In terms of potential applications, it is not yet clear whether higher-order topological modes localized to corners or hinges have practical advantages over their conventional counterparts. For instance, higher-order topological insulators rely on the existence of crystal symmetries that typically limit the robustness of the edge modes. Moreover, it has been shown that protected modes can also be localized to points or lines of dimensionality lower than $(d-1)$ in ordinary topological insulators that have material defects[11–14].

Finally, one can speculate about such systems beyond third order — in other words, beyond the octupole moment. However, these are difficult to realize because of the unfortunate lack of spatial dimensions in our everyday world. Possible ways of overcoming this difficulty include resorting to 'synthetic' dimensions provided by internal degrees of freedom (such as the oscillation modes of a resonator), or artificially enhancing the connectivity of crystal lattices using long-range links[15].

The authors' experimental evidence for higher-order topological insulators illustrates the rapid transition from theoretical proposals to experimental realizations in current research on topological materials. We expect the next few years will be the time for such materials to prove their engineering worth. ■

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IMMUNOLOGY

Melanin triggers antifungal defences

Melanins are enigmatic pigments that have many roles, and the melanin in pathogenic fungi can aid host infection. Identification of a mammalian protein that recognizes melanin now reveals an antifungal defence pathway. SEE LETTER P.382

ARTURO CASADEVALL

Most organisms produce numerous varieties of the highly diverse dark pigments known as melanins, which are among the last remaining biological frontiers with the unknown. These polymer molecules can act in protective or harmful ways, in biological functions as diverse as providing protection against DNA-damaging ultraviolet radiation[1] to bolstering fungal cell-wall strength[2]. Melanins bolster microbial virulence[3], including that of many disease-causing fungi. The presence of melanin can trigger an immune response in the infected organism[4], but how this occurs was unknown. On page 382, Stappers *et al.*[5] report the identification of a protein that can recognize a type of melanin produced by the fungus *Aspergillus fumigatus*. Their finding illuminates the immune-system response to a fungal infection that can be lethal in people who have a suppressed immune system, such as those who have undergone transplantation surgery[6].

Melanin pigments are stable free radicals, and, in animals and fungi, they are produced in membrane-bound organelles known as melanosomes, which shield the cell cytoplasm from the potentially damaging free-radical reaction needed for melanin production. They are insoluble and resistant to degradation by acids. These striking characteristics probably explain why their structures are difficult to analyse and are not fully understood. Host immune cells can trigger potentially damaging cell-signalling pathways in fungi. But such attacks can be neutralized by fungal melanin, which also reduces susceptibility to antifungal drugs[3].

Human disease caused by fungi of the genus *Aspergillus* is called aspergillosis. If a

50 Years Ago

Like many other museums of its type, the Museum of Comparative Zoology has teaching and curatorial responsibilities, expeditions are organized to build up collections, and staff travel to study collections in other museums. Research conducted in the museum covers a wide range of topics — evolution, behaviour, ecology, zoogeography, physiology and biochemistry and taxonomy. Almost all the research produces results of interest to the evolutionist. One interesting find during the year was the discovery of a fossil insect from Cretaceous amber from New Jersey. This is the oldest known ant and is apparently virtually a missing link between ants and wasps. The presence of worker characteristics in these insects is evidence of the existence of social Hymenoptera as far back as about 100 million years.
From *Nature* 16 March 1968

100 Years Ago

An announcement in the daily Press states that whale-meat furnished the principal article of food at a luncheon given in New York by the American Museum of Natural History to demonstrate the possibilities of whale-meat for home consumption, in order that the beef thus saved might be sent by America to relieve the scarcity prevailing among the Allies in Europe … Unfortunately, we can do little to assist in this saving, for the whales in our home-waters cannot be "fished", since neither ships nor men are available for the purpose … It is to be hoped, however, that the fullest possible use will be made of the carcasses of the various species of Cetacea stranded around our coasts. Of course, no great quantity of meat would thus be obtained, but locally it should form a very welcome addition to the scanty meat rations now of necessity prevailing.
From *Nature* 14 March 1918