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properties — were 'stepped' through their ranges of uncertainties. This process produced probability distribution functions that represent the probable range of the forcing. The relatively small uncertainty reported by Bellouin *et al.* arises from use of the relatively accurate MODIS optical depths, as compared with the wide range of optical depths generated by the aerosol chemical-transport models that contributed to the IPCC assessment.

So far, so good. But this won't be the end of the story. For example, one wonders how well global estimates of biases in the MODIS aerosol optical depths[3], which Bellouin *et al.* attempted to remove, coupled with the aerosol optical properties derived from just six continental sites, characterize aerosols of anthropogenic rather than natural origin. Also, Bellouin *et al.* assumed that the aerosol direct radiative forcing for overcast regions was negligible. As they note, such forcing will be difficult to deduce, but it is bound to be as large as, if not greater than, their claimed uncertainty.

Likewise, the MODIS aerosol optical depth increases with increasing cloud cover[5], whereas the comparisons with surface-based observations used to establish the accuracy of the MODIS aerosol properties favour largely cloud-free conditions[3] — changes in aerosol properties in the vicinity of clouds suggest that the MODIS observations could have biases that have not yet been characterized. Finally, aerosols also affect the size and numbers of droplets in clouds, thereby altering the amount of sunlight reflected by clouds. The extent of this effect, known as 'aerosol indirect radiative forcing', remains largely unknown. But it may offset greenhouse-gas warming even more than the aerosol direct radiative forcing[6].

Assessments of climate change caused by human activity have been stymied in part by the sizeable uncertainty in estimates of the aerosol direct and indirect radiative forcings. The strategy of using combinations of global space-based and surface-based observations to constrain model estimates, as followed by Bellouin *et al.*, is a promising way of reducing these uncertainties. Space missions such as CALIPSO and CloudSat are to become part of the A-Train — the Aqua satellite constellation — early next year. They will help to improve the characterization of aerosols, particularly over continents where the direct radiative forcing is greatest, as well as the treatment of cloud–aerosol interactions. ■

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GENOMICS

Multiple moulds

André Goffeau

Three species of *Aspergillus* fungi are the latest organisms to have their genome sequenced. Comparison of the genomes sheds light on, among other things, what endows them with pathogenic or beneficial features.

The genome sequences of three *Aspergillus* fungi are reported in this issue: *Aspergillus oryzae*[1], used in making the Japanese drink sake; the human pathogen *Aspergillus fumigatus*[2]; and the genetic model species *Aspergillus nidulans*[3]. The 185 known species of *Aspergillus* include 20 human pathogens, numerous plant pathogens and a variety of species that we use to produce foods, chemicals and industrial enzymes. The genomes provide a wealth of information about the evolution of this fascinating group of organisms, and about the beneficial or detrimental characteristics of each species.

The sequences, published by teams from Japan, the United States and Europe, cover an average of nearly 95% of each genome. In total across the three species, more than 95 megabases have been sequenced, crammed with over 33,500 protein-coding genes contained on 24 chromosomes (eight chromosomes per species). By comparison, the human genome has about 30,000 protein-coding genes in 3,000 megabases.

Aspergillus oryzae has been used for nearly a thousand years to produce traditional Japanese fermented foods and drinks. Its genome[1] has about seven to nine megabases more DNA than *A. fumigatus* and *A. nidulans*. To account for this, the authors propose that some genes were transferred to *A. oryzae* from other species during evolution. The extra DNA stretches are dispersed throughout the genome and are enriched in genes involved in the synthesis and the transport of numerous secondary metabolites — the chemical compounds in an organism that are not directly involved in normal growth, development or reproduction.

50 & 100 YEARS AGO

50 YEARS AGO

"Influence of space flight on engineering and science"

— Within the past few years many scientists have predicted seriously and confidently that human beings from the Earth would, in the foreseeable future, travel to the Moon and the nearer planets. The ranks of those who would dispute this project are diminishing rapidly. Although much of the progress is still guarded by military necessity, space flight is emerging as an activity in its own right — one that can command the efforts of many scientists and engineers... A recent survey shows that the study of physics in American public high schools has been declining for more than half a century... why [does our youth] turn away from a career in science? We can only grope for the answer. Perhaps they sense, better than their elders, that too much of our scientific talent is engaged in the unproductive task of developing weapons for war. Is there much inspiration to devote one's life to this end, when we are rapidly approaching the borderline of total destruction? I believe that space flight might serve in no small measure to turn men's minds toward a more appealing scientific goal. As the exploits of Cabot, Drake and Davis inspired many generations of Englishmen to turn to the sea, so may the first astronauts reawaken our youth to the romance of scientific exploration.

Milton W. Rosen, Naval Research Laboratory, Washington, D.C.

From *Nature* 24 December 1955.

100 YEARS AGO

Heredity. By C. W. Saleeby, M. D. The appearance of a little shilling book on heredity is almost startling, when we consider the difficulty of the subject and the relative youth of its exact study. That a book like this should be possible indicates that considerable progress has been made in recent years. Was it not Leibnitz who said, "The more a science advances, the more it becomes concentrated in little books"?

From *Nature* 21 December 1905.