Since most previous studies used samples taken over a short time, we compared rates of fetal movement recorded automatically with the 4-hour samples and daily rates. In all cases, samples ranging from 30 to 200 minutes were not representative of the daily rates. The 4-hour samples were closest to the daily rates. There did not appear to be any systematic relationship between the mother's activity and changes in daily rates, 4-hour rates, or automatically recorded rates of fetal movement.

Because the mother's report was commonly used in earlier studies, we assessed the accuracy of such reporting by having each mother estimate how many movements had occurred during automatic recording either at home or in the laboratory. Even the most accurate mother had greater than 10 percent error in 57 percent of her estimates. The similarity in behavior of all fetuses is evidence that a direct and continuous account of fetal development is possible with our method.

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Economic Meaning of a Labor Shortage

Keynes pointed out that in a laissez-faire economy geared to a high level of investment spending, population growth, via its effect on investment, might be an important factor in maintaining prosperity. He also showed, however, that fiscal and monetary policy could be used to counteract fluctuations in private investment and thus maintain a generally high level of income and employment whatever might be happening to population growth.

Now a new concern is being voiced: Without population growth, crippling labor shortages may develop. According to Boffey's report (*1*) on Japan's Population Problems Inquiry Council, "the recommendations are aimed at alleviating some potentially serious economic and social problems that are related, at least in part, to Japan's success in curbing its population growth. One such problem is a worsening labor shortage that threatens to undermine Japan's 'economic miracle' . . ." It might seem that the relation between population growth and labor shortage is a simple one: Rapid growth assures an abundance of labor; slow—or negative—growth creates a shortage. Actually, the relation is more complicated.

In the "short-run," Keynesian sense, a shortage—or surplus—of labor is a result of the relation between aggregate demand and aggregate supply in the economy. Since aggregate demand can be altered by appropriate fiscal and monetary measures, it follows that we can always create, or relieve, a labor shortage. Recent U.S. history provides an interesting example: From 1957 to 1963 the growth of the labor force was relatively slow (800,000 per year), while labor was relatively abundant (unemployment averaged 6 percent). Since 1965, labor force growth has been much larger (1,600,000 per year), but until quite recently the labor market has been unusually tight (3.7 percent average unemployment). Now, in the interest of combating inflation, the Administration is using fiscal and monetary policy to create a bit more of a labor surplus.

"Labor shortage" can also be used in a "long-run," or structural, sense. Instead of the relation between aggregate demand and aggregate supply, what is involved in this concept is the relation between the supply of labor and the supply of capital. If capital is growing rapidly, while labor is growing slowly, or not at all, labor will be scarce and wages will rise more rapidly than would otherwise be the case. It should be obvious that in this sense a shortage of labor is the same as an abundance of capital. Surely no democratic government, if it understood clearly what it was doing, would attempt to keep capital from becoming more abundant relative to labor.

That a shortage of labor is nonetheless looked on as a threat to a nation's economic health is the result no doubt of a failure to distinguish between per capita and overall expansion. It is true, of course, that Japan's total gross national product (GNP) can expand faster if the labor force grows than if it does not. But aside from military considerations—themselves of dubious validity in a nuclear age—the objective of policy should be expansion of per capita not of total GNP. And per capita GNP will be higher, generally speaking, the larger the amount of capital there is for each person to work with. The case for considering per capita rather than total GNP is especially strong in a country like Japan where overcrowding is already acute and where the negative effects of expansion on the quality of life, which are not included in the conventional measure of GNP, are in consequence especially large.

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Interference in the Lowry Method for Protein Determination

In view of the widespread use of the Lowry method for determination of proteins (*1*) and the increasing popularity of Good's buffers (*2*), we feel that certain incompatibilities between the two should be recorded. In the Lowry reaction, some of the commercially available buffers and some analogous compounds give color in the absence of protein; among them are (*3*) HEPPS, HEPES, and Bicine, and to a much lesser degree BES, PIPES, ADA, ACES, MOPS, glycine amide, TAPS, and CAPS. This color has the same absorption spectrum as the color produced by protein. Five micromoles of HEPES is equivalent to 300 micrograms of bovine plasma albumin.

Some of the buffers, in addition to giving color, prevent the formation of the normal amount of color by proteins, for example ADA, Tris, Tricine, and TAPS. The buffers MES (pK_a at

20°C, 6.15) and TES (pK_a at 20°C, 7.5) are innocuous, at least to a level of 50 micromoles in the usual assay (*1*). Dr. Good informs us that the interference in the case of Tricine is probably due to competition for the copper in the assay, and that the depressed values can be restored by increasing the concentration of copper. In any case a standard protein curve should be established in the presence of appropriate amounts of buffer when these compounds are used.

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Direct Oxidation by Adsorbed Oxygen during Acidic Mine Drainage

In a report on acidic mine drainage, Singer and Stumm state that the rate-determining step in oxidation of iron pyrite is the oxidation of ferrous iron (*1*). The resulting ferric ions are the oxidizing agent for pyrite. The authors dismiss the oxygenation, or direct oxidation by adsorbed oxygen, as insignificant in natural environments.

At Ohio State University kinetic studies of both pyrite oxidation modes, that is, oxygenation and ferric ion oxidation, have shown that the rates are independent and that either can be the major contributor to acidic mine drainage formation. The work at Ohio State University also specifies conditions at the reaction site which determine the reaction regime. It was found that the rate-determining mechanism in most acidic mine drainage sources is the oxygenation rate—not the rate of ferrous ion oxidation, and, in any natural environment, oxygenation rate is significant.

Singer and Stumm have based their conclusions on data obtained from "museum grade" pyrite rather than from the naturally occurring pyritic material (sulfur ball) found in coal measures. For particles of the same mesh size, the surface area and adsorption characteristics of the two types of materials differ greatly. For example, under conditions of high catalytic activity that maximize the rate of ferrous ion oxidation, the ratio of ferric ion oxidation rate to oxygenation rate for museum grade pyrite is 200. Under the same conditions this ratio for sulfur ball material is less than 4.

In addition, ferrous ion oxidation in acidic mine waters is a microbiologically catalyzed solution reaction whose rate is proportional to the number of bacterial cells present. Oxygenation however is a heterogeneous reaction dependent upon the exposed pyrite surface area. Use of museum grade pyrite having relatively small surface area and adsorptive capacity in relation to the volume of water to which it is exposed will reduce the heterogeneous reaction rate to comparative insignificance. The museum grade, oxidation system used by Singer and Stumm, in which the ratio of pyrite surface to volume of water is much lower than at natural pyrite oxidation sites, has lead them to the erroneous conclusion that oxygenation rates are negligible. In a natural environment the oxygenation rate is always significant and, we believe, more important than ferric ion oxidation in the majority of mine drainage problems due to natural limitations on the rate and extent of microbial activity near the reacting pyrite surface.

Therefore their suggestion for abatement of acidic mine drainage, that is, the inhibition of the catalytic oxidation of ferrous ions, is not appropriate. Efforts in this direction can at best reduce the rate of formation in some cases, but they will have negligible effect in many natural situations.

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The primary objective of our study was to isolate the specific individual chemical reactions which lead to the formation of acidic mine drainage and to characterize the kinetics of these specific reactions. In order to control the variables, crystalline pyrite was used. This is the same pyrite which is present in "sulfur ball" and coal seams, as determined by x-ray analyses. Previous studies, including those performed at Ohio State University, have failed to isolate the individual component reactions. The oxygenation of iron pyrite, as investigated by Smith and Shumate, leads not only to the formation of sulfuric acid but also to release of soluble ferrous iron. Subsequent oxygenation of the ferrous iron yields ferric iron, causing the residual pyrite to be subject to both direct oxygenation and indirect oxidation by ferric iron. Pyrite oxidation by oxygen and ferric iron have not been proved to be independent modes.

In spite of the fact that the crystalline pyrite has a relatively small surface area and adsorptive capacity in relation to the volume of water to which it is exposed, the heterogeneous oxidation by aqueous ferric iron still proved to be extremely rapid. (We observed half times of approximately 50 minutes.) Similar studies with crystalline pyrite exposed to oxygen in the absence of externally added ferric iron showed a negligible change in acidity even after 7 days.

Recent studies (*1*) in our laboratory have shown that, either in the presence of bacteria or under sterile conditions, the rate of oxidation of pyrite is independent of the surface area of pyrite. On this basis, the oxygenation of pyrite must proceed through the ferrous-ferric indirect mechanism, with the oxygenation of ferrous iron serving as the rate-limiting reaction.

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