It is difficult to decide to what extent the presence of filaments is responsible for the broad transitions below 0.7°K. Furthermore, the presence of filaments cannot convincingly explain the observed (*3*) pressure dependence of T_c above 1.3°K. However, no such difficulty exists with the present model, which suggests that the broadening of the transition below 0.7°K might equally well be due to the presence of an inhomogeneous strain field. The development of this strain throughout part of the sample is unavoidable during the cooling of polycrystalline material because of the highly anisotropic nature of the thermal expansion below 43°K. A crude estimate of the maximum internal pressure developed can be made from a consideration of the measured volume increase (0.27 percent) of a single crystal between 50°K and 4.2°K (*7*). If we assume that the total volume increase is effective in producing the internal pressure, with a compressibility of 9×10^{-7} bar^{-1}, the pressure developed is expected to be of the order of 3 kb. Such a pressure would be sufficient to account for the difference in the superconducting transitions of single-crystal and polycrystalline material. It would seem that such pressures are easily generated at grain boundaries since other uranium samples prepared by the grain-coarsening technique, but containing more than one single-crystal grain, have broad transitions similar to those reported by Hein, Henry, and Wolcott (*2*).

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11. The model offered here is patterned after that suggested for plutonium (*10*), which is as follows: (i) The γ-to-δ transition involves the demotion of about 0.2 electron from the valence band to the *5f* level; (ii) the gradual promotion of 0.1 electron from the *5f* level to the valence band in the δ ranges, and (iii) a promotion of an additional 0.1 electron from the *5f* level to the valence band associated with the δ'-to-γ transition.
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14. See, for example, A. W. Lawson and T. Tang, *Phys. Rev.* **76** 301 (1949); P. W. Bridgman, *The Physics of High Pressures* (G. Bell, London, 1949); A. I. Likhter, Yu. N. Ryabinin, L. F. Vereshchagin, *Soviet Phys. JETP English Transl.* **6**, 469 (1958); R. Herman and C. A. Swenson, *J. Chem. Phys.* **29**, 398 (1958); E. G. Ponyatovski, *Soviet Phys. "Doklady" English Transl.* **3**, 498 (1958).
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16. We thank W. E. Gardner, H. J. Williams, and G. Knapp for providing us with the unpublished results on magnetic susceptibility which indicate very little temperature dependence below room temperature and, in in particular, no unusual behavior in α-uranium below 43°K.
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18. For example, high-purity polycrystalline α-uranium, when measured by the Schawlow-Devlin technique [A. L. Schawlow and G. E. Devlin, *Phys. Rev.* **113**, 120 (1959)] at 16 kcy/sec, a method which is particularly sensitive to filaments, showed very broad superconducting transitions above 0.8°K. The exact temperature depended on the metallurgical history; transitions beginning as high as 1.7°K were obtained for samples quenched in the arc furnace. The same samples measured by the ballistic or low-frequency ($\sim$22 cy/sec) methods, which are less sensitive to the presence of filaments, had transitions which were just as broad ($\sim$ 0.5°K) but were usually a few tenths of a degree lower. It was possible to break up some of the filaments by filing the bulk polycrystalline material. The measurements at 16 kcy/sec of the filings then indicated transitions from 0.3° to 0.7°K only, and the ballistic measurements transitions from $\sim$ 0.15° to 0.55°K. By a special annealing procedure (for which we thank J. P. Remeika) of cooling a bulk sample through the β-α transition in a temperature gradient at a rate of 0.75°K per hour, it was possible to obtain in the bulk the same superconducting results with both the 16-kcy/sec and ballistic measurements as for the filings.
19. We thank a number of our colleagues for helpful discussions, particularly A. M. Clogston, Mrs. V. B. Compton, W. E. Gardner, W. M. Lomer, and N. E. Phillips; and G. W. Hull, Jr. for help with the superconductivity measurements. Work at Argonne National Laboratory supported by AEC. Work at La Jolla supported in part by U.S. Air Force Office of Scientific Research.

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Contact Photomicrography in the Ultraviolet on High-Resolution Plates

Abstract. *Ultraviolet photographs of cells can be made without quartz optics by placing the cells on high-resolution plates capable of resolving more than 2000 lines per millimeter and by passing monochromatic radiation of the desired wavelength through them to the emulsion. Prints can be made by enlarging the resulting negative with a microscope to the magnification desired.*

Kodak high-resolution plates, originally marketed for microphotography (*1*), proved usable for contact photomicrography with 2300- to 3650-angstrom radiation. Thus, minute biological subjects, tissue cultures, or thin sections can be photographed in the ultraviolet without recourse to quartz microscope lenses (*2*). The properties of the plates that make contact photomicrography possible with intense radiation are: (i) extremely high resolution, at least 2000 lines per millimeter, sufficient to permit enlargement of the negative 1000 times with minimum or no grain notable in prints or lantern slides; (ii) very slow speed (the ASA rating is currently 0.003); (iii) extreme contrast; and (iv) thin emulsion that obviates scattering of light in the emulsion plane.

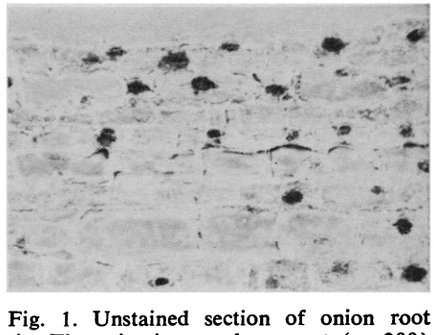

Fig. 1. Unstained section of onion root tip. The print is an enlargement (× 200) from a contact negative made with 2600-angstrom monochromatic radiation. Absorbance by nuclei is clearly shown.

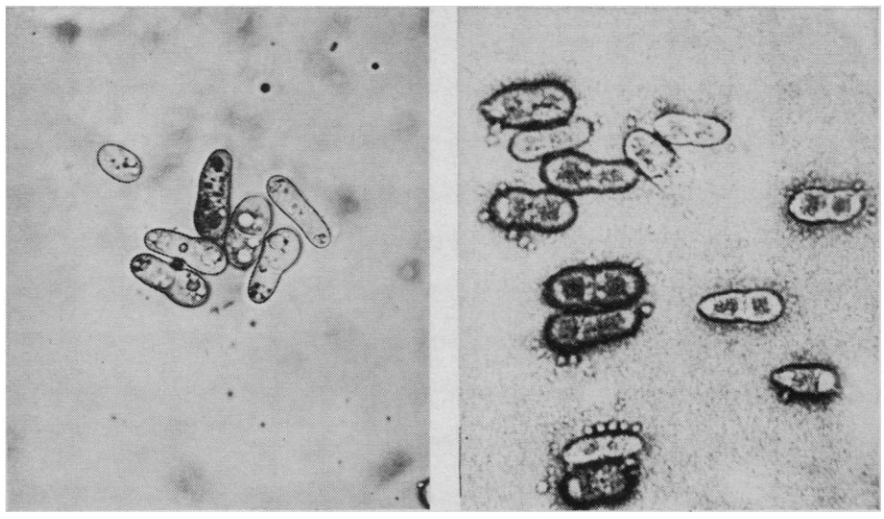

Fig. 2. *Ascochyta conidia* photographed in aqueous mounts. (Left) Photomicrograph (× 1000) made with blue light. This is a contact print from the negative. Note sharply defined cell walls and gutulae conspicuously revealed by blue light. (Right) The print is an enlargement (× 1000) from a contact negative made with 2600-angstrom monochromatic radiation. Note absorbance in areas where nucleic acids presumably occur, wide cell wall bands due to lens effect of curved edges of conidia, and substances extruded from cells. The nature of the substances revealed by this photograph has not been determined.

Negatives are made by placing objects on plates the same size as microscope slides (2.5 by 7.5 cm) and by exposing them to monochromatic ultraviolet radiation. The resulting negatives are printed to the size desired with appropriate microscope lenses. The requirements for critical images of cells and their contents are as follows. (i) The rays must be collimated before they strike the object. (ii) The subject must not be of such shape and composition that it itself functions as a lens. For example, starch grains on the surface of the emulsion function as little lenses and produce "hot spots" that do not resemble starch grains. (iii) Resolution is directly proportional to the closeness of the object, or part of the object, to the emulsion and inversely proportional to the wavelength of light. Depth of field, expressed as a function of usable magnification, is, however, far greater than can be obtained with microscope optics. Fortunately, this is especially true in the ultraviolet region, from 2300 to 3000 angstroms, where critical focus with quartz optics is difficult and time-consuming. There are no focus problems whatever in this approach to ultraviolet photomicrography. Tissues, blood smears, thin masses of cells, and other materials can be placed on a plate and exposed to monochromatic light; then the plate can be developed and a permanent record of absorbance phenomena in literally thousands of cells can be made in less than 10 minutes.

We make negatives in the ultraviolet with a 250-mm Bausch and Lomb diffraction grating monochromator, illuminated with a 900-watt xenon lamp, and a bandwidth of 60 angstroms. The high-resolution plates are mounted at the focal point of the light beam and a camera shutter is mounted near the exit lens. A metal shield with a 4- by 15-mm slit is placed in front of the emulsion to reduce scattering of light. Exposures average around 1/50 second at 2600 angstroms when the plates are developed as recommended by the manufacturer (*3*). Figures 1 and 2 show examples of the technique.

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References and Notes

1. Trial of high-resolution plates for photomicrography was suggested to us by Malcolm M. McWhorter of Stanford University, who had used them for making microelectronic circuits.
2. The utility of high-resolution plates for contact photomicrography with visible light was described at the symposium of the Biological Photographic Association at the University of Washington in Seattle, on 7 March 1965. This method of photomicrography should not be confused with anatomical analysis by microradiography, a process that does not require ultrafine-grain emulsions.
3. A discussion of the preparation of objects for exposure and of special methods of development is in preparation.

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Microorganisms Three Billion Years Old from the Precambrian of South Africa

Abstract. *A minute, bacterium-like, rod-shaped organism,* Eobacterium isolatum, *has been found organically and structurally preserved in black chert from the Fig Tree Series (3.1 × 10⁹ years old) of South Africa. Filamentous organic structures of probable biological origin, and complex alkanes, which apparently contain small amounts of the isoprenoid hydrocarbons pristane and phytane, are also indigenous to this Early Precambrian sediment. These organic remnants comprise the oldest known evidence of biological organization in the geologic record.*

During the past decade, and particularly within the past few years, there has developed a marked revival of interest in the classical problem of the antiquity of life on earth. Although parallel to a current expansion of interest in theoretical and experimental approaches to the origin of living systems, paleobiological research on the antiquity of life is developing within a geological and geochronological framework which is unique in the history of paleontology. To a great extent this derives from a firmly based and fast-growing body of data on the radiogenic age of the earth and, in particular, on the age of its Precambrian sedimentary rock systems. The application of electron microscopy to organic sediments, moreover, has made it possible to transcend the limits of optical microscopy in observing minute objects of possible biological origin. In addition, development of analytical instruments for the detection and characterization of organic compounds in sediments provides refined techniques for the detection of correlative evidence of past biological systems.

We now report results of the application of optical and electron microscopy to sediments exceeding 3000 million (3×10^9) years in age. The sediments are organic-rich black cherts, interpreted as primary chemical precipitates, in which are found discrete microfossils of bacterium-like size and form, as well as larger remnants of partially organized organic matter. Unpublished results of organic geochemical analyses establish that small concentrations of complex, high-molecular-weight alkanes are also present in this Early Precambrian sediment (*1*). Chromatographic