ing regions oriented successively from the surface inward: a cicatrix composed of oxidation products from dead cells, a dormant zone (Fig. 1*a*), a zone of cell division, and a zone of wound vessel differentiation (Fig. 1*b*). The dormant zone is represented by a multilayered region of morphologically unchanged pith parenchyma cells situated between the cicatrix and the zone of cell division (*6*). Previous research has indicated that the extent of the dormant zone can be experimentally modified by treating wounds with chemical inhibitors (*4*). The clearing and dissection technique has eliminated the cicatrix, and the zone of cell division is not visible in the photomicrographs.

Treatment by rotation on the klinostat and inversion resulted in increased numbers of wound-vessel members as compared to the controls (Table 1). Moreover, shoots treated by rotation on the klinostat exhibited differentiated wound-vessel members nearer the cicatrix with a complete absence of the dormant zone (Figs. 2 and 3). However, shoots which were alternately inverted and placed in upright position on a 24-hour cycle contained a dormant zone as in the controls (Fig. 4). The greatest increase in cells differentiated was observed when the cells were treated by rotation for 24 hours followed by 6 days in erect position. As the time of rotation was increased, the wound-vessel pattern and number of cells differentiated became more variable.

Brain (*7*) has demonstrated that rotation on a klinostat of preparations of *Lupinus albus* resulted in an increase in diffusible auxin. The present experiments lend support to this evidence. Recently Hoshizaki and Hamner (*8*) reported that flowering response of *Xanthium pennsylvanicum* Wallr. is decreased when the plant is rotated around a horizontal axis. Increased diffusible auxin and corresponding increased wound-vessel differentiation resulting from geotropic stimulation may possibly result from increased auxin synthesis, decreased auxin degradation, release of bound auxin, or increased basipetal or acropetal auxin transport. Increased peroxidase activity resulting from geotropic stimulation (*9*) may be involved in stimulating xylem differentiation (*10*). Also the polar transport mechanism of auxin has been shown to be disturbed by geotropic stimulation (*11*). The changed pattern of wound vessel differentiation in plants treated by klinostat rotation may result from an altered bioelectric potential at the wound surface. The experiments of Schrank have demonstrated that geotropic stimulation of coleoptiles of *Avena* altered the bioelectric potential and the pattern of auxin movement (*12*).

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References and Notes

1. M. H. M. Goldsmith and M. B. Wilkins, *Plant Physiol.* **37**, suppl., xvii (1962).
2. C. J. Lyon, *Science* **137**, 432 (1962).
3. W. P. Jacobs, *Am. J. Botany* **39**, 301 (1952).
4. L. W. Roberts and D. E. Fosket, *Botan. Gaz.* **123**, 247 (1962).
5. Supported by the National Science Foundation (G-17741).
6. K. Surrey, thesis, University of Missouri (1955).
7. E. D. Brain, *New Phytologist* **41**, 81 (1942).
8. T. Hoshizaki and K. C. Hamner, *Science* **137**, 535 (1962). These workers have suggested that the decreased flowering response of *X. pennsylvanicum* due to klinostat rotation may have resulted from increased auxin levels within the shoot system of the treated plants.
9. A. H. Westing, *Am. J. Botany* **47**, 609 (1960).
10. W. A. Jensen, *Plant Physiol.* **30**, 426 (1955).
11. A. C. Leopold, private communication. Unpublished research from the laboratory of Dr. Leopold has shown that inverting an intact plant for 5 hours may decrease the basipetal auxin transport by as much as 25 percent as compared to erect control plants.
12. A. R. Schrank, *Plant Physiol.* **20**, 133 (1945).

22 October 1962

The Fungus Beauveria tenella

Abstract. Beauveria tenella, an insect pathogen, grows well and sporulates freely in submerged culture. Enzymes that loosened bovine hair that were found in broth cultures were not produced in the presence of chitin, and substitution of peptone broth for peptone-glucose broth did not increase their concentration. Under certain conditions, oxalic acid was the main metabolic product in the peptone medium.

A culture of *Beauveria tenella* (Delacr.) Seim. (*1*) was isolated from laboratory air during a search for depilatory enzymes with unique properties. This organism produces enzymes which loosen the hair on animal hides, but the depilatory action was not particularly strong and did not differ, as far as we could tell, from that of enzymes produced by other fungi. In attempts to increase the production of depilatory enzymes various culture conditions were employed, and some interesting observations were made. MacLeod (*2*) has made an excellent study of the group of insect pathogens to which this fungus belongs.

Figure 1 shows the fruiting habit of the fungus when grown on an agar medium. Growth is very good in shake flasks on common media such as glucose-peptone-mineral salts solution. However, yeast extract and corn steep liquor increase the growth rate. The *p*H of such media decreases with growth and may fall to about 3.5 unless the solution is buffered. The optimum temperature for growth is about 28° to 30°C; growth was noticeably slower at 25°C, and there was no growth at 40°C. Conidia are readily produced in submerged culture. If calcium carbonate is added to the medium after 1 or 2 days' growth in a shake flask, the production of conidia becomes profuse. Newly formed and germinating

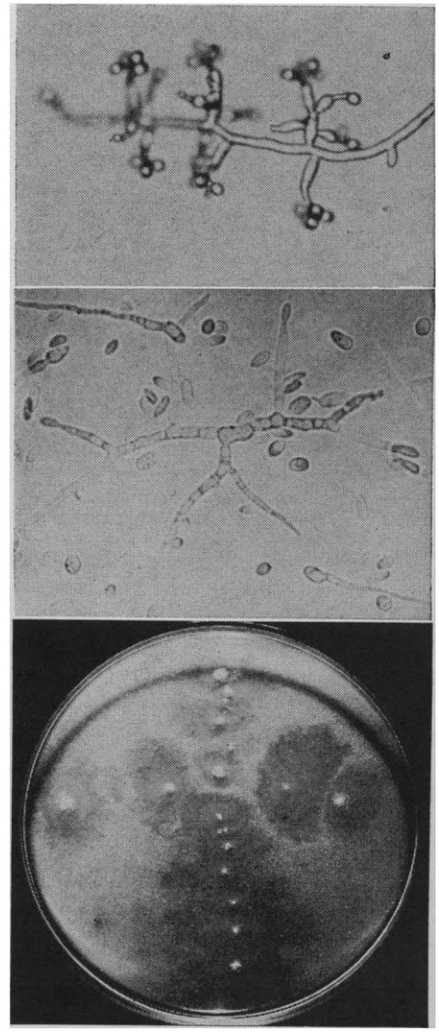

Fig. 1. *Beauveria tenella.* (Top) Conidiophores and conidia formed an agar medium (about × 760). (Middle) Concurrent spore germination and fruiting in submerged culture (about × 343). (Bottom) Chitin decomposition in an agar medium in a petri dish. The fuzzy white dots are mycelia with conidia and the dark areas are regions where the chitin has been digested (about × 0.59).

conidia are often present in the same culture (Fig 1). This might be a useful method of producing spores for insect pathogenicity studies and control studies.

The hair-loosening action was strongest when the culture was grown at a *p*H above about 5.0. At a *p*H below this the activity was much decreased, and if the *p*H dropped below about 4.0, no hair-loosening activity was present.

This organism was induced to grow fairly well on chitin by gradually increasing the chitin content of the medium while decreasing the other nutrients (Fig. 1). However, no hair-loosening activity was produced when the organism was grown on this medium. Attempts to make the fungus attack keratin (horn and hoof meal) were not successful.

When the organism was grown on a peptone-meat extract medium (nutrient broth, Difco), the *p*H dropped from 6.8 to 3.7. This occurred repeatedly when 350-ml volumes of the inoculated broth [24 g/liter (3 times the usual strength)] were placed in Fernback flasks and shaken at 84 cy/min at a temperature of 28°C on a reciprocating shaker. However, if only 200-ml volumes of broth were used, a surprising result was obtained—the *p*H, instead of dropping, increased to 8.2 to 8.8. This was probably due to changes in the degree of aeration caused by the differences in volume.

To identify the constituents responsible for the drop in *p*H, the fungus was grown on 350 ml of a peptone-meat extract medium, and a portion of this broth was treated with enough alcohol to make the solution 80 percent in alcohol. When this had stood 1 or 2 days a large amount of material (about 0.5 g) crystallized out. After filtration, the solution was examined by ion exchange and paper chromatography and found to contain oxalate as its main anion. Paper chromatography of the crystals and treatment with alkali showed them to be ammonium oxalate. The oxalate from the crystals and the oxalate remaining in solution were both precipitated as calcium salt and characterized by x-ray diffraction powder patterns. Approximately 20 percent of the original solids content of the broth was found to be oxalic acid. Peptone-meat extract broths in which the *p*H increased were not analyzed. A paper chromatogram of a broth from a culture grown on medium containing glucose showed no oxalic acid.

The production of oxalic acid from peptone by fungi has been discussed and documented by Foster (*3*), but as far as we know it has not been previously reported for fungi of this group.

The formation of unidentified crystals in the blood of insects infected by *Beauveria* species has been reported by Steinhaus (*4*). There is a very good chance that these crystals are the same as those we have isolated—ammonium oxalate.

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References and Notes

1. We thank Dorothy I. Fennell of the Mycology Laboratory, Pioneering Research Division, Quartermaster Research and Engineering Center, Natick, Mass., for making the identification.
2. D. M. MacLeod, *Can. J. Botany* **32**, 818 (1954).
3. J. W. Foster, *Chemical Activities of Fungi* (Academic Press, New York, 1949), p. 346.
4. E. A. Steinhaus, *Principles of Insect Pathology* (McGraw-Hill, New York, 1949), p. 374.

8 August 1962

Diamonds in the Dyalpur Meteorite

Abstract. Diamond was found by x-ray diffraction techniques in the Dyalpur stone; this is the fourth meteorite in which this mineral has been discovered. The diamond crystallites resemble those of Novo-Urei more than those of Goalpara.

Meteoritic diamonds have been known since 1888 when Yerofeyev and Lachinov (*1*) discovered them in the ureilite, Novo-Urei. Since that time x-ray diffraction techniques have confirmed their presence in this meteorite (*2*) and in two others: the giant iron, Canyon Diablo (*3*), and the ureilite, Goalpara (*4*). The third known ureilite, Dyalpur (*5*), had never been examined.

In previous papers (*6*, *7*), I have discussed the formation of meteoritic diamonds. The conclusions were that they were formed from graphite by shock, during meteorite impact with the earth (Canyon Diablo) or during breakup of the meteorite parent body (Goalpara and Novo-Urei).

The Chicago Natural History Museum kindly gave me the opportunity to study several small samples from their two specimens (total mass 0.4 grams). These were examined by x-ray diffraction with techniques and equipment described previously (*7*).

Several samples showed lines at spacings corresponding to those of diamond (Fig. 1). In addition, I observed diffraction lines corresponding to those from graphite and kamacite (α iron) in the same specimens. Other portions from this meteorite revealed olivine (which was visually recognizable) and clinopyroxene, in addition to the kamacite. That the diffraction pattern of kamacite appeared in almost all of the samples taken implies that kamacite is spread approximately uniformly throughout Dyalpur.

Patterns taken from unrotated specimens revealed that the diamond crystallites fall into two size ranges, a few large crystals and a large number of rather small ones. In this respect, the crystallite size distribution (unpublished data, *8*) more closely resembles that in Novo-Urei than that in Goalpara; the crystallites in the latter appear to be only a few hundred Angstroms in size (*4*). The carbonaceous inclusions in Dyalpur appear as visible grains jutting from the meteorite's surface; in each grain there are about equal amounts of graphite and diamond. Some diamond crystals from Novo-Urei show octahedral faces and are therefore apparently well developed (*9*).

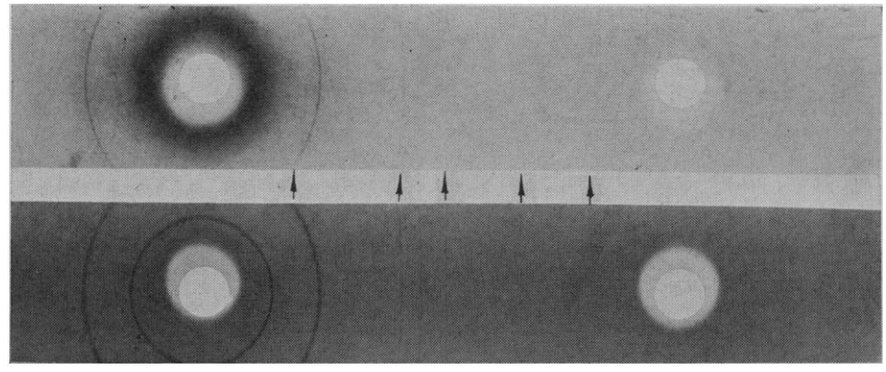

Fig. 1. (Top) X-ray diffraction pattern of 3- to 6-micron diamond powder. Nickel-filtered CuKα radiation. (Bottom) Carbonaceous inclusion from the Dyalpur meteorite. Graphite and kamacite (α iron) are present in addition to the diamond. The arrows indicate diffraction lines characteristic of diamond.