of $\delta \lambda$ may ultimately lead to the elucidation of the structure of the nuclei of different elements. On examining the table of atomic weights, we find the number of H-protons sometimes greater than the value given by taking O = 16; it may rest on imperfect experimental data, but probably there is also electro-magnetic ground to account for the discrepancy. It will be necessary, strictly speaking, to give more accurate figures to isotopes than whole numbers, as the structure of the nucleus becomes better known.

In connexion with the present note, we have to remark that, by using the expression for the quantised energy deduced by Born and Hückel for two vibrating atoms, and neglecting higher terms due to vibration, the frequency difference of two lines the quantum numbers of which differ by unity must be constant, if the term due to rotation remains unchanged. Many lines having this property and not belonging to series are found in argon, copper, tin, lead, arsenic, antimony, and bismuth. It is probable that these lines are due to atomic vibrations; moreover, many lines of lead belonging to this type show strong reversal, which can be explained from the same point of view. Some chlorine pairs above considered can also be arranged in a similar manner.

The present research is of special interest as affording a means of investigating the nuclear structure from the examination of spectral lines, and though our knowledge of the nuclei is still vague, fresh light can be shed on it by the extension of spectroscopic research. The excitation of many non-series lines will open a wide field of investigation, not only in searching for isotopes, but also in elucidating many unsolved problems of spectrum analysis.

H. NAGAOKA. Y. SUGIURA.

Institute of Physical and Chemical Research, Komagome, Hongo, Tokyo, January 29.

Liquid Crystals, Soap Solutions, and X-Rays.

ORDINARY liquids when not subject to strain are isotropic and appear dark when examined between crossed Nicols, whereas most crystals are anisotropic and light up the field. Several hundred pure organic substances exist at suitable temperatures in an intermediate condition in which they are more or less fluid but are anisotropic.

Lehmann, who first recognised this state of matter, has been severely criticised for coining the descriptive term "liquid crystals" (or "crystalline liquids"). Lehmann, like most German and French authorities,

Lehmann, like most German and French authorities, accepted Bose's (1908) explanation of the effect as being due to parallel arrangement of long, thin molecules, which do not however form the regular space lattices of true crystals. In conformity with this, van der Lingen showed in 1913 that "liquid crystals" do not give a crystal X-ray picture, and all subsequent attempts have likewise given negative results.

Most solutions, whether of colloids or of crystalloids, are strictly isotropic: there are, however, a few colloidal sols, such as Freundlich's vanadium pentoxide, which are anisotropic whenever the anisotropic particles are oriented by stirring. Solutions of soap are almost unique in exhibiting the same spontaneous crystalline liquid properties as do pure organic substances.

There is a wide range of such colloidal soap solutions, and indeed all concentrated soap solutions whether at ordinary or higher temperatures are in this condition. All these anisotropic soap solutions are clear, transparent, soft, plastic fluids. These solutions likewise fail to give any indication of crystalline structure by

NO. 2841, VOL. 113]

X-rays. Good specimens for study at room temperature are afforded by all potassium laurate solutions over three times normal strength and by all solutions of oleate above once-normal; and commercial "neat soap" in the soap pan is typical of this condition.

Soap and its solutions can, however, exist in five other forms. If neat soap be cooled, a proportion of it may separate out as undoubted crystals or, alternatively, as the curd fibres familiar in household and hard white toilet soap. Both the undoubted true lamellar crystals and the curd fibres give X-ray spectra. Soap remaining in solution at room temperature is always transparent in each of the four following forms : there are three states of colloidal electrolyte, namely, anisotropic plastic liquid, isotropic jelly, or isotropic fluid; whilst dilute solutions in which hydrolysis has been suppressed contain only crystalloid.

Friedel in 1921 classified Lehman's crystalline liquids into two groups, namely, "liquide à conique" and "liquide à fils," these names being taken chiefly from the appearance of the boundaries of different portions of the specimens when examined in polarised light: More recently Friedel (Ann. de phys. 1922, 9, 273) has withdrawn these names in order to call the first "smegmatic" (or "soap-like") and "nematic" (or "thread-like"). Surely "soaplike," with its six widely different forms, is about the last term that one would employ to characterise precisely a new state of matter. Why, again, employ an unspecified kind of soap solution to define the state of pure substances ?

Friedel has introduced a further confusion in his classification by including soap curds among the "smegmas" or "liquides à conique," a procedure which to any one familiar with the behaviour of these two forms of soap would appear to be inadmissable. Not only so, but he has used the X-ray spectra obtained by himself and de Broglie with soap curds (proper details are lacking) to substantiate the structure which he has postulated for the "liquides à conique." My colleague, Mr. Piper (Proc. Phys. Soc. 1923, 35, 269), has (in my opinion mistakenly) followed Friedel's procedure without criticism (see also Annual Reports of Chemical Society for 1923, p. 243).

The fact is that so far, no one appears to have obtained an X-ray spectrum from any homogeneous "liquid crystal"; whereas, in direct contrast, the X-ray photographs of soap curds resemble those of the ordinary fatty acids which are definitely interpreted as crystalline (Annual Report, p. 244).

I would urge, then, the retention either of Lehmann's terms, which have been so long in use that they have ceased to mislead, or, alternatively, of the truly descriptive term "anisotropic liquids." I would emphasise that the renaming of the sub-groups "liquide à conique" and "liquide à fils" must lead and has already led to real confusion. Soap curds are too different from anisotropic soap solutions to belong to the same state of matter.

The University, Bristol.

JAMES W. MCBAIN.

The Temperature of Reversing Layers of Stars.

The question of the relation of the temperature of a reversing layer of a star to the star's effective temperature is raised by Dr. J. Q. Stewart in NATURE of March 15. In the investigation of mine to which Dr. Stewart refers (Mon. Not. R.A.S., 82, 368, 1922) it was shown that the temperature of an indefinitely thin layer in radiative equilibrium, subject on one side to black radiation of effective temperature T_1 and subject on the other side to no radiation, lies between T_1 and $\frac{1}{2}T_1$, whatever the selective absorption of the thin layer. As Dr. Stewart points out,