many points of wide philological interest; to mention only two: the existence of the most complex ablaut-system known (in Lappish) and the valuable evidence for the earliest Indo-European history afforded by the loan-words of Finno-Ugrian and Samoyede.

ALAN S. C. ROSS.

The University,
Leeds.
May 15.

Illustration by Analogy

AT the recent British Association conference more attention was given to agencies (Press, B.B.C., etc.) for 'getting science across' to the ordinary citizen than to the mental technique. An outstanding technique is illustration by analogy (Jeans and Eddington in theoretical physics and the late Alfred Marshall and recently Miss Scott in economics). Instances are afforded by the likening of an atom (or electron) to a railway system, solar system and organism (de Broglie), of economic elasticity to mechanical elasticity, of economic laws to tidal law in an estuary, and of the bankers' loan and reserve system to the cyclic juggling of five oranges with both hands. Such comparisons are often effective and exact; but it is desirable that the authors, in writing, and the reader, in reading, should be clear as to what precisely is being asserted and should not fall into the intuitive trap of assuming either too much or too little.

The results of my recent work on analogy in science and language seem particularly relevant in the above connexion and possibly useful as a guide. It can be shown that all analogy is, or may be regarded as, the outcome of diverse things interacting to produce the same or similar effect or result, the result being a single property (if the *reactants*, or *analogues*, have common properties these will be connected with producing the effect); (2) analogy is the source of all substitutes and substituting. It is (2) which is especially relevant to illustration by analogy.

It will be best to take as illustrations 'analogies' somewhat simpler than those referred to above. A well-known elementary *illustrative* analogy in physics is that between a 'one-way' hydraulic system and a 'one-way' dynamo-generator current system. The operational *effect* of the two valves in the pump is identical with that of the divided ring of the commutator. A *scientific* analogy is the 'displacement' produced by the action of mechanical force on a spiral spring and of electric force on a dielectric or conductor. Another with different logical properties is the effect of strychnine on a rabbit and mercuric chloride on a man.

In all three cases we are able to illustrate the same *effect* or action by substituting one set for another. All that one does in 'popularizing' science is to choose the more familiar. It will be noted that the analogous sets or systems themselves differ in respect of substitution or rather partial substitution. The valves cannot be substituted for the commutator, but the strychnine can be substituted for the mercuric chloride at least if the maximum ultimate effect is required; so also can the rabbit and man (without interchanging the poisons).

It should be noted that logically scientific analogies, similes and parables are indistinguishable, and both may be equally true. The difference lies in the importance of the identities to the science or sciences concerned, which *partly* depends on their not being fortuitous and on their being exact', especially mathematically. (*Use* is the chief factor.)

When we view two analogous sets or empirical systems statically or 'structurally' we may write:

$$\lambda\,(\alpha \longrightarrow \beta)$$
$$x_1 \ldots . x_n \quad y_1 \ldots . y_n$$

(or $x_1 \rightarrow x_2 \rightarrow \ldots . x_n$, $y_1 \rightarrow y_2 \rightarrow \ldots . y_n$ if homologous series).

For the dynamic or operational view, we may write for two reactants:

$$(x_1)\, x_2 \ldots . x_n \searrow E \qquad \text{or} \qquad (x_1)\, x_2 \searrow \quad E$$
$$(y_1)\, y_2 \ldots . x_n \nearrow \equiv \lambda \qquad\qquad (y_1)\, y_2 \nearrow \equiv \lambda$$

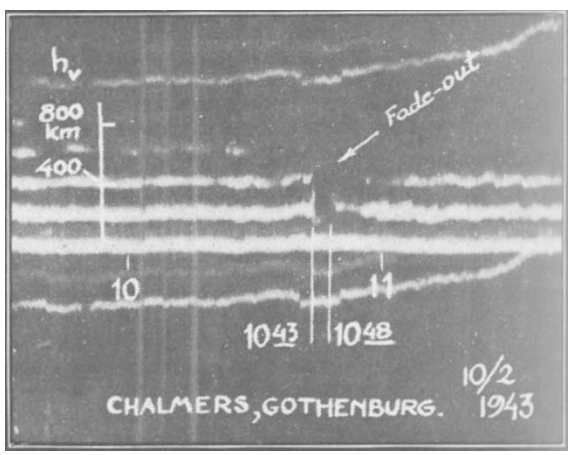
(as in the case of simple isomorphy in the theory of groups). The differences between the x's (and between the y's) vary according to the nature of the sets or systems.

W. R. DUNLOP.

1 Binsey Lane, Oxford.
April 28.

Radio Fade-Out in Sweden

ON February 10, 1943, the Prague Observatory reported strong, brilliant sunspot eruptions. On the same day, the Chalmers Ionospheric Observatory registered a radio fade-out between 10.43 and 10.48 local time as shown by the recording. The frequency used was 2·93 Mp./s. It is interesting to note that an oblique incidence double pulse (from a distant sender) was recorded at the same time, as shown by the lowest pattern. During the fade-out, starting and ending before and after it, the recorded double



pulse was apparently reflected from the region of abnormal ionization below the regularly reflecting layer. Finally, it should be remarked that the magnetograms showed no conspicuous change at the time of the fade-out.

In order to find out whether the fade-out had any connexion with the sunspots or not, the Chalmers Observatory would like to receive observations from other observatories in the sun-lit hemisphere.

O. E. H. RYDBECK.

Chalmers Institute of Technology,
Gothenburg.