mitochondria are the enzymatic sites of intense glycolytic activity and also the view (*3, 7*) that hormonal regulation of glucose phosphorylation in living cells takes place at the mitochondrial level of organization.

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2a. *Note added in proof*: Since this article was submitted for publication, essentially the same results have been obtained in chemically defined media containing larger amounts of ATP. Details of these experiments are in preparation.

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Analysis of Standard Granite and Standard Diabase for Trace Elements

The standard granite (sample G-1) and the standard diabase (sample W-1) have been used as interlaboratory calibration standards for analysis for major constituents of silicate rocks (*1*). In the course of this study, three sets of spectrochemical analyses of the trace elements were performed by R. L. Mitchell, K. J. Murata, and L. G. Gorfinkle and L. H. Ahrens. Partial trace-element analyses have been subsequently reported by other authors (*2*). The techniques used were neutron activation, stable-isotope dilution, and spectrochemical analysis.

Most of the trace-element data reported for standard granite and standard diabase have been obtained by direct-current-arc spectrochemical procedures. Although these techniques can give results reproducible to better than ± 5 percent, the accuracy is frequently off by as much as a factor of 2, because of large matrix effects, selective volatility of the elements, and so forth. The analyses reported here were performed by x-ray fluorescence techniques. The elements determined were copper, nickel, rubidium, zinc, strontium, zirconium, and manganese. The results are shown in Table 1, where they are recorded as parts per million (ppm).

X-ray fluorescence methods offer the advantages of excellent reproducibility and an exact method of accounting for matrix effects. The analyses were made with a North American Phillips x-ray fluorescence unit, using a tungsten target x-ray tube, a scintillation detector, and a helium atmosphere. Standards consisted of oxides of the elements in an aluminum oxide matrix. Selenium was used as the internal standard for elements below the absorption edge of iron (Zr, Sr, Rb, Zn, Cu, and Ni). The titanium already present in samples G-1 (1500 ppm) and W-1 (6530 ppm) was used as the internal standard for manganese.

The precision of the determinations of elements with concentrations higher than 25 ppm averaged ± 5 percent; the precision for elements with concentrations below 25 ppm averaged ± 10 percent. With the proper selection of an internal standard, the absorption corrections for the matrix should be accurate within a few percent. Therefore, the accuracy of the determinations reported here should lie within the combined errors of sample preparation, precision of counting, and the error of the matrix. The accuracy of the determinations for elements with concentrations greater than 25 ppm should be about ± 10 percent; for those below 25 ppm, about ± 15 percent. However, the accuracy of the Cu determinations is probably not this good because the CuKα radiation is partially interfered with by WLα_1 radiation originating from the x-ray tube, making a background correction difficult.

Since samples G-1 and W-1 are to be used by many laboratories as calibration samples for future analyses, every effort should be made to determine the trace elements in the best possible manner. Most trace-element analyses thus far have been performed by the frequently inaccurate spectrographic technique. This report is an attempt to contribute more accurate information on the trace elements in these important standards.

Table 1. Results of trace-element analysis of the standard granite (sample G-1) and standard diabase (sample W-1).

Element	Concentration (ppm) G-1	Concentration (ppm) W-1
Manganese	212	1400
Nickel	3	68
Copper	18	171
Zinc	26	78
Rubidium	248	25
Strontium	263	197
Zirconium	268	94

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Gravity Shields

In a recent paper D. C. Peaslee pointed out that so-called "antiparticles"—that is, particles that are related to normal particles by the *charge conjugation* operator of quantum theory—have positive mass and, hence, would be useless for employment in gravity shields (*1*). This argument is, of course, unexceptionable; however, it does not exclude the possibility of elementary particles with negative mass (whose antiparticles would possess negative mass as well), although such particles have not yet been discovered. There are some arguments tending to indicate that such particles may not be capable of existence at all (Pauli's derivation of the connection between spin and statistics), but they are not yet to be regarded as conclusive. In this contribution (*2*), I should like to describe briefly the behavior pattern of such particles if they should exist; I shall also demonstrate that such particles would be of very dubious value in "gravity shields."

For a particle of negative mass, according to Newton's second law ($f = ma$), force and acceleration point in opposite directions. Particles having masses of the same sign will attract each other gravitationally—that is, the *forces* will point toward each other—whereas particles of opposite masses will repel each other. Hence, all *accelerations* of particles of whatever mass will point toward particles of positive mass and away from particles of negative masses. If two particles having masses of opposite sign and equal magnitude act on each other purely gravitationally, then the particle of negative mass will chase the particle of positive mass, both their accelerations pointing in the same direction.

Let us now consider a particle of negative mass which also carries an electric charge. Under the influence of an applied electromagnetic field, such a particle will move according to the value of e/m—that is to say, a particle of negative