

The experiments confirm those recorded in the preceding section. Abdominal compression raises the vena cava pressure, and so leads to increased cerebral capillary pressure, and in this way to increase in the volume of the cerebro-spinal fluid secreted. Increase of volume, as before, is accompanied with fall in the percentage of solids present.

*Intra-vascular Injection of the Cerebro-spinal Fluid.*

One of us (W. D. H.), in conjunction with Dr. Mott, F.R.S., has been for some time engaged in examining the results of injecting into animals cerebro-spinal fluid removed from cases of brain atrophy, especially from cases of general paralysis of the insane. This fluid contains a toxic substance, choline, doubtless derived from the disintegration of lecithin in the brain. Injection of such fluid into the jugular vein of animals (dogs, cats, rabbits), anæsthetised with ether, causes a marked lowering of arterial blood pressure, which is partly cardiac in origin, but principally due to the local action of the poison on the neuro-muscular apparatus of the peripheral vessels, especially in the splanchnic area.\*

The fluid obtained from the present case was also injected in a similar way. Quantities varying from 7 to 10 c.c. were injected into the circulation in dogs, but with entirely negative results. Such a quantity in the case of fluid from a general paralytic would be quite sufficient to cause a marked fall of arterial pressure.

Similar negative results, both as regards blood pressure and respiration, were obtained with other specimens of normal cerebro-spinal fluid removed from other animals, or from cases of meningocele and hydrocephalus in children. In all such cases, also, choline was searched for chemically, but with negative results.

“The Thermal Deformation of the Crystallised Normal Sulphates of Potassium, Rubidium, and Cæsium.” By A. E. TUTTON, B.Sc. Communicated by Captain ABNEY, C.B., F.R.S. Received January 31,—Read February 16, 1899.

(Abstract.)

In this memoir are communicated the results of sixty-four determinations of the thermal expansion of the orthorhombic crystals of the normal sulphates of potassium, rubidium, and cæsium, carried out for the three axial directions of the crystals with the aid of the compensated interference dilatometer previously described by the author.†

\* ‘Physiol. Soc. Proc.’ Feb., 1897, and Feb., 1898 (‘Journ. of Physiol.’ vols. 21 and 22).

† ‘Phil. Trans.’ A, vol. 191, p. 313.

The employment of the compensated method has proved highly successful, extremely concordant results being afforded with crystals not necessarily more than 5 mm. thick. The twenty-nine different parallel-faced crystal-blocks employed varied in thickness from 4·8 to 10·7 mm. The main conclusions from the work are given in the following summary.

The coefficients of cubical expansion exhibit a progression, corresponding to the progression of the atomic weights of the three respective metals. This is true of both the constants  $a$  and  $b$  in the general expression for the coefficient of cubical expansion,  $\alpha = a + 2bt$ , for any temperature  $t$ . The actual values are shown in the following table:—

	$a$ .	$b$ .
K <sub>2</sub> SO <sub>4</sub> .....	0·000 104 75	0·000 000 069 8
Rb <sub>2</sub> SO <sub>4</sub> .....	0·000 103 14	0·000 000 076 7
Cs <sub>2</sub> SO <sub>4</sub> .....	0·000 101 70	0·000 000 081 0

The order of progression of the two constants is inverted;  $a$ , the coefficient for 0°, diminishes with increasing atomic weight of the metal, while  $b$ , half the increment of the coefficient *per* degree of temperature, increases. Consequently, the coefficients of cubical expansion of the three salts converge, with rise of temperature, and attain equality in pairs. Identity is attained for potassium and rubidium sulphates at 114°, for potassium and caesium sulphates at 136°, and for rubidium and caesium sulphates at 168°. At 136° equality for all three is only deviated from by one unit in five hundred. Beyond the temperature of identity divergence occurs, and an increase of atomic weight is now accompanied by an increase of expansion.

The thermal deformation is of the nature of an expansion in all directions in the crystals of all three sulphates.

The differences between the coefficients of linear expansion along the three axial directions of any one salt, although only amounting to one-eighth of the total coefficient, are large compared with the differences between the values for the same direction of the three salts. This, together with the fact that the replacement of one metal by another is accompanied by considerable modifications of the relations of two of the three values for the original salt, those corresponding to the axes  $a$  and  $c$ , prevent the coefficients of linear expansion for any one direction of the three salts from exhibiting any progression corresponding to that of the atomic weights of the three metals. These directional perturbations are, however, mutually compensative, so that the effect of interchange of the metals is clearly exhibited by the solid deformation, the cubical expansion, in the progressive manner already indicated.

The increment of the linear coefficient of expansion along the axis  $c$  of each salt is about twice as large as the increments for the other two

directions,  $a$  and  $b$ , for which latter the increments are nearly equal. This is analogous to the optical behaviour, the refractive power being altered (diminished) by rise of temperature much more in the direction of the axis  $c$  than in the other two directions, in which the lesser amounts of change are nearly equal.

The amount of expansion along the direction of the axis  $b$  is approximately identical for all three sulphates, indicating that interchange of the metals is without influence on the thermal behaviour along this axis. The crystals of all three salts expand least in this direction, which is, therefore, the common minimum axis of the thermal ellipsoid.

The chief of the directional perturbations previously referred to consists of a reversal, for temperatures below  $50^\circ$ , of the directions of the maximum and intermediate axes of the thermal ellipsoid for rubidium sulphate, compared with their directions in the potassium and caesium salts. The maximum thermal axis is  $c$  for the two latter salts, but  $a$  for rubidium sulphate. A similar reversal of the direction of the maximum axis of the optical ellipsoid (the indicatrix), the first median line, from  $c$  to  $a$ , occurs for the same temperatures, in the case of rubidium sulphate. The maximum thermal axis is identical with the first median line in all three salts.

At high temperatures the same relations continue to hold for the potassium and caesium salts, both thermally and optically. But owing to the increment of expansion along  $c$  being so much greater than for the other directions, the intermediate expansion along  $c$  for rubidium sulphate attains equality at  $50^\circ$  with the expansion along  $a$ , and beyond this temperature  $c$  becomes the maximum thermal axis for this salt, as it is for the other two sulphates. Consequently, at  $50^\circ$  the crystals of rubidium sulphate are apparently thermally uniaxial. At temperatures varying  $10^\circ$  each side of  $50^\circ$  for different wave-lengths of light, they have previously been shown to simulate uniaxial optical properties. The thermal and optical ellipsoids of revolution are not, however, identically orientated, the axis of the former being  $b$  and of the latter  $a$ . Further, the change of direction of the maximum thermal axis of rubidium sulphate from  $a$  to  $c$  is followed optically at  $180^\circ$  by the change of the first median line from  $a$  to  $c$ , rendering the rule as to coincidence of the maximum thermal axis and the first median line again valid.

A close parallelism between the linear thermal expansion and the directional optical behaviour is thus found to exist. The optical constants have been shown in a previous memoir\* to exhibit a clear progression following the order of progression of the atomic weights of the three alkali metals; the values for the three salts are very much more widely separated than in the case of the linear thermal constants,

\* 'Journ. Chem. Soc., Trans.,' 1894, p. 628.

and consequently the progression is undisturbed by the modification of the directional differences for the same salt, which are relatively so much more important in the case of the thermal constants.

The net effect of the replacement of one metal by another has, however, been shown to be clearly demonstrated by the progression of the coefficients of the cubical expansion and their increments.

The final conclusion of the investigation, therefore, is that :

*The thermal deformation constants of the crystals of the normal sulphates of potassium, rubidium, and cesium exhibit variations which, in common with the morphological, optical, and other physical properties previously investigated, follow the order of progression of the atomic weights of the alkali metals which the salts contain.*

“On the Reflex Electrical Effects in Mixed Nerve and in the Anterior and Posterior Roots.” By Miss S. C. M. SOWTON.  
Communicated by A. D. WALLER, M.D., F.R.S. Received  
December 12, 1898,—Read February 16, 1899.

The following experiments were made during the months of May, June, and July, 1897, in the Physiological Laboratory of Leipzig, under the guidance of Professors Hering and v. Frey, to test whether in the frog, reflex electrical changes could be demonstrated at the central end—

- I. Of a mixed nerve.
- II. Of anterior roots alone.
- III. Of posterior roots alone.

As regards the first two heads, the end in view was simply the actual verification of an extremely probable phenomenon, preparatory to an examination of the third head, viz., reflex electrical effects propagated down the posterior roots, which, in 1891,\* were pointed out by Gatch and Horsley, and offered as proof of the passage of centrifugal nerve impulses in normally afferent nerve channels. The results obtained in the present experiments being somewhat difficult to interpret, the notes were laid aside until opportunity should offer for carrying the investigation further. Professor Bernstein having, however, quite recently† discussed the question of the reflex negative variation of the nerve current, the moment seemed opportune for submitting these results as they stand to the attention of those interested in the subject.

The galvanometer used was on the lines of Thomson's reflecting instrument, with modifications by Carpentier. The leading-off electrodes had finely pointed camel's hair brushes inserted in the plug

\* 'Phil. Trans.,' B, vol. 182.

† 'Pflüger's Archiv,' vol. 73, p. 374, 1898.