difference in atomic weight of 0·00014 between atmospheric oxygen and oxygen present in water.

K. R. K.

Silica in Portland Cement.—A rapid method for the determination of silica in Portland Cement has been described (Edwin E. Maczkowske, *J. Res. National Bureau of Standards*, 1936, **16**, 549–553). The method consists in mixing the sample of cement with roughly an equal quantity of ammonium chloride, digesting the mixture with hydrochloric acid for about half an hour and filtering off the silica as usual. This shortened procedure avoids the tedious double evaporation customary in silica determinations. The results obtained by this procedure have been compared with those obtained by the standard method and have been found to be reliable.

K. R. K.

The French Sugar Scale.—The French Sacharimeter Scale yields values for sucrose content which differ by about 0·1 per cent. from the values obtained with the International Scale (Frederick Bates and Francis P. Phelps, *J. Res. National Bureau of Standards*, 1936, **17**, 347–353). This is due to the incorrectness of the normal weight of sugar prescribed by the French Technologists. This paper points out that correct calculation of the data obtained by French investigators leads to a figure for normal weight which is identical with the International Standard, namely, 16·269 g. It is, therefore, recommended that the French Sugar Scale should be rectified by discarding the present normal weight of 16·29 g. and employing instead the International value, *viz.*, 16·269 g.

K. R. K.

Biological Digestion of Garbage with Sewage Sludge.—The underground sewerage system of removal of household wastes developed so far and the methods of purification adopted thereto have concerned themselves mainly with fluid wastes. Quite recently, however, attempts have been made, principally in America, to grind up the solid wastes, *e.g.*, waste-food (garbage) by electric motors and to convey them through the sink and plumbing into the sewers. This improvement, if adopted on the large scale, would ensure a more complete removal of waste material and at the same time serve to enrich the sewage with substances of high manurial value. The slow progress, however, which such an extension of the sewage method to the disposal of garbage has made so far, would draw attention to certain difficulties that lie in the way of its adoption, from the engineering as well as chemical points of view, *e.g.*, questions involving the capacity and ability of plumbing systems and sewers to convey ground garbage suspended in water, the nature of the increased load placed upon sewage treatment plants, the factors controlling the digestion of garbage with sewage, the optimum dosage of garbage which could be successfully manipulated, etc.

In an interesting pamphlet issued by the University of Illinois (*Bulletin* No. 24, Nov. 20, 1936), Dr. Babbitt and co-workers have subjected the chemical factors underlying the biological digestion of garbage with sewage, to a critical examination, conducting their experiments on a semi large scale. They find that garbage could be satisfactorily digested with sewage sludge, provided that it is finely ground and intimately mixed with the sludge and the percentage of sewage solids is kept above 20% (preferably about 40%) of the total volatile solids. The digestion could be carried out in Imhoff tanks, provided the rate of feeding did not exceed 1½ tons of wet garbage per million gallons of sewage. Temperature controlled digestors could be operated successfully at a loading equipment of about 3 c.ft. of digester capacity *per capita*, based on a retention period of 30 days. The rate of gas production was markedly increased by the addition of lime (but not of caustic soda or soda ash), the peak being reached at 3 c.ft. of gas per day per c.ft. of tank capacity.

C. N. A.

Disperse Systems in Gases : Dust, Smoke and Fog.

THE study of disperse systems in gases is of great interest from the theoretical and technical standpoints and has received considerable attention from chemists and physicists. The discussion organised by the Faraday Society in April 1936 has considerably helped workers in this field by placing before them the present position of the several aspects of the subject.

General Properties of Aerosols.

In the introductory paper Whytlaw-Gray (p. 1042)* has briefly dealt with the general properties of disperse systems in gases, pointing out the scope of the subject under discussion.

The Formation of Aerosols.

The work of Stumpf and Jander (p. 1048) dealing with several methods of preparing finely divided and approximately unidisperse smokes in reproducible ways is of special importance for the systematic investigation of the dispersoids. Cawood and Whytlaw-Gray (p. 1059) have studied the effect of pressure on the photochemical production of ferric oxide aerosols. Their experimental results lead to the conclusion that the condensation nuclei are larger at lower pressures than when pressures are high, though as

* References are to the pages in the Monograph (*Trans. Faraday Soc.*, 1936, 1042–1297).

Goodeve (p. 1066) has pointed out from theoretical considerations that at all pressures, the primary particle should be the ferric oxide molecule itself. Regarding the formation of mineral dusts met with in industry, the work of Green (p. 1091) is of interest; he has examined such dusts with regard to their size distribution. It is shown that most of the particles are $0 \cdot 2\,\mu$ to $2\,\mu$ in diameter. He has suggested that dusts are formed by the release of fine particles from the freshly formed surface and is closely connected with secondary structure in crystals. Philip (p. 1182) has considered the mechanism of formation of the aerosol that obtains when air charged with hydrochloric acid gas is passed through a solution of sodium hydroxide containing traces of ammonium hydroxide.

Stability and Coagulation of Aerosols.

Whytlaw-Gray has pointed out in the introductory paper that there is no evidence to show that stabilisation of aerosols can be brought about by protective colloids; R. S. Bradley's (p. 1088) theoretical considerations support this view. Any influence of the foreign substance on the formation of a fog should be interpreted on the basis of the effect that may be produced by the added substance on the size and form of the primary crystals (Fuchs, p. 1055). Fuchs has pointed out that stabilisation of a unipolarly charged cloud cannot be obtained by charging the walls of the containing vessel. If all the walls are charged to the same potential there will be no field inside. If however the potential varies along the walls of the vessel, the cloud moves across and settles at some portions of the walls. Smoluchowski's theory for rapid coagulation should therefore be applicable for aerosols. Harper's paper (p. 1139) on the theory of coagulation and the discussion thereon have definitely shown that there is no doubt regarding the correctness of the coagulation coefficient as calculated on the basis of Smoluchowski's theory. The disagreement with experiment observed by Cawood and Whytlaw-Gray (p. 1059) at lower pressures is ascribed to the heterogeneity of smoke and the departure of the shape of the particles from sphericity. The unusual stability of sulphuric acid mist obtained when sulphur trioxide reacts with water is shown by Dooli and Goodeve to be due to the formation of sulphuric acid droplets and not S_2O_6 as assumed by Sackur. Sulphur trioxide readily combines with water vapour and the droplets thus formed are big and exhibit but feeble Brownian movement. Collision with the liquid is therefore inappreciable and the droplets are quite stable. Remi shows that the absorption of sulphuric acid mist is mainly due to the turbulence of the air carrying the mist.

The course of coagulation under the action of sonic and ultrasonic waves has been followed up by photo-micrographic and kinematographic methods by Brandt and Hiedemann (p. 1101). There are two principal phases of the process as revealed by photo-micrographs taken at short intervals after the sonic waves are set up. In the first, the particles oscillate under the influence of the waves, take part in general circulation between node and antinode, and increase in size in the sound field by collision. In the second phase, the particles are so much enlarged that they no longer oscillate, but describe irregular tracks. The rate of growth of particles is studied by sedimentation velocity and nephelometric methods and is found to increase with sound intensity and time. Flowing aerosols of ammonium chloride and tobacco smoke were found to be effectively coagulated and precipitated by an air-jet generator of sound waves. Experiments with ultrasonic waves, however, are found to give different results. All particles do not oscillate and under certain conditions the particles rotate round one another without colliding and thus there is no coagulation. The theoretical aspect of coagulation under the influence of supersonic waves has been studied by Andrade (p. 1111) with certain simplifying assumptions. Andrade's theoretical considerations have been experimentally supported by Parker (p. 1115), who has worked with magnesium oxide smoke at a frequency of 220 k.c. a second. Grant has pointed out (p. 1120) the possibility of large-scale application of supersonics as a preliminary to electrical precipitation for removing smoke and dust particles from gases.

Particulate Volume in Aerosols.

Whytlaw-Gray, Cawood and Patterson (p. 1055) have described a sedimentation method for counting the number of particles present per unit volume in a smoke. Hill (p. 1125) has investigated the use of a photoelectric density meter to measure the optical density of smoke stains obtained by drawing a known volume of aerosols through a restricted area of filter paper. The concentration of smoke has been estimated to an accuracy of five per cent. The method has been employed in the measurement of atmospheric pollution.

Mass and Size of Particles in Aerosols.

Patterson and Cawood (p. 1081) have described the photometric and the graticule methods for determining the size distribution in smokes. These methods are applicable to a smoke having particles larger than $0 \cdot 1\,\mu$ in diameter. The mass and size of atmosphere nuclei have been determined by Nolan and Guerrini (p. 1175) by measuring the sedimentation velocity and the diffusion coefficient.

Rate of Charging of Particles by Ionic Current.

Fuchs, Petrjanoff and Rotzeig (p. 1131) have described a method for the determination of the rate of charging of floating particles by an ionic current. It consists in passing a narrow cloud-jet parallel to the axis of a cylindrical electric precipitator and measuring the charges acquired by the particles. The flowing particles are sucked into an ultramicroscopic cell for the measurement of the mass and the charge of the particles by the photographic oscillation method which has been developed on the basis of an ingenious idea of Wells and Gerke.* The particles

* *J. Am. Chem. Soc.*, 1919, **41**, 312.

are allowed to fall under the force of gravity and at the same time are compelled by an alternating electric field to oscillate in a horizontal direction. Photographing the zig-zag paths of the particles, the size is determined from the rate of fall and the charge from the horizontal velocity. Experiments were made with oil droplets of $0 \cdot 5\,\mu$ to $3\,\mu$ in radius. There was good agreement with theory when the effects due to mirror forces and diffusion of ions were neglected.

Electrostatic and Thermal Precipitation of Aerosols.

Mierdel and Seeliger (p. 1284) have discussed the general principles involved in electric precipitation. Meek and Lunt (p. 1273) have examined the conditions observed in electrostatic precipitation in view of Prinz's theory. Cawood (p. 1068) as well as H. W. Watson (p. 1073) have discussed the factors contributing towards formation of dust-free space around hot bodies. The latter has discussed the theory of his dust sampling apparatus (which is based on the principle of thermal precipitation).

Dispersoids in Country and Town Air.

Dobson (p. 1149) has dealt with the nature and the formation of fogs. Fogs are caused in a humid atmosphere by the condensation of water vapour on hygroscopic nuclei. Near industrial towns, the nuclei consists mainly of sulphuric acid droplets. In the country air (particularly near the sea-coast) sea salt particles function as nuclei. The size of the fog droplets depends upon the humidity of the atmosphere and the surface tension and osmotic pressure of the liquid constituting the droplet. The size of the droplets—rather than their number—determines the haziness of a fog. The red appearance of the sun through a town fog is due to the presence of a large number of minute dust particles in the atmosphere and not to the droplets which are much larger in size (being a few microns in radius). Kobler (p. 1152) finds the chlorine content of fog droplets to be of the same order as that of rain drops. Arguing on the assumption that the chlorine salts are the nuclei, he concludes that rain drops are not formed by the direct condensation of water vapour on the fog droplets. The nature of the dispersoids usually present in country and town air has been discussed by Coste (p. 1162). Town air mainly contains tar, coke, sulphur dioxide, ammonia, nitrous fumes, etc., all obtained from flue gases. Pollution depends upon the locality as well ; thus iron oxide is generally found near railway stations. The organic suspensions consist of hairs. moulds and bacteria. Coste and Courtier (p. 1198) have investigated the sulphuric acid content of London air. The cause of several deaths and respiratory troubles brought about by the persistence of a fog for five days in the Meuse valley (Belgium) in December 1930, has been traced by Firket (p. 1192) to the sulphur dioxide present in the fog. Whipple (p. 1203) has shown by the examination of the data obtained at the Kew Observatory, that the electrical resistance of the atmosphere increases throughout the hours when pollution is occurring. This is ascribed to the capture of the positive ions by dust particles. Owens (p. 1234) in his paper on " Twenty-five years' progress in smoke abatement " has discussed the work carried out by the " Advisory Committee on Atmospheric Pollution " and has briefly indicated the broad conclusions obtained from statistics gathered at different stations.

Natural Dissipation of Aerosols and Their Practical Removal.

Bosanquet and Pearson (p. 1249) have carried further their mathematical analysis of phenomena involved in eddy diffusion in the spread of smoke and gas from chimneys. Meldau (p. 1270) has shown how fog and dust may first concentrate at unexpected places, sometimes quite remote from their place of origin and how it cannot be explained merely on the basis of wind direction. Goodeve (p. 1218) has described a centrifugal type of mist remover. Lessing (p. 1223) has dealt with the various factors that cause dust in atmosphere and has discussed the relative merits of the several methods of purification. Nonhebel (p. 1291) has described a commercial plant for the removal of smoke and oxides of sulphur from flue gases. The dissipation of fog by electrical, mechanical, thermal and chemical methods has been studied by Brunt (p. 1264). The thermal method seems to have many limitations. The chemical method, however, is more promising. It consists in destroying the equilibrium between the fog particles and the medium by the introduction of a hygroscopic substance like calcium chloride and the consequent evaporation of the fog particles.

The above review of the subject matter contained in the monograph—brief as it is—is sufficient to show the diversity of the points of view from which the study of dispersoids in gases has been approached. The monograph would no doubt be read with great advantage by all those who are interested in the subject.

B. Sanjiva Rao.