in the $3d^9$ $4s$ level and a hydrogen atom may result in bringing the copper atom to the $3d^{10}$ level and exciting the hydrogen atom to higher levels.

It is also observed that the injection of steam or hydrogen greatly modifies the intensity of a number of copper lines, especially in the region below λ 3000. A detailed analysis of the lines which are so modified will give a clue to the nature of the collision processes involved in the arc.

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GEL-FORMATION BY MUTUAL INTERACTION OF OPPOSITELY CHARGED SOLS

A STUDY of the literature reveals that most of the inorganic gels have been prepared by the following two methods:

(*i*) Metathetical reaction: In this method solutions of definite concentrations of substances which on reacting give rise to the gel-forming substance, are mixed in suitable proportions. The resultant mixture is clear in some cases (silicic acid)[1] while in others[2,3] a precipitate is obtained which disappears on slight or vigorous shaking.

(*ii*) Addition of an electrolyte to a sol: In this case certain electrolytes of suitable concentration are added to a fairly concentrated sol of the gel-forming substance, dialysed to a certain extent.[4]

However, other methods, such as the action of α-, β- and X-rays on a sol (Fernau and Pauli),[5] addition of non-electrolytes to a sol (Freundlich),[6] dilution of a true solution of a gel-forming substance (Prasad and Desai),[3] have been used in particular cases.

The authors have discovered that transparent or translucent gels are formed when oppositely charged sols of suitable concentrations, dialysed and undialysed, are mixed together in proper proportions. So far as the authors are aware it has always been observed that mutual coagulation takes place when oppositely charged sols are mixed together in proper proportions. The formation of gels by mixing oppositely charged sols seems to be a new observation. The first observations were made on mixing the sol of nickel hydroxide (negatively charged) with sols of ferric and aluminium hydroxide (positively charged). The nickel hydroxide sol was prepared by shaking with distilled water the gel obtained by the addition of NaOH solution to a saturated solution of nickel hydroxide in tartaric acid and its colloidal content corresponded to 3·01 g. of nickel per litre of the sol. The ferric and aluminium hydroxide sols were prepared by the hydrolysis of ferric chloride and aluminium acetate, respectively, and their colloidal contents were found to correspond to 3·05 g. of Fe_2O_3 and 2·34 g. of Al_2O_3, respectively, per litre of the sols. Gels were obtained when 5 c.c. of the nickel hydroxide sol were mixed with the following volumes of the ferric hydroxide sol dialysed to different extent.

TABLE I

Days of dialysis	Volume limits
0	1·30—1·55 c.c.
1	1·70 - 2·40 ,,
2	2·35—3·05 ,,
3	3·50—4·20 ,,
4	5·30 -5·80 ,,
5	5·25—6·75 ,,

Gels have now been obtained on mixing (*i*) the sol of aluminium hydroxide (+ve) with sols of manganese dioxide (—ve), antimony sulphide (—ve) and silicic acid (—ve), and (*ii*) the sols of ferric hydroxide (—ve) and silicic acid (+ve).

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PARACHORS AND MOLECULAR DIAMETERS

THE mean value of $\frac{[P]}{V_0}$ is 2·873,[1] where [P] is the parachor and V_0 is the zero volume at absolute zero. At absolute zero, parachor can be written as

$$[P] = \frac{M}{D_0 - d_0} \gamma_0^{1/4} = V_0 \gamma_0^{1/4},$$

all the terms involved having their usual significance.

So, $\frac{[P]}{V_0} = \gamma_0^{1/4} = 2 \cdot 873$. Hence, $\gamma_0 = 68 \cdot 2$ for a majority of substances. However, it has been observed that γ_0 varies between 60 and 80 for many organic substances.[2] But, for purposes to be described below, the value of γ_0 may be taken as a constant for all normal substances.

The following equation[3] gives a relation between density and temperature;

$$D_0 = \frac{D - d}{(1 - T_r)^{3/10}}$$

Since $V_0 = \frac{[P]}{2 \cdot 873} = \frac{M}{D_0}$, $D_0 = \frac{M.\ 2 \cdot 873}{[P]}$.

Temp.		Benzene		Chlorobenzene		Carbon tetrachloride	
		σ_v	σ_p	σ_v	σ_p	σ_v	σ_p
0° C.	..	5·87 × 10^{-8} cm.	5·89 × 10^{-8} cm.	6·15 × 10^{-8} cm.	6·17 × 10^{-8} cm.	6·03 × 10^{-8} cm.	6·03 × 10^{-8} cm.
40	..	5·97	5·97	6·23	6·24	6·13	6·12
80	..	6·08	6·08	6·32	6·33	6·25	6·23
120	.	6·21	6·21	6·42	6·42	6·39	6·37
160	..	6·38	6·37	6·53	6·54	6·57	6·55
200	..	6·63	6·62	6·68	6·69	6·85	6·81

Hence, neglecting d which is usually small and rewriting,

$$[P]\cdot\frac{D}{M} = 2\cdot873\,(1 - T_r)^{3/10} \text{ or}$$

$$[P]\,V = 2\cdot873\,(1 - T_r)^{3/10},$$

where V is the molecular volume.

This relation between molecular volume and parachor is useful in calculating molecular diameters of substances at any temperature. The above expression gives

$$V = \frac{[P]}{2\cdot873\,(1 - T_r)^{3/10}}.$$

If molecules are assumed to be elastic spheres closely packed together, it is calculated that

$$\sigma = 1\cdot326 \times 10^{-8}\,\sqrt[3]{V}\text{ cm.,} \qquad \text{(i)}$$

where σ is the molecular diameter. Substituting for V in (i),

$$\sigma = 1\cdot326 \times 10^{-8}\,\sqrt[3]{\frac{[P]}{2\cdot873\,(1 - T_r)^{3/10}}}\text{ cm.}$$

$$= 0\cdot933 \times 10^{-8}\,\frac{[P]^{1/3}}{(1 - T_r)^{1/10}}\text{ cm.} \qquad \text{(ii)}$$

It may be remarked that if γ_0 varies between 60 and 80 (see reference 2), the values of γ_0 under extreme cases, may be taken as 68·2 = 12. Since the value of γ_0 employed in deducing equation (ii) is the reciprocal of the 12th root, the maximum possible error in calculating the value of σ would be 1·5%.

In the above table, the values of molecular diameters for three substances at six different temperatures are calculated by both the equations (i) and (ii). The values of σ_v are obtained by equation (i), from V = M/D where M is the molecular weight and D is the density of the liquid. Density data at various temperatures are taken from Sugden's paper 4; σ_p is calculated by equation (ii).

The good agreement between the two sets of values of molecular diameters of non-associated liquids is a proof regarding the validity of the equation (ii) proposed for calculating molecular diameters in normal liquids, over a wide range of temperatures. Strictly speaking, the values of σ represent the upper limits of the average distances between the centres of adjacent molecules in the liquid state.

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VITAMINS, MINERALS, CARBOHYDRATES AND PROTEINS IN FRUITS—II

THE amount of minerals such as calcium and phosphorus and of vitamins that take part in human metabolism are not large. Therefore one may look for a supply of these essentials in fruits though in small quantities, but in the *soluble form*. In the investigation presented here we have analysed ten fruits for protein, sugars, calcium, phosphorus, vitamin B_1 and in some, vitamin C. Water and trichloracetic acid extracts and ash of the fruits were examined for soluble and insoluble constituents.

Detailed estimations of carbohydrates are published elsewhere.[1] Brigg's colorimetric method for phosphorus, McCrudden's volumetric method for calcium and Kjeldhal's method for protein were adopted. For vitamins C and B_1 the water extract of fruit was taken. For the estimation of vitamin C dichlorophenol-indophenol method[2] was adopted. In the case of vitamin B_1 the quantity of water used for extraction was kept large. The extract was clarified with the minimum quantity of basic lead acetate and sulphuric acid and was then treated with norite. Pure vitamin was retained by norite which was later on released by acidulated water and estimated by using thiochrome method by H. Tauber.[3] Details will be published elsewhere.

All fruits contain sugars and some have starch in addition. Sugars present are mainly glucose and fructose. The concentration of phosphorus from water and acid extracts and from ash is same and is in ortho condition. Same is true with calcium except in sapota