

RESEARCH ITEMS.

Relations between the Melting Points, Boiling Points and Critical Constants of Homologous Compounds and the Number of Carbon Atoms they Contain.—In the *Proceedings of the Koninklijke Akademie van Wetenschappen of Amsterdam*, 1937, 40, 164, J. H. C. Merckel has adduced a number of formulæ which satisfactorily represent the melting points, boiling points and critical constants of a number of compounds of the paraffin series as a function of the number of carbon atoms they contain (n). The following formulæ are taken from his paper:

(1) *Melting point*.—If $T^\circ \text{K}$ is the melting point and n the number of carbon atoms contained, the formula

$$\log T = -\frac{2.091}{n-1} + 2.6018$$

represents the melting points of the odd members $\text{C}_{11}\text{H}_{24}$, $\text{C}_{13}\text{H}_{28}$... up to $\text{C}_{35}\text{H}_{72}$ within an error of 1° . The melting points approach the limiting value 399°S . The agreement is not good for the members previous to $\text{C}_{11}\text{H}_{24}$.

The formula

$$\log T = -\frac{1.870}{n-1} + 2.5896$$

holds for the even members from $\text{C}_{10}\text{H}_{22}$ to $\text{C}_{24}\text{H}_{50}$. From $\text{C}_{24}\text{H}_{50}$ up to $\text{C}_{60}\text{H}_{122}$, we have the formula

$$\log T = -\frac{2.284}{n-1} + 2.6136.$$

(2) The boiling points at 76 cm. pressure are represented by

$$\log T =$$

$$0.212 \log \{(n-1)^2 - (n-1) + 1\} + 2.2546.$$

This holds for both the odd and even members of the series. The boiling points at 15 mm. pressure follow the formula

$$\log T =$$

$$0.1986 \log \{(n-1)^2 - (n-1) + 1\} + 2.1758.$$

(3) The critical temperatures T_{cr} are given by

$$\log T_{\text{cr}} =$$

$$0.159 \log \{(n-1)^2 - (n-1) + 1\} + 2.4957.$$

(4) The critical pressures P_{cr} are represented by

$$\log P_{\text{cr}} =$$

$$-0.346 \log \{(n+2)^2 - (n+2) + 1\} + 2.0747.$$

T. S. S.

Mass Spectrograph and Isotopic Weights.—Prof. Aston has improved his mass spectrograph so as to give second order focussing and in *Proc. Roy. Soc.*, (A), 1937, 163, 391, he gives the values he has recently obtained for a number of isotopes. Table I gives his results. Provisional values are included within brackets.

Prof. Dempster has also determined the masses of a number of heavy atoms using a double focussing spectrograph and his new spark discharge source of ions. The following results (Table II) are from his paper in *Phys. Rev.*, 1938, 53, 64.

TABLE I.

| Symbol | Packing Fraction | Isotopic Weight | Symbol | Packing Fraction | Isotopic Weight |
|------------------|------------------|------------------------|-------------------|------------------|-----------------------|
| ^1H | + 81.2 | 1.00812 ± 0.00004 | ^{35}Cl | — 5.71 | 34.9800 ± 0.0008 |
| ^2D | + 73.55 | 2.01471 ± 0.00007 | ^{37}Cl | — 6.10 | 36.9775 ± 0.0008 |
| ^4He | + 9.77 | 4.00391 ± 0.00016 | ^{36}A | — 6.10 | 35.9780 ± 0.0010 |
| ^{10}B | + 16.1 | 10.0161 ± 0.0003 | ^{40}A | — 6.15 | 39.9754 ± 0.0014 |
| ^{12}C | + 2.96 | 12.00355 ± 0.00015 | ^{78}Kr | — 7.30 | 77.9430 ± 0.0020 |
| ^{14}N | + 5.28 | 14.0073 ± 0.0004 | ^{82}Kr | — 7.70 | 81.9369 ± 0.0015 |
| ^{18}O | + 3.2 | 18.0057 ± 0.0002 | ^{84}Kr | — 7.60 | 83.9362 ± 0.0015 |
| ^{19}F | + 2.36 | 19.0045 ± 0.0005 | ^{86}Kr | — 7.40 | 85.9363 ± 0.0015 |
| ^{20}Ne | — 0.70 | 19.9986 ± 0.0006 | ^{118}Sn | — 5.8 | 117.930) |
| ^{27}Al | — 3.3 | 26.9909) | ^{120}Sn | — 5.8 | 119.930) |
| ^{28}Si | — 4.90 | 27.9863 ± 0.0007 | ^{129}Xe | — 4.46 | 128.9424 ± 0.0020 |
| ^{29}Si | — 4.7 | 28.9864 ± 0.0008 | ^{132}Xe | — 4.4 | 131.942) |
| ^{31}P | — 5.30 | 30.9836 ± 0.0005 | ^{200}Hg | + 1.4 | 200.028) |
| ^{32}S | — 5.53 | 31.9823 ± 0.0003 | | | |

TABLE II.

| Mass No. m | Ions | Diff. of Packing Fractions ($f_2 - f_1$) | m | Ions | $f_2 - f_1$ | m | Ions | $f_2 - f_1$ |
|--------------|---------|--|-------|---------|-----------------|-------|----------|----------------|
| 16 | O - Ti | - 7.22 \pm 0.1 | 116 | Sn - Th | 10.14 \pm 0.1 | 99 | Ru - Pt | 8.26 \pm 0.2 |
| 12 | C - Ti | - 9.8 \pm 0.4 | 119 | Sn - U | 10.41 \pm 0.1 | 69 | Pd - Ga | 1.29 \pm 0.3 |
| 14 | N - Fe | -12.3 \pm 0.4 | 91 | Zr - W | 7.85 \pm 0.2 | 71 | Pd - Ga | 1.37 \pm 0.3 |
| 16 | O - Cu | - 6.9 \pm 0.2 | 92 | Zr - W | 8.05 \pm 0.2 | 94 | Mo - Os | 7.78 \pm 0.3 |
| 27 | Al - Ag | - 1.2 \pm 0.2 | 97 | Mo - Pt | 7.7 \pm 0.2 | 95 | Mo - Os | 7.76 \pm 0.3 |
| 65 | Cu - Pt | 8.93 \pm 0.1 | 98 | Mo - Pt | 7.68 \pm 0.2 | 96 | Mo - Os | 7.58 \pm 0.3 |
| 65 | Cu - Au | 8.90 \pm 0.2 | 96 | Mo - Ir | 7.72 \pm 0.2 | 19.5 | K - Ru | 0.4 \pm 0.3 |
| 49 | Au - Ti | 9.36 \pm 0.2 | 95.5 | Mo - Ir | 7.68 \pm 0.2 | 20 | Ni - Ru | 1.1 \pm 0.3 |
| 54 | Ag - Fe | 2.55 \pm 0.3 | 104 | Pd - Pb | 7.96 \pm 0.15 | 27 | Al - Pd | 1.6 \pm 0.3 |
| 21.3 | Ag - Zn | 2.0 \pm 0.3 | 102 | Pd - Pb | 8.07 \pm 0.2 | 117.5 | Sn - AcU | 10.5 \pm 0.3 |
| 22 | Ag - Zn | 2.5 \pm 0.3 | 103 | Rh - Pb | 7.96 \pm 0.15 | 96 | Mo - Pt | 8.3 \pm 0.3 |
| 23 | Na - Zn | 4.9 \pm 0.5 | 102 | Pd - Ti | 8.03 \pm 0.2 | | | |
| | | | 104.5 | Pd - Bi | 7.81 \pm 0.1 | | | |
| | | | 96 | Ru - Os | 7.91 \pm 0.2 | | | |

Then assuming f_1 for O to be 0, f_2 for Ti 48 is deduced as -7.22 ± 0.1 and so on.

T. S. S.

Dilatancy and its Relation to Thixotropy.—An interesting study, "on the relation between dilatancy and thixotropy" has been made by H. Freundlich and H. L. Röder (*Trans. Farad. Soc.*, 1938, 34, 308). An example of dilatancy is to be found in moist quartz sand which whitens and appears dry as the foot falls on it and becomes wet again on raising the foot. A part of dilatant mass can be cut out with a spatula as if it were a solid cake while immediately after this, it flows down the spatula like a treacly liquid. Dilatancy may be considered to be an opposite to thixotropy. In thixotropic systems, viscosity decreases by stirring and increases on standing whereas dilatant systems on stirring exhibit increased resistance to deformation.

Dilatancy is readily observed only in a rather narrow range of concentration; in quartz-water suspension only between 42 per cent. and 45 per cent. of solid per volume. Rice starch and potato starch also exhibit this phenomenon at about the same concentration. For dilatancy, absolute independence of particles from one another is essential. Tendency to adhere reduces dilatancy.

In order to measure the degree of dilatancy, an apparatus has been devised, by which the speed of a sphere moving in a dilatant system is measured in relation to the driving force, i.e., the rate of shear in relation to shearing stress. At a low rate of shear, the mass behaves like an ordinary viscous liquid. At a certain rate of shear, however disproportionately high, resist-

ance sets in and any further increase of the shearing stress has no effect on the speed of the sphere.

The mechanism of dilatancy is interesting. At low rates of shear the particles in front of the sphere have sufficient opportunity to slip over each other. At a certain rate of shear when dilatancy sets in, shearing process may become so rapid that the particles are no longer able to "make way" but are piled up in front of the moving sphere and create a considerable resistance. Behind the sphere the mass is stretched, cracks may form which become filled with the liquid. The local accumulation of the solid particles on one side of the moving sphere and gathering of liquid in cavities on the other, causes such a system to behave like a solid. Similar structure is supposed to exist in thixotropic systems. In dilatant systems the solid state is unstable, kept up only by external force and with the removal of the force, the particles having no tendency to adhere distribute more uniformly. Thus the system becomes fluid and remains so. The mechanical treatment therefore causes a change from a more regular "fluid" distribution of the particles into an irregular "solid" distribution. In thixotropic systems however particles having a tendency to adhere, the irregular solid distribution is more stable but on shaking the system becomes fluid owing to more uniform distribution.

Besides the above systems, with microscopic particles, systems containing ultramicroscopic

particles like a concentrated solution of potassium silicate containing a certain amount of silicic acid and Nuodex calcium—S (a colloidal solution of 10 per cent. calcium naphthenate in petroleum distillate) are found to show dilatancy.

Quartz powder and starch grains with non-polar liquids like benzene and carbon tetrachloride, etc., form thixotropic pastes whereas with polar liquids like water, ethyl alcohol and glycerol show dilatancy. This is due to the fact that particles of quartz and starch in water, being charged have no tendency to adhere whereas in non-polar liquids, being uncharged or poorly charged adhere and form clusters. Thus thixotropy in many respects is the opposite of dilatancy.

K. S. RAO.

Nerve Distribution in the Muscles of the Ox.—A very valuable and interesting treatise dealing with the distribution and deviations of important nerves and blood vessels in the anatomy of the ox has recently appeared. ("Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on Certain Anatomical Deviations," by H. N. Chelva Ayyangar. pp. 60, 55 illustrations. Published by the Manager of Publications, Delhi, 1937, Price Rs. 4-10-0.) The author has to be congratulated on the valuable discoveries of certain important variations which may be of immense use in correctly assessing the functions of certain organs in the ox. Text-books on the anatomy of domesticated animals invariably deal with the anatomy of the horse, only important differences in other domesticated animals being described casually. The author has done an immense service to the veterinary profession in opening up a new line of work especially for us in India who are to deal more with the ox tribe in our daily routine.

A few of the important findings of the author in his own words are:—1. The usual nerve supply to the levator anguli scapuli is from the 5th to 8th cervicals. Very frequently, it is also supplied by a branch from the 1th. 2. The nerve supply to rhomboideus, generally, is from 5th and 6th cervicals. It often gets a supply from the 4th also. Occasionally, branches from the 7th contribute towards the nerve supply of this muscle. 3. The nerve supplying the levator anguli scapuli and rhomboideus, besides being more flexuous than in the horse, show very frequent anastomosis which condition is not met with in the horse. 4. The formation of flattered and various shaped fasciculi at the junction of the various nerves supplying the rhomboideus on the deep face of the muscle, the coursing backward of the united nerve in an arch-like manner giving off twigs (entering the deep face of the rhomboideus) mostly from its dorsal face and the ease with which the common cord could be traced to the most posterior part of the dorsal rhomboideus all along its deep face are points not experienced in the dissection of the "Nerve to rhomboideus" in the horse. 5. (a) The branches from the 5th, 6th and 7th usually form the roots of the phrenic nerve in the ox. (b) The branch from

the 5th which is inconstant in the horse, is always present in the ox. (c) The branch from the 5th is the largest and the longest and is always placed on the deep face of the scalenus. (d) The branches from the 5th and 7th are always on the superficial face of the scalenus. (e) Sometimes, a branch from the 4th cervical nerve also forms one of the roots of the phrenic nerve. (f) The branch from the 7th is the shortest and the narrowest. (g) The branches from the 6th and 7th first unite and this cord then enters the thorax where it is joined by a branch from the 5th behind the level of the first rib. (h) When the 4th nerve enters into the formation of the phrenic, the branch from the 4th first unites with that from the 5th and the common cord resulting from this meets the common cord formed by the union of the branches from the 6th and 7th in the thorax.

S. D. A.

The Hällefors Dolerite Dike and Some Problems of Basaltic Rocks.—In a valuable contribution appearing in the *Bulletin of the Geological Institution of the University of Upsala*, (1937, 26, 113), Krokström dealt with the arresting problems of Basaltic Rocks,—tracing the genesis of their differentiation to a common parent stock,—and particularly of the contrasted types, granites and dolerites. He attempts to solve also some of the problems connected with the mineral associations of the rocks, namely, the association of monoclinic and Orthorhombic pyroxenes, the crystallisation of diabantite and ferite as mutually exclusive members and the order of crystallisation of Olivine, Plagioclase, Pyroxene, and iron ores. Then he goes on to examine the theories of Bowen, Fenner, Holmes and Kennedy to find a suitable explanation for the occurrence of the contrasted types,—the Breven and Hällefors dolerites, and their associated granophyres.

To this end he has worked out extensive optical, chemical and petrographic data of the minerals and rocks under study. Some of the following conclusions of his deserve notice.

While estimating the anorthite content of plagioclases he points out that the extinction angles are really controlled by the anorthite content and the mutual proportions of alkali silicates are of very little influence. That TiO_2 in the pyroxene tends to lower the value of $2V_\gamma$ is another observation.

He further points out that the textural relationship of basic rocks is influenced by the silica content. Thus the ophitic texture is developed in undersaturated rocks and the doleritic texture (British "Intergranular") in rocks, where there is an enrichment of silica in the residuum. He says that the same result would follow if the residuum were enriched in iron.

For the origin of the associated granophyre dykes he rejects the "Acid Residuum" theory of Bowen, and admits Holmes' "Partial Refusion" theory as the more tenable, and classifies the dolerite magma of the above dykes as belonging to Kennedy's Olivine-Basalt Magma type.