms:

Consolidated balance-sheet.

Holding company.

Debenture.

Fixed assets.

Floating assets.

Friday, July 14, 1933

2 *p.m.*—6 *p.m.*

Candidates were provided with a plan of an oi cooler, details of the construction of which were give as follows: Tube battery consists of six passes, eacl pass consisting of 60 tubes of 1¼-in. bore. The end a B is fitted with a cover so that internal surfaces of th tubes may be cleaned without dismantling, and th chest at the end B passes through a gland so tha stresses due to unequal thermal expansion may b avoided. The construction is, moreover, intended t permit of the tube nest being withdrawn from end A.

Candidates were required:

(1). To draw a sectional elevation showing full detail of the end B.

(2). To draw end elevation of one end with cove removed, showing details of tube pitching and passes Scale 1½ in. = 1 ft.

LAC RESEARCH

Studies on the heat curing of shellac, made b Dr. R. W. Aldis and Mr. S. Ranganathan at the India Lac Research Institute, are described in Bulletin No. 1 issued by the Institute. The bulletin gives details o the retarding effect which pressure has on the time o heating required to cure shellac, and a rough classificatio of substances causing variation in the time of curin has also been attempted. Alkalis and solvents a shown to have retarding influences, whilst accelerato include acids, ester-forming catalysts, and ammoni and ammonia-liberating substances.

Mr. M. Rangaswami, of the Indian Lac Researc Institute, has also published a Research Note (No. 8) o Wax-Free Shellac. The note points out that in son industries wax is undesirable and is filtered off befo use, whilst others, notably the gramophone recor industry, insist on the presence of a certain amount o wax. A comparison of the properties of varnish prepared from shellac, with and without the filtratio of the wax, was therefore made. The wax-free film w shown to be clearer and more attractive in appearanc less hygroscopic than ordinary shellac, and with a much resistance to ordinary wear and weathering. was, however, lacking in mechanical strength, chief in elasticity, which implied that the function of th wax present in shellac is that of a fairly good plasticize The considerably lower resistance of the wax-free la to the scratching needle supports the demand of th gramophone record manufacturers for shellac with fair amount of wax.

In view of the smaller effects of water absorptio more attractive appearance, etc. it is suggested that wax-free film or one with a low percentage of wax preferable wherever baking is practicable, as, f example, in the electrical industry. For other purpos the removal of wax makes for a definite disadvantage i loss of mechanical strength. The bulletin conclud with the suggestion that in cases where the advantag of a wax-free shellac are wanted but baking is impracti able, it may be possible to substitute suitable plasticize for the natural wax, and the practicability of th

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

Council. A casual vacancy among the ordinary members of Council has been created by the elevation of Dr. J. T. Dunn to the Presidency.

The Council acting on the powers conferred on it by the by-laws has elected to fill the vacancy Mr. H. Raymond Feeny, until recently Hon. Secretary of the Liverpool Section.

British Standards Specification on Chemicals used for Electro-plating. The General Secretary will be glad if members capable of usefully criticizing the proposed specification for cyanides used in electro-plating will communicate with him with a view to assisting the committee concerned by their communicated advice.

CORRESPONDENCE

A FERTILIZER COMPLEX

SIR,—We were greatly interested in your editorial of July 21 under the heading "A Fertilizer Complex." We ourselves are in entire agreement with you that the ever-increasing number of compound names for fertilizers is likely, in the long run, to cause a certain amount of confusion. For this reason this company designates the ammonium phosphate group of fertilizers as N.P. Types A, B, or C, each with its appropriate analysis. The concentrated complete fertilizers containing N, P, and K are sold merely under the initials 5.7.7 F. No. 1 and so on. Here again the analysis is printed for each number not only in percentage of ingredients but in proportions of N, P, and K.

In the straight fertilizer field we think that little doubt should exist in the minds of general consumers regarding the products sold in any considerable quantity, viz., superphosphate, basic slag, sulphate of ammonia, nitro-chalk, and nitrate of soda. Long use has imprinted the names and properties of these fertilizers in the minds of most farmers.

We are, Sir, etc.,
For IMPERIAL CHEMICAL INDUSTRIES, LTD.,
E. N. WISE,
Assistant Secretary

London, S.W.1
Aug. 8, 1933

PERSONAL AND OTHER ITEMS

We notice among recent company registrations that of the Lansdowne Varnish & Enamel Co., Ltd., of which Mr. H. Talbot, in addition to his many other activities, is director and secretary. Mr. S. Solomon, for the last 10 years until recently works manager of Thos. Parsons & Sons, Ltd., Mitcham, is also a director. The company has acquired a factory at Barnet from a subsidiary of Imperial Chemical Industries, Ltd., and hopes to commence production at an early date.

We deeply regret to announce the death of **Mr. George Sales Jarmain, of Dalton Lodge, Huddersfield, president of the Wool Carbonizers' Federation and head of Jarmain & Sons, Ltd., carbonizers, scourers, and bleachers, Minerva Works, Kirkheaton,** at his home on August 12, at the age of 80. Mr. Jarmain was one of the Society's oldest members, his membership dating from 1890. His father discovered the wet process of wool extracting, and Mr. Jarmain developed the discovery commercially and himself did much to improve the process of carbonization.

We regret to learn of the death on August 16 of Dr. A. W. J. MacFadden, C.B., who until his retirement four years ago was Senior Medical Officer in charge of the Food Department of the Ministry of Health. During the war he was Chief Inspector of Foods and in this capacity undertook on behalf of the War Office the supervision of the whole of the food supplies of the Army. In the post-war years he took a prominent part in bringing into effect legislation dealing with the hygienic control of milk and preservatives.

Dr. Henry P. Stevens, analytical and consulting chemist, of 15, Borough High Street, London Bridge, S.E.1, announces that as from January 1 last he has taken into partnership his son, Mr. W. H. Stevens, A.R.C.Sc., A.I.C., who has been associated with him for the last six years. The name of the firm will be *Henry P. Stevens & Son.*

Dr. H. W. Coles has been appointed to a fellowship at Mellon Institute, Pittsburgh, to continue pharmaceutical research work sustained at the Institute for some years past by the New York firm of E. R. Squibb & Sons. Dr. Coles has been engaged on pharmaceutical research work for the past six years, and has contributed to the literature of the chemistry and fermentation of sugar derivatives, organic antimony compounds, and ephedrine intermediates.

Mr. W. Gibbins, formerly chairman of the Birmingham Battery & Metal Co., Ltd., brass and copper manufacturers, left estate of the gross value £235,510, with net personalty £223,791. Included in his bequests was one of £10,000 to the University of Birmingham for the purpose of providing a scholarship or scholarships for research work connected with the non-ferrous metals.

Mr. William Watson, of William Watson (Dundee), Ltd., the dye works at Forebank, Dundee, left personal property in England and Scotland valued at £98,498.

Mr. H. E. S. Furness, of the South Durham Steel & Iron Co., and other iron founders, left estate of the gross value of £288,899, with net personalty £208,302.

Leverhulme Fellowships

It was announced in the JOURNAL of June 2, 1933, that the trustees of the will of the late Lord Leverhulme had resolved to devote £12,000 annually to the establishment of research fellowships, particularly for experienced workers to undertake or complete investigations. The advisory committee which was set up for the purpose has now selected 17 of the applicants and they have been awarded Fellowships for periods varying up to 2 years. The names of some of the Fellows with the subjects of their researches are as follows: D. H. Hammick, M.A., Fellow and Tutor, Oriel College, Oxford—"Investigations on the interaction of nitro-compounds with aromatic bases and hydrocarbons"; H. S. Hatfield, Ph.D., London—"The behaviour of crystalline substances in electric and magnetic fields";

A. G. Lowndes, M.A., Marlborough College, Wilts—"The polygraphic process: ultra-rapid cinema photomicrography": W. F. K. Wynne-Jones, B.Sc., Lecturer in Physical Chemistry, University of Reading—"The nature of acids and bases." It is understood that Mr. Wynne-Jones' research work will be carried out either at Copenhagen or in the United States.

The Faraday Society

The Faraday Society is to hold a general discussion on "Free Radicals" in the Laboratory of Physical Chemistry, Cambridge, from September 28 to 30, 1933. Members of the Faraday Society and visitors are to be accommodated during the meeting in Pembroke College. A number of distinguished foreign scientists are to attend the meeting.

The discussion will commence with an introductory statement by Prof. T. M. Lowry, after which there will be a session dealing with "Free Radicals of Relatively Long Life," to which contributions will be made by Prof. M. Gomberg and Dr. H. R. Gamrath (Michigan), Dr. S. Sugden (London), Prof. K. Ziegler (Heidelberg), Dr. E. Huckel (Stuttgart), and Drs. H. Cordes and P. W. Schenck (Frankfurt-on-Maine). The second session will be on "Free Radicals of Short Life: Chemical Aspects," and contributions will be made to the discussion by Prof. R. Paneth (London), Prof. M. Bodenstein (Berlin), Dr. R. G. W. Norrish (Cambridge), Prof. F. O. Rice, (Baltimore), and Dr. Belchetz (Cambridge). At the final session dealing with "Physical Aspects," contributions will be made by Prof. E. R. Mecke (Heidelberg), Dr. F. W. Aston (Cambridge), Dr. E. J. B. Willey (London), and Dr. R. Fraser (Oxford). Full particulars can be obtained from the secretary of the Faraday Society, 13, South Square, Gray's Inn, W.C.1.

Overseas Trade

The value of imports into the United Kingdom during the first six months of 1933 was £360,000,000, or 11·2% below that of the corresponding period of 1932, representing, if allowance is made for changes in price levels, a decrease in volume of 3·2%. Of the total imports nearly 38% came from British countries, being a slight increase compared with last year. Exports declined in value by 6·3% to £175,000,000 and in volume by 3·4%, and the percentage exported to British countries was almost unchanged at a little more than 44%.

A Fungus on Foodstuffs

The July number of *The Journal of Botany* published a note by Mr. G. Smith, of the London School of Hygiene and Tropical Medicine, and Miss M. Olliver, of Chivers & Sons, Ltd., describing a fungus of the genus *Byssochlamys*, which was first shown to be a new monotypic genus by Westling in 1909. The new species differs from Westling's original species, which he named *B. nivea*, and has been called *B. fulva*. It has been isolated from processed fruits and is stated to be of fairly widespread occurrence. It is of considerable economic importance as a cause of spoilage of canned and bottled fruits of all kinds, and is readily disseminated by small and very abundant conidia. Its natural habitat has not yet been discovered, but the mature spores can survive cooking for thirty minutes at 87°—88° C., which explains the survival of the fungus in canned and bottled fruits. More detailed information is to be published in due course.

The Methylene Blue Reductase Test for Milk

Attention has been given to the methylene blue reductase test as a method of examining milk samples for bacterial content. The test, which was originated in 1912 by Barthel and Orla-Jensen, depends upon the fact that bacteria are able to reduce certain dyes to colourless form; thus when methylene blue is added to milk containing bacteria, the blue colour eventually disappears. An account of work recently carried out at Bristol University to determine the value of the test has been given by Mr. C. S. Miles in the August number of *The Journal of the Ministry of Agriculture*. Conclusions arrived at as a result of this work were that the test is unsuitable as a method of examination of milk of low bacterial count, and consequently, compared with the plate count method it does not constitute a fair means of determining bonus payments to be made for such milk. If the keeping quality test is regarded as a measure of the commercial value of milk, the results of the plate count are stated to be more indicative of commercial value than the reductase test.

Convocation on Corrosion

An international convocation on corrosion is being held in Chicago on September 7 under the auspices of the Electrochemical Society of America. Many prominent engineers and chemists will take part, including A. W. Hothersall, S. C. Britton, and Ulick R. Evans of England, Karl Daeves and M. Ragg of Germany, P. Herzog of France, L. de Bruyn of Holland, L. Hajda of Czechoslovakia, and O. P. Watts and K. H. Logan of America. Subjects for discussion include the adhesion of electro-deposited coatings to steel, protective pointing and the use of lead pigments to protect iron and steel.

International Society of Leather Trades' Chemists

The bi-annual conference of the International Society of Leather Trades' Chemists is being held this year from September 17 to 21 at Amsterdam, in conjunction with the Internationalen Vereins der Leder Industri Chemiker. The presidential address of Mr. F. C. Thompson will be delivered on September 18. During the meeting Dr. H. R. Kruyt, of Utrecht, will speak on "Colloid Chemistry of Collagen and Gelatin," Prof. A. R. Katz will give a paper on "X-Ray Spectographs of Albumen with Relation to Gelatin," and a number of other prominent chemists from this country and the Continent will take part in the proceedings.

Canadian Mining

The July issue of *Canadian Mining and Metallurgical Bulletin* contained an article on "Early Days of the International Nickel Co.," prepared by Mr. E. Collin for the annual general meeting of the Canadian Institute of Mining and Metallurgy in April last.

The oldest copper mine in operation in Canada is the Eustis mine, near Sherbrooke, Quebec, controlled by the Consolidated Copper & Sulphur Co. After 55 years of practically continuous operation, the mine is still producing metal, although the sulphur content of the pyrite is more important to the company under existing

conditions. The mill treats an average of 250 tons of ore daily, producing by a differential flotation process two concentrates, one of which contains about 28% of copper and the other about 50% of sulphur.

The Canadian Geological Survey publishes, *in Summary Report*, 1932, Part D, a study by Dr. E. Poitevin of the occurrence of wolframite and molybdenite in New Brunswick. Copies of the report in question can be consulted at the reference library, Canada House, Trafalgar Square, London, S.W.1.

The Sullivan mine at Kimberley, British Columbia, is the world's largest producer of zinc ore and one of the leading producers of the ores of lead and silver. This mine has produced a grand total of 1,596,153 tons of lead, 1,241,473 t. of zinc, and 55,184,466 oz. of silver since it began to operate in 1909, up to the end of 1932. Last year *1,441,045 t. of lead–zinc–silver ore were milled*, as compared with 1,614,740 t. in 1931.

British Columbia's mineral production last year was valued at $28,241,618, as compared with $34,883,181 in 1931, the decline being attributed to lowered outputs of copper, zinc, and coal and to much lower metal prices. From the point of view of value in 1932, British Columbia's *leading mineral products are coal, lead, zinc, gold*, copper, silver, structural materials, miscellaneous metals, and minerals. Gold, which came sixth in 1931, was fourth in the list last year.

During the year there was an extensive revival in lode and placer gold mining in the province, and there seems little doubt that several new mines will result from the *extensive development under way and planned for the* 1933 season, the increased output in 1932 being only a slight indication of the active search for and development of gold properties now in progress. British Columbia producers last year benefited by approximately $556,000 from the exchange premium accorded to gold producers by the Dominion Government.

According to *The Financial Times* (Montreal), sufficient radium has now been produced at the Port Hope (Ontario) refinery of Eldorado Gold Mines, Ltd., to fill the initial order given by the Ontario Department of Health. This radium has been produced from ore forming part of the first shipment of 20 tons from Great Bear Lake to the Dominion Department of Mines at Ottawa. Uranium salts, forming a by-product of the extraction process, have already been shipped to England for use in the ceramic industry.

Researches in Indian Institute of Science

Scientific researches of fundamental importance holding possibilities of practical application to the advancement of industry in India have been carried on in the Indian Institute of Science (Bangalore) during the past year.

Since 1929 Mr. M. Srinivasa and his co-workers have been investigating the possibilities of prodncing different lac products under Indian conditions. Their efforts have already met with a considerable measure of success.

Among some of the more important products prepared by them may be mentioned: (1) A shellac varnish useful for impregnating transformers, magnet coils, armature windings, etc. Nearly 40 transformers have already been impregnated and baked in the biochemical laboratory and subsequently tested by the Mysore Electrical Department. The reports so far obtained are stated to be satisfactory. (2) A special type of oil varnish incorporating lac suitable for impregnation of wooden pins and other moisture-absorbing materials which are used in the Electrical Department. This varnish can be used for baking purposes and offers immense possibilities of application in general varnish trade. (3) Pigmented lacquer enamels have been prepared and used by the Mysore Public Works and Railway Departments. A few cars have also been sprayed with lacquer. They have so far withstood weathering for over a year.

In collaboration with the Mysore Electrical Department attempts have been made to prepare different moulded articles used in electrical trade, and a number of promising compositions, with lac as the chief building material, have been prepared.

Some of the above products are now being produced on a commercial scale by an enterprising local firm—the Mysore Scientific Instruments Syndicate.

Indian Science Congress

The 21st session of the Indian Science Congress will be held in Poona in January next under the presidentship of Dr. Megh Nath Shah, the renowned Indian physicist.

The last session was held at Patna. Every year the session is held in a different city, alternating between *North India and South India, generally*.

The session of the Congress is always held in the first week of January. Scientific discussions are held daily for a week, for which the Congress divides itself into nine sections.

Steel in Laminated Sheets

Recent work at the Mellon Institute, Pittsburgh, has resulted in the production of laminated material incorporating a steel sheet. The steel sheet is in the form of "Robertson Bonded Metal" (R.B.M.) which has an applied fibrous surface. This surface is particularly well adapted to provide anchorage for an adhesive, and serves also to supply a cushioning effect between the steel and the veneer layers, thus ensuring a more uniform contact and adhesion in the laminating operation. This new laminated sheet has obvious economic advantages, for it may be made with the metal supplying all the desired strength, the decorative effects being provided by only very thin veneer layers.

Reptile Skins for Commercial Purposes

A booklet of interest to leather chemists has recently been issued by the Imperial Institute, South Kensington, London, with the title "The Collection of Reptile Skins for Commercial Purposes, with Reference to the Possibilities in Empire Countries." During the last few years there has been an increasing demand for such skins, and the exports last year from India alone numbered 2,500,000. A sub-committee of the Imperial Institute Advisory Committee on Hides and Skins has been examining some aspects of the production of these skins and have prepared in this booklet a useful report. One section deals with the preparation of the skins for the market and details the means by which insect damage may be prevented in transport and storage. Other sections include a list of the species of reptiles the skins of which are already used commercially, and another list of those not so far used but which are worthy of consideration.

REVIEWS

SECOND YEAR COLLEGE CHEMISTRY. By W. H. Chapin. 3rd ed., revised. Pp. xiii + 374. New York: J. Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1933. 18s. 6d.

This is a textbook for the second year American college student, supposed to have acquired in his first year a *fair knowledge of the facts of general and inorganic* chemistry. What may be the best system of teaching in America may be unsatisfactory over here and it is manifestly unfair to condemn a book for failing to cater for people for whom it has never set out to cater. For use in this country, it contains too much for the school boy and too little for the student working for a chemical degree.

The early chapters are devoted to the fundamentals of general chemistry—the kinetic theory, Avogadro's hypothesis, the periodic system, the atomic theory, and the structure of the atom and similar subjects, usually *rather briefly treated at the beginning of a textbook of* inorganic chemistry. These are here treated at greater length than is usual, but interest is lost as there is very little attempt to trace the historical development of the subject, beyond brief footnotes. The later chapters *deal with various aspects of physical chemistry*—osmotic pressure ionization, equilibrium, the theory of indicators, colloids, and electrochemistry. The author here does not go as deeply into the subject as the English student requires. The references to original papers make a welcome feature in this book. *It* should never be too early for the student to consult the original literature, which provides the surest method of getting a thorough grasp of the subject. At the end of each chapter are exercises on the subject-matter of the chapter. These are worded so as to demand only one possible answer and thus they provide no stimulus for *the student to think for himself.* L. M. M.

TWENTY-FIVE YEARS OF CHEMICAL ENGINEERING PROGRESS. SILVER ANNIVERSARY VOLUME OF AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Edited by S. D. Kirkpatrick. Pp. ix + 373. New York: D. Van Nostrand Co., Inc., 1933. Obtainable also from the Executive Secretary, American Institute of Chemical Engineers, Bellevue Court Bldg., Philadelphia, Pa. $4.

Twenty-five years of chemical engineering achievement in America in virtually all branches of the industry is summarized in the 25 essays by recognized authorities comprising this volume, published by the American Institute of Chemical Engineers on the occasion of the silver anniversary of its founding in 1908. Individually each essay reviews the progress made during the last quarter of a century in a definite industrial field. Collectively they portray the stirring epic of the birth and growth of chemical engineering in America and the events that in a mere 25 years have transformed it from a formless conglomerate of chemistry and engineering into the crystalline structure of a new profession, recognized to-day as a definite branch of engineering.

Fortunate, indeed, it is that most of the men who have shaped the destiny of chemical engineering are still in active service and have contributed to this volume from a wealth of professional experience that covers the entire period under discussion. Dr. Arthur D. Little, the dean of American chemical engineers, traces the history of research and touches on the most significant developments in this line and their implications to manufacture; banker, and the general public. Mr. E. R. Weidlein, Director of the Mellon Institute of Industrial Research, in collaboration with Mr. L. W. Bass, presents a statistical survey of the economics of the chemical industries for the period 1909-31, showing, among other things, the number of establishments, wage earners, and salaried employees in the different branches of the industry together with data on wages, salaries, cost of material, value of output, and manufacturing profits. Manufacturing indexes of different industries, fuel and power consumption, exports and imports, and financial aspects are set forth in tabular form with explanatory notes.

Other contributors discuss specific rather than general features of certain chemical industries.

As a broad and fascinating portrayal of the whole development of chemical engineering in America in its myriad forms, this volume has a place in the library of every chemical engineer, in the plant and laboratory reference room and in the schools and colleges where the embryo chemical engineer first envisions the career that lies ahead in his elected profession.

COMPANY NEWS

INTERNATIONAL NICKEL CO. OF CANADA, LTD.

The second quarterly statement of the company for 1933 shows a net profit of $1,943,046, which is the highest quarterly profit recorded by the company since the quarter ended September, 1930. This profit represents earnings of 10 cents per share after allowing for preference dividend. It succeeds a loss in the first quarter of $80,158, and the net profit for the six months ended June 30, 1933, after making the usual deductions is $1,862,888, as compared with a loss of $93,255 in the first six months of 1932. The surplus carried forward now stands at $15,808,960.

In a letter to the shareholders the chairman of the company draws attention to the increased consumption of nickel through the development of chromium-nickel stainless alloys. The letter states that these stainless steels have maintained a comparatively high production rate during the past three years of acute recession in the steel industry. As the properties and production methods of white metal alloys are improved through research and practical application, it is possible to explore new industrial fields in which these alloys should be particularly valuable. The company has been actively associated with progress along these lines and is looking forward to further development of the use of white metal alloys.

UNITED STATES STEEL CORPORATION

The corporation reports a net loss for the second quarter of the year of $8,627,000, bringing the total loss for the first six months of this year to $25,357,000, as compared with $33,670,000 loss for the first half of 1932. Dividend has been declared at 50 cents per share, the same as in the first quarter.

MARKET REPORT

The Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

The following alterations in prices are reported since the publication of the last Market Report (*cf.* CHEM. & IND., Aug. 11, 1933, p. 663).

TAR PRODUCTS

Benzole, 90%.. 2s. 2d.—2s. 3d. per gal. Pure, 2s. 7d.—2s. 8d. per gal.

PATENT LIST

The following is a list of complete specifications of chemical interest which are open for inspection under Section 91 (4) (a) of the Patent Acts. Printed copies are not available, but photographic copies may be obtained at a charge of 1s. per page (minimum 1s.) from the Patent Office, Chancery Lane, W.C.2.

I. 3585–6 (1933). Appareils et Evaporateurs Kestner. Crystallization of substances that crystallize exothermically.

17,967 (1933). Nat. Electric Heating Co. *See* XI.

21,145 (1933). Minton. Absorbent fluid filters.

II. 1586 (1933). Ruhrchemie A.-G. Separating diacetylene from gases containing acetylene.

21,616–7 (1933). Pavitt. Coke ovens.

III. 1970 (1933). Carbide & Carbon Chemicals Corp. Making keten.

2995 (1933). Soc. Chem. Ind. in Basle. Manufacture of aromatic amino bases.

3425 (1933). Du Pont de Nemours & Co. Manufacture of derivatives of 1-nitroanthraquinone-6-carboxylic acid.

IV. 3251 (1933). I. G. Farbenind. Manufacture of dyestuffs of the azine series.

V. 2882 (1933). Bleibler. *Moulding of hollow cellulose bodies.*

3252 (1933). Kodak, Ltd. Fibrous esterification of cellulose.

VII. 16,242 (1932). Norsk Hydro-Elektrisk Kvaelstofakt. Production of sodium nitrate and calcium chloride.

1556 (1933). N. V. Philips' Gloeilampenfabr. *See* X.

VIII. 3124 (1933). Brit. Thomson-Houston Co. Joining different kinds of glasses.

3581—2 (1933). Soc. Anon. des Manuf. des Glaces et Prod. Chim. de St. Gobain, Chauny et Cirey. Manufacture of vitreous products.

3597 (1933). Laurent. Refractory compound.

IX. 2635 (1933). Riverside Cement Co. Cement having advantageous setting and hardening properties.

X. 27,956 (1932). Gen. Electric Co. Coating articles with molybdenum.

881 (1933). Fustier, and Soc. Anon. J. Bocuze & Cie. Electrolytic treatment of copper wire.

1556 (1933). N. V. Philips' Gloeilampenfabr. Precipitating zirconium and/or hafnium on a core of highly *refractory material.*

3222 (1933). Kanz. Additional material for hard-soldering and welding purposes.

3625 (1933). Kinzoku Zairyo Kenkyusho. Magnetic alloys.

3627 (1933). Hoesch-Köln-Neuessen A.-G. Production of corrosion-resistant iron alloys.

XI. 881 (1933). Fustier, and Soc. Anon. J. Bocuze & Cie. *See* X.

17,967 (1933). Nat. Electric Heating Co. Electrically heating or drying materials.

XIII. 651 (1933). Fritz. Manufacture of a plastic material capable of being hardened.

2994 (1933). Soc. Chem. Ind. in Basle. Manufacture of artificial masses.

3234 (1933). Internat. Gen. Electric Co. Production of resinous condensation products.

3503 (1933). Hercules Powder Co. Moisture-proof composition.

3591 (1933). Soc. Chem. Ind. in Basle. Manufacture of artificial masses.

XVI. 3321 (1933). I. G. Farbenind. Extermination of weeds.

XXI. 3043—4 (1933). Jasmatzi. Toning process particularly for toning the red colour component image for multi-colour photography.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has received the following inquiries for British goods. British firms may obtain further information by applying to the Department and stating the specific number. *Austria:* Metals (copper, zinc, tin, lead, etc.), raw materials for the paper industry (clays, pyrites, etc.) (178). *British India:* Steel (157). *Canada:* Vegetable and cold water glue (163). *Poland:* Metal powders (bronze and aluminium) (189).

Import Duties Advisory Committee

The Import Duties Advisory Committee has recommended and the Treasury has approved the revision in certain respects of the classes or descriptions of *machinery to which Section 10 of the Finance Act*, 1932, applies. The effect of listing a class of machinery under the Section is not to free machinery of that class generally from import duty. Licences for import without duty are issued only in respect of particular consignments, where it is found that the requirements of the Section concerning non-procurability in this country etc. are satisfied. The Committee is unable to entertain applications received after the consignment has been imported, or where duty has been paid outright.

The revised list includes machine tools, metal-working and finishing and wood-working machinery, battery-making machinery, machinery for making, *finishing and measuring textiles and textile goods*, glass-making and working machinery and electric lamp and valve-making machinery, chemical and soap-making and mixing machinery, packaging and labelling machinery, paper and board-making and finishing machinery, foundry machinery, wire working and wire-winding machinery, testing machinery, presses, machinery for sterilizing and food preparation, matchmaking machinery, and deep oil-well machinery.

Application may be made by or on behalf of a firm purchasing machinery for its own use, or by an importer having the sole agency for the sale of a particular machine in this country. The appropriate forms of application may be obtained from The Secretary, Import Duties Advisory Committee, Caxton House, Tothill Street, London, S.W.1.

The Import Duties Advisory Committee gives notice of the applications for drawback under Section 9 of the

Finance Act, 1932, in the case of: (i) steel bulbs of the kind used in aerated water syphons; (ii) parts of trackless trailer units, viz., rollers, side-arms and links of iron and steel.

Any representations in regard to these applications should be addressed to The Secretary of the Committee, Caxton House, Tothill Street, London, S.W.1, not later than September 11, 1933.

The Committee announces that it has decided not to make any recommendations in respect of the applications previously advertised for: (*a*) an increase in the import duty on tools and machinery parts wholly or partly manufactured of natural or artificial abrasives; (*b*) the adjustment of the duties on brown artificially *fused aluminium oxide and natural emery garnet and* corundum in grain; (*c*) the addition to the Free List of white artificially fused aluminium oxide, whether in the lump or in grain; brown artificially-fused aluminium oxide, and natural garnet and corundum in the lump only.

Nitrate of Soda Prices

Imperial Chemical Industries, Ltd. announce that *the price of British nitrate of soda, which was recently* quoted at £7 5s. per ton, is as follows for delivery in the months stated: August—October, £7 8s. 6d.; November, £7 11s.; December, £7 13s. 6d.; January, £7 16s.; February *June*, £7 18s. 6d. *per ton.* These prices are the same as those ruling for Chilean nitrate of soda.

Sands, Clays, and Minerals

The publication of *Sands, Clays, and Minerals* was begun less than a year ago and it is by now established as a sound journal dealing with economic minerals. The fourth number which has recently been published contains several useful articles. One of these deals with the commercial possibilities of Irish peat and several interesting illustrations are included. Geologists will be interested in an article on "The Genesis of Gangue," which reviews the means by which metalliferous lodes *not containing the economically valuable ores*, were formed. There is also a well-illustrated article on "Cobalt and Its Uses" and a useful review of the abrasive materials employed as polishing powders. The publisher of *Sands, Clays, and Minerals* is A. L. Curtis, of the Westmoor Laboratory, Chatteris, England.

A Book Guide

The Best Books of 1931 is a very useful guide to the most important publications during 1931 and will be found of use by the student as well as those concerned with the compilation of libraries, whatever subject is concerned. Books are classified on the Dewey Decimal System, and a number of authorities have given assistance in selecting those worthy of classification. It can be obtained from Messrs. Simpkin Marshall, Ltd., *Stationers' Hall Court, London*, E.C.4.

Coal Refining

It is announced that the first commercial plant of British Coal Refining Processes, Ltd. is to be erected on the outskirts of Huddersfield. Sources of coal supplies have been secured together with sufficient land for future expansion. The process is founded on the Salerni system of low-temperature carbonization. The co pany is also studying the question of hydrogenation.

The Fagelston Continuous Gas Indicator

In CHEMISTRY AND INDUSTRY, September 23, 19 pages 796–7, an account was given of the continuo gas indicator developed by Mr. I. Fagelston, M.S of the Admiralty Research Department, and manufa tured by Griffin & Tatlock, Ltd. An excellent descri tive brochure dealing with the indicator has now be issued and will be found of use and interest to ma facturers concerned with the estimation of gas compo tion and contamination, efficiency of recovery proce quality of absorbents, etc.

Two standard types of the gas indicator are n being marketed, the first being known as the "air typ which is intended for detecting leaks of natural g coal gas, hydrogen and methane and for use in analysis of carbon monoxide and hydrogen and carb *dioxide and hydrogen mixtures, and in the manufac* and distribution of oxygen, nitrogen, hydrogen, nitrog hydrogen mixtures and rare gases.

The second is known as the "petrol type" and specified as suitable for application to the manufact use, and recovery of solvents, the evaluation of qualities of adsorbents, the determination of the c stituents of natural gases and gasoline, petrol refin and storage and the safe working of refinery pla coal carbonisation, the determination of composit changes in coal gas, oil gas, water gas and produ gas, carbon dioxide content of flue gases, water vap content of gases, and gases in the heavy chem industry.

The instrument possesses a number of advanta over other apparatus employed for gas analysis, amon which are to be noted the rapidity with which a sin determination can be made, its simple and rob design, its transportability, and, as it operates on sim physical principles, the almost foolproof continuity analysis which it provides, whilst it possesses remarka sensitivity and accuracy of determination. The desc tive brochure can be obtained from Griffin & Tatlo Ltd. of Kemble Street, London, W.C.2, or the compar branches.

Spectrum Analysis

"The Practice of Spectrum Analysis with Hil Instruments" has now reached its sixth edition, wh is evidence enough of its usefulness. The new edit follows the same *outline* as the last, *but each chap* has been overhauled, some material deleted, and n material included.

The main alterations are to be found in the chap dealing with quantitative spectrum analysis, and recent advances in this part of the field are covered detail. The use of the logarithmic wedge sector discussed at length and the work done by its mean reviewed. The use of the microphotometer comes for examination, whilst other aspects of the subject which attention is devoted are the new Ratio Quan ative system, and the possible attainment of hig accuracy in quantitative analysis.

The book contains 58 pages, and is obtainable, p 3s. 8d. post free, from Adam Hilger, Ltd., 98, Kin Road, London, N.W.1.