semi-natural vegetation—in woods, for example, the retention of the shrub layer would be vital for the shelter which it provides. And lovers of old churches and their memorials should be pleased to know that lichenologists will support them in their conservation campaigns. Laundon's survey ends with the cheerful prophesy that planning controls, clean air policy, and the preservation of areas of vegetation for their amenity, recreational and scientific value should ensure that lichen communities are harmed less in future urban developments than in the past.

DUST STORMS

Windfalls from Africa

from our Geomagnetism Correspondent

SAMPLING of the atmosphere over Barbados during the past four years has demonstrated the presence of appreciable quantities of dust in the north-east trade winds which cross the island. But where do the dust particles come from? Various studies of the mineralogy of the dust, the average concentration of which is about 2 μg per cubic metre of air, suggest that the source is an arid region, most likely North Africa. This supposition is strengthened by the facts that the quantity of dust arriving is about an order of magnitude higher during the summer and autumn than during winter and spring, and that within the seasons there is a day to day variation of a similar magnitude, for this is the pattern that might be expected from the variability of dust storm activity in Africa. Even so, up to now the evidence for this connexion has been circumstantial—no particular dust load over Barbados has been correlated unambiguously with a specific dust storm in Africa.

From a study of the records, however, Prospero *et al.* (*Earth Planet. Sci. Lett.*, **9**, 287; 1970) have demonstrated just such a correlation, chiefly by an analysis of the size distribution of dust particles. The average size distribution of Barbados dust is very much what might be expected, with the lighter particles (more easily transported) forming a higher proportion than heavy ones. In general, more than 40 per cent (by weight) of particles have diameters less than 2 μm and less than 2 per cent have diameters greater than 10 μm. The sample of June 10–12, 1967, was anomalous, however, in two respects. For one thing, it was unusually large, the atmospheric dust density being 26·2 μg per cubic metre of air; and for another, the distribution was biased towards heavier particles, more than 25 per cent by weight being in the fraction above 10 μm diameter and more than 4 per cent above 20 μm. Clearly the source event, whatever it was, must have been unusually energetic.

To determine the specific source region, Prospero *et al.* have attempted to compute the trajectories of the anomalous particles. This is not easy, of course, because various assumptions must be made concerning such features as height of travel, whether the flow is smooth or turbulent and sources of particle drag. The most reasonable travel path, based on real measurements of wind speeds over the Atlantic, suggests that the dust in question crossed the African coast in the vicinity of Mauritania on June 7 and sped towards Barbados at an average speed of about 40 km h^{-1}.

But were dust storms particularly prevalent in West Africa at that time? There was, in fact, a sharp increase in reports of dust storms on June 7, with eight such storms being concentrated along the Senegal and Mauritanian coasts. Moreover, this high activity was clearly confirmed by an ESSA 5 satellite photograph of June 7 which showed the storm region to be elongated in the direction of the trajectory computed by Prospero *et al.* Finally, winds of 60 km h^{-1} in the trajectory direction were reported.

The consequences of this correlation are at least as interesting as the correlation itself. The theoretical (Stokes) settling velocity for the particles having diameters of more than 20 μm is greater than 2·75 km day^{-1}, which implies that to be able to reach Barbados in five days the particles must have been raised to a height of more than 14 km by the storms. At the same time, radiosonde ascents on June 7 indicated a maximum height of only 4 km. How, then, did the heavier particles get to Barbados? The only possibility seems to be that the lower atmosphere along the trajectory over the ocean was stirred vigorously to keep the heavy particles airborne. Even so, many such particles probably also fell into the Atlantic, a proposition which implies that some of the large-grained pelagic sediments in the equatorial Atlantic were transported by wind from the African deserts.

THIN FILMS

Multum in Parvo

from our Materials Science Correspondent

PEOPLE who want to make thin films of alloys or cermets traditionally use either co-evaporation or co-sputtering, and have to go to great trouble to achieve uniformity of composition. Now an ingenious scientist at the RCA Laboratories in Princeton, J. J. Hanak, has turned this problem on its head and published a method of making a film with variable composition (*J. Mater. Sci.*, **5**, 964; 1970). He argues that a materials specialist who is monitoring a range of compositions in a binary or ternary system for, say, superconducting properties, spends many weary hours preparing a succession of uniform films of different compositions; how much more sensible to produce a single film with a range of compositions varying smoothly along the length or circumference (according to specimen shape) and then to make a series of electrical measurements on the one film.

Hanak describes in detail a tried method for doing this, using r.f. co-sputtering from segmented or sectored elemental targets. Once the deposition profile of each constituent has been determined for a given configuration (the straightforward method for doing this is explained), then the complete composition profile of a particular film can be computed from just two thickness measurements at arbitrary points along the film. The validity of this method is demonstrated. A film in the shape of a centipede allows many individual electrical measurements to be made for a range of compositions. Hanak estimates a time-saving factor of about 30× for a binary system and about 750× for a ternary system, compared with the traditional technique based on films of uniform composition.

Another article in the same issue of *Journal of Materials Science*, again by RCA scientists, V. S. Ban and D. A.