LETTERS TO THE EDITORS

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The Social Sciences

AN editorial appeared in *The Times* of March 28 under the heading "Social Surveys", accompanied on the same day by a special article entitled "War-time Social Surveys". It was there suggested that a Social Science Research Council might be set up as a guide to the Government.

In view of recent discussions that have taken place about the establishment of such a Council, certain suggestions there put forward by the writer of the special article seem to call for comment.

Some of the most fruitful experiments in social life as well as in the practice of government spring out of the needs of war-time. No one more than myself will praise the "utilitarian objective" in science. (Incidentally, I note that the word 'science' has dropped out of "Social Science Research Council" and the word "National" has been inserted; surely a significant change.) No one will despise £40,000 annually coming from the Government "for the Advancement of Science". But I do sincerely trust that any Social Science Research Council that may be set up after or during this War will not be a Government-controlled body, but an academic body.

The Economic Advisory Council or its successor is appropriate to meet, under Cabinet control, the Cabinet's need. Politicians and Civil Servants are not generically inspired by the pure desire to know; and the sharp distinction between science and 'business of State', menaced in every direction of modern life, is far more basic in the social than in the physical or medical sciences. This does not mean that an academic Social Science Research Council, enjoying the same independence as the Royal Society, cannot be of immense aid to a Government that refers problems to it for research, in just the same fashion as its counterpart, the American Social Science Research Council has been.

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The Solar Corona

THE difficulties which have so far been experienced in working out a physical theory of the solar corona (*vide* Rosseland, "Theoretical Astrophysics", Chap. 14) have apparently been increased by the discovery of Grotrian and Edlén that many of these lines are due to forbidden transitions of highly stripped atoms of iron and nickel having the constitution $3p^x$ ($x = 1$ to 5), and to calcium atoms having the constitution $2p^x$; thus the line 5303 is produced by an iron ion which has lost as many as thirteen electrons. After learning of this extraordinary discovery from an article by Prof. H. N. Russell in the *Scientific American* of August, 1941, I undertook a critical examination of the available spectroscopic data, and can confirm that the claim is a sound one.

Prof. Russell has pointed out that the solar corona apparently shows a predominance of the very same elements which are found prominently in iron-meteors, but to me the coincidence appears to be only fortuitous. From extant observations we can draw a fairly safe conclusion that the lines cannot be due to large-scale meteor flashes; but the stripped atoms responsible for the lines are streaming outwards with high velocities. This conclusion follows (1) from the work of Lyot[1] (1937) that the breadth of the coronal lines, which is unusually large for a temperature of 6,000°, *increases* as we approach the solar limb; (2) from the work of Waldemeier[2] (1938), in which it is shown that the great breadth of the coronal lines may be explained as being due to radial streaming of particles, and the greater the breadth, the greater is the velocity. In the inner corona, the velocity is reduced to nearly 60 km./sec., but it must be much larger in the chromosphere, and in the reversing layer, where as will be shown presently, the particles originate.

If these conclusions are granted, we have next to find out what physical processes give rise to such highly stripped atoms and send them through the solar envelope with such tremendous velocities. It is obvious that we have to exclude thermal or photo-electric ionization and generally all extra-nuclear processes.

The only plausible hypothesis appears to be that these highly stripped atoms are produced in a nuclear reaction, analogous to uranium fission, occurring somewhere inside the reversing layer. It is known from investigations on uranium fission that the fission fragments separate from each other with energies of the order of 80 Mev. corresponding to a velocity of 6–8 cf, where c is the velocity of light, f is the Sommerfeld fine-structure constant (cf is the velocity of the electron in the first H-orbit). These fission fragments are known from experiments by Böggild, Lauritsen and others[3] (1942) at Prof. Bohr's laboratory at Copenhagen to be endowed with a high net positive charge at the moment of their production; in fact, they are found to have lost all those outer electrons the orbital velocities of which are inferior to their own velocity of separation (6–8 cf). An iron atom which retains only 10 electrons, namely, $Fe^+ 1s^2 . 2s^2 . 2p^6 . . .$ should have a velocityof $6{\cdot}5\,cf$ at the moment of its production and hence its energy should be 60 Mev. There is one difficulty in this hypothesis. So far only ^{238}U, ^{235}U, ^{232}Th and ^{231}Pa have been shown to be capable of fission (Bohr and Wheeler[4], 1939), and experimentally fission into two fragments only has so far been demonstrated. But this difficulty is not insuperable; on energetic grounds, fission into a larger number of fractions, say three or four, is possible. As for the presence of the fission elements in the sun, their spectra is so complex that no serious attempt at identification has yet been undertaken.

In any event, the presence of Fe^{+13} or Ni^{+15} moving through the solar envelope with large velocities is a demonstrated fact, and one can calculate the range and electron exchange of these particles. If we make the reasonable hypothesis that the iron ions start at the moment of their production as $Fe^{+16}\,1s^2 . 2s^2 . 2p^6$, they would have an initial velocity of $6{\cdot}5\,cf$. Their career through the solar atmosphere is analogous to that of α-particles, or better of fission fragments, through the cloud chamber. They would be losing energy all the way because they ionize the solar atoms with which they come into contact according to the process known as ionization by collision. The solar atoms from which α-rays are expelled may be supposed to be mostly hydrogen atoms, and on reasonable assumptions, the range comes to about 10^{21} hydrogen atoms. The particles must, therefore, originate inside the reversing layer.