rections along the c-axis, as in the ideal structure (structure A, Fig. 2), or in the same direction (structure B, Fig. 2), without appreciably changing the environment of any atom. Hence, the two structures must be energetically nearly equivalent. As a result, in actual crystals of rutherfordine, faults occur in the stacking of the layers; regions in which the sequence of layers corresponds to structure A are occasionally terminated by regions in which the layers follow the sequence of structure B. There is evidence that the degree of disorder may differ significantly from crystal to crystal, perhaps as a function of the age of the crystals. This situation has not yet been completely analyzed.

References and Notes

1. Publication of this paper was authorized by the director of the U.S. Geological Survey. This work was completed as part of a program undertaken by the U.S. Geological Survey on behalf of the Division of Raw Materials of the U.S. Atomic Energy Commission. We are indebted to Clifford Frondel of Harvard University for the mineral specimen from which the crystals of rutherfordine were obtained. A detailed discussion of the structure of rutherfordine, particularly of the nature of the disorder and its mineralogical implications is in preparation.
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15 December 1954.

Communications

Big Business and Research

R. W. Lippman has made a comment [*Science* **120**, 1036 (1954)] about big business and scientific research that runs counter to my own experience. I think it creates, moreover, a rather false notion of the way many business corporations look on the role of basic science in today's world. Lippman states that anyone who has tried to find money for basic research from business organizations knows the difficulties. He states that even what business calls basic research is not that but, rather, something of limited scope and usually directed toward the solution of a specific project in which the company has a direct business interest.

It is true that responsible officers of large corporations often feel that their support of basic scientific research must be directed toward something with relevance to the operations of the company. But this does not mean that such officers seek to impose limitations on the nature of the research, its directions, or its outcome. Moreover, there is a fast-growing tendency for the managements of many large corporations to make very liberal interpretations of the interests of the companies in judging what is proper for them to support.

Our observatory has just completed the construction of a new solar laboratory made possible by some 37 nongovernment donors. The building will be used for fundamental research in solar astronomy. No specific company will gain direct benefit from our research, although the welfare of the nation as a whole will be advanced. No "practical" goals have been set for our study, and no conditions of any sort have been imposed by any donor. I have just made a quick count, and, of the 37 contributors, 11 were corporations, six of which are definitely in the category of "big business." In addition, at least nine contributions were made by individuals who were primarily businessmen. Moreover, seven additional contributions were given by foundations established by men who had made their fortunes in business.

Naturally we expect that our basic research will have widespread practical application and, thus, will materially benefit a wide variety of interests. But no individual company can expect to be preferentially aided. The support so generously given is for basic research—and the fact that such support is available is an evidence, to my mind, of the sound insight of these business executives into the role of fundamental science in modern life.

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14 January 1955.

Influence of Humic Acids on Plant Growth

Recently attention has been paid to the ferric chelate of ethylenediamine tetraacetic acid (EDTA) as a source of iron for plants in nutrient culture (*1*) and for chlorotic fruit trees (*2*). Evidence that the FeEDTA molecule was absorbed and translocated as a whole was provided by supplying FeEDTA containing isotopically labeled nitrogen, whereupon it was found that the amounts of iron and isotopic nitrogen reaching the leaves were in stoichiometric agreement (*3*).

In recently described experimental work (*4*) in which the roots of a sunflower plant were divided so as to absorb nutrients from two containers, it was demonstrated that the plant grew healthily if EDTA was supplied to one compartment and iron and phosphate to the other, whereas the plants became chlorotic if EDTA was omitted.

In our earlier work (*5*) we showed that the growth-promoting effect of a lignite was the result not of its trace-element content but of humic substances that made iron in the nutrient solution readily available (*6*), even in the presence of high phosphate. Iron chlorotic plants were found to have high concentrations of iron in the roots, probably immobilized as

complex ferric phosphates. This indicated that the effect of humic acids was not merely an ion exchange at the root surface, but that the translocation of iron to the leaves was being promoted. This could be demonstrated by a split-root technique, and experiments with tomatoes were in progress when the afore-mentioned report (*4*) appeared. Our results are therefore briefly presented here (*7*).

We have been able to confirm that EDTA, absorbed by the roots in one compartment, caused translocation to the leaves of iron supplied in the presence of high phosphate from the roots of the other compartment. Within 1 mo about two-thirds of the EDTA supplied had disappeared.

If a water extract of peat was used instead of EDTA the plants grew equally healthily. Humuslike substances synthesized from "A.R." sucrose (*8*) were equally effective in preventing iron chlorosis. The plants became chlorotic if the humic water was withdrawn.

A ratio of phosphorus to iron in healthy leaf cells varies within narrow limits, chlorotic leaves having either high (iron deficiency) or low (iron toxicity) ratios (*5*). If ferric chloride was supplied to one compartment and phosphate to another, the plants continued to grow healthily. It would appear that it is the level of soluble iron in the cells of the root that determines how much iron will be translocated to the leaf. A more detailed description of these experiments is in preparation.

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10 January 1955.

Improved Adhesion and Visibility of Cytologic Preparations by Use of the Frosted Glass Slide

Frosted glass may be used to good advantage as an aid in the adhesion of material to a glass slide in the preparation of various types of nonmucoid fluids and secretions for microscopic study. The slide discussed here is frosted or etched on the entire surface of one or both sides and is referred to as the *frosted glass slide* [U.S. Pat. pending].

During the process of staining cellular material spread over a conventional type of slide (only one side frosted on one end for easy marking purposes),

Fig. 1. (Left) Unmounted slide showing material smeared on both frosted and clear surfaces. (Right) Same slide when mounted with a cover glass.

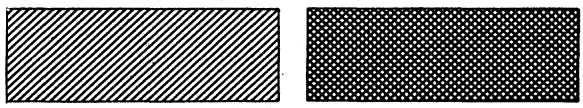

Fig. 2. (Left) Slide frosted on one surface. (Right) Slide frosted on both surfaces.

it was observed that, where the specimen partially covered the label end or frosted surface, it appeared more intense than on the clear surface. There was a distinct difference in the two areas, the line of change occurring at the boundary of the frosted edge. It was apparent that the material adhered more readily to the area of frosted glass than to the clear surface (Fig 1, left). After mounting (Fig. 1, right), the frosted glass was observed to be completely clear in the area of contact with the mounting medium.

These observations led to testing and then to use of the frosted glass slide for cytologic and histologic preparations. It was also found useful in bacteriologic, hematologic, and other laboratory studies. Experiments were performed using slides frosted from end to end on one or both surfaces and varying in degrees of grain (Fig. 2).

Frosted glass comparable to a 150-emery grain has proved most satisfactory for routine cytologic and histologic procedures; however, variations ranging from 120- to 170-emery grain may be used for the other preparations mentioned in the foregoing paragraph.

Principle A: adhesion of material. Cells, bacteria, and other inclusions found in body fluids and secretions adhere more readily to a frosted or etched glass surface than to a smooth one. One of the most serious problems in the cytology laboratory today is that of preparing smears to meet the cytologist's requirements for giving an accurate interpretation. Since many specimens encountered are nonmucoid, there is always the problem of a certain loss of important material. Routine staining procedures require much washing, which results in considerable loss of material, regardless of the amount of caution taken during processing.

Such substances as egg albumin are now being used for adhesive purposes. However, use of the frosted glass slide eliminates the need for such adhesive substances, which often obscure the important detail, especially in the examination of watery-type specimens. The slide frosted on one side is suggested for routine use (Fig. 2, left, 150-emery grain).

Principle B: diffusion of light. Frosted glass diffuses the light coming through the microscope and thus cuts down the glare and reduces eye fatigue. This is accomplished when the frosted surface is on the