destroyed by the inclusion of Pr with Pa, Nd with U, Sm with Pu and Eu with Am, not merely in the same group but also in the same sub-group *c*. Advocates of 'long' forms of table are unlikely to be converted in this way.

It is also wrong to speak of Mendeleef's 'classification' and to identify it with the 'short' form of table. In 1871 Mendeleef himself produced a 'long' form (though he had the 'typical' elements in one block in the centre of the stage instead of in the wings as in most modern tables). In his Faraday lecture of 1889 [2], he said : "It [geometrical analysis] must find the means of representing in a special way not only such long periods as that comprising, K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br but short periods like the following : Na Mg Al Si P S Cl". In fact, he was the spiritual parent of all subsequent two-dimensional 'tables', whether 'short' or 'long'. Chemical students must not be defrauded of half their inheritance.

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[1] Clifford, A. A., *Nature*, **184**, 2012 (1959).
[2] Mendeleef, D. I., "Faraday Lectures 1869–1928", 167 (Chemical Society, 1928).

In comparing my arithmetical table[1] with his adaptation of Mendeleef's short chart, A. A. Clifford[2] states that a Periodic Table must show the variation in the properties of the elements with atomic number. This is an argument against short charts[3], because they fail to retain beyond the third period the continuous variation of properties from active metal to active non-metal. Vertical relationships between the elements are very strong at the extreme right of the arithmetical table ; traversing towards the left they weaken, and when the transitional elements are reached horizontal as well as vertical relationships are apparent ; still farther to the left, horizontal relationships are most marked[4]. Other tables do not exhibit this important change in direction and strength of the chemical relationships.

Some elements are arbitrarily placed in Clifford's table. A column is headed 3*c*, presumably for symmetry, but it contains no element. Whereas lanthanum is placed in a *d* sub-group, subsequent lanthanides are not so located. The first two actinides are placed in *d* sub-groups, but the rest are in *f* sub-groups. These, doubtless dictated by observed spectrographic ground-states, are arbitrary adjustments within the framework of the table. The provision of two $s^1$ and $s^2$ columns in groups 1 and 2 is another arbitrary arrangement.

Clifford's need to choose group 3 as the basis for naming the periods of his table results from the schism that occurs naturally after group 2. This schism is a special feature that distinguishes the arithmetical table from others and follows logically from its mode of construction ; each period ends with group 2 and the orbitals are regularly filled.

Short charts are more compact than long, but this is not serious ground for preference. The rectangularity claimed by Clifford is achieved by providing misleading empty spaces at the right of most of his rows. The arithmetical table differs from most other long charts in that it introduces no meaningless medial gaps[5].

Among Luder's arguments against short charts[3] are that no clear separation of metals from non-metals is possible thereby, and that elements which form colourless and diamagnetic ions are not distinguished from those which give coloured and paramagnetic ions.

If Clifford's closing paragraph implies that historical precedence is a factor, the long chart is preferable because Mendeleef's first scheme is stated to be best classed as such[6]. Many well-known modern textbooks are written around long charts[7] and they can scarcely be regarded as an experiment in new forms, whether or not such is to be discouraged.

Among the more important features of the arithmetical table are the logical and didactic advantages of being based on an arithmetical result of quantum principles, and of having a construction that is described succinctly in about two dozen words ; most tables defy verbal description and their connexion with basic concepts is obscure. From the form of the table follow a rule for writing down the electronic configurations of atoms in the order of increasing orbital energies, algebraic expressions for calculating the period from the atomic number[1] and the atomic numbers of the members of the vertically related elements[4].

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[1] Simmons, L. M., *J. Chem. Educ.*, **25**, 658 (1948).
[2] Clifford, A. A., *Nature*, **184**, 2012 (1959).
[3] Luder, W. F., *J. Chem. Educ.*, **20**, 21 (1943).
[4] Simmons, L. M., *J. Chem. Educ.*, **24**, 588 (1947).
[5] For example, Werner, A., *Ber. deutsch. chem. Ges.*, **38**, 914 (1905). Foster, Laurence S., *J. Chem. Educ.*, **23**, 602 (1946).
[6] Quam, G. N., and Quam, Mary Battell, *J. Chem. Educ.*, **11**, 28 (1934).
[7] For example, Pauling, L., "General Chemistry" (Freeman and Co., San Francisco, 1953). Moeller, Therald, "Inorganic Chemistry" (John Wiley and Sons, Inc., New York, 1952). Sienko, Mitchell J., and Plane, Robert A., "Chemistry" (McGraw-Hill Book Co., Inc., New York, 1957). Cranston, John A., "Rational Approach to Chemical Principles" (Blackie and Son, Ltd., London, 1955). Simmons, L. M., "A Comprehensive Text Book of Inorganic Chemistry" (Wm. Brooks, Sydney, 1957).

In my earlier communication[1] I argued that it was better to use a conventional table, adapted to show electronic configurations, than the unusual and reversed forms that have been proposed[2-4]. I chose the short form as giving the best adaptation, pointing out that chemical resemblances between sub-groups are not to be expected.

The conventional long form, adapted and extended to include the inner transition elements, is set out here in Table 1. It has, to a certain extent, the advantages that Simmons claims[2] in showing the change from vertical to horizontal relationships. It shows less clearly, however, which orbitals are being filled in each period. Another disadvantage is that the positions of elements are dictated by the shape of the table, and this is not always desirable. Lanthanum, for example, is in some ways better shown as a transition element. It has no *f* electrons and it shows chemical similarities to yttrium and scandium, while the rare earth elements resemble it. Actinium and thorium are transition elements, electronically speaking ; further along the actinide series, because of the small energy difference between the 5*f* and 6*d* orbitals, some chemical properties typical of transition elements are shown. While no generally accepted conclusion can be reached about such elements, my original table has alternative positions