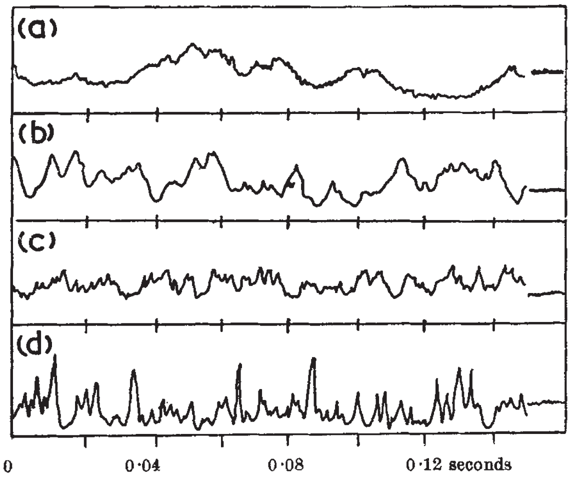

Oscillograms showing stellar scintillation.
(*a*) Vega, 12° elevation; 15 in. aperture.
(*b*) Betelgeuse, 30° elevation; 15 in. aperture.
(*c*) Capella, 64° elevation; 15 in. aperture.
(*d*) Capella, 64° elevation; 4 in. aperture.

taken within half an hour of each other on a night with a moderate westerly wind and a few clouds. So far, our work only covers a small sample of nights. There is, however, every reason for believing that both the root-mean-square amplitude and the frequency vary to some extent from night to night and even during the course of a single night. Nevertheless, the figures quoted appear representative of what has been obtained so far.

If we diminish the aperture of the telescope, the effect is to increase both the amplitude and the frequency. For the stars nearest the horizon the increase in amplitude is proportionately less than for those stars high up, while the reverse appears to be true for frequencies. A single example, with the telescope aperture reduced to four inches, is shown as trace (*d*). It is of the star Capella and was taken within a few minutes of (*c*). It will be seen that the peaks are more prominent than in (*c*), and on a trace of several seconds duration they number up to 500 a second. Also, if due allowance is made for the reduced mean intensity of the star compared with that of (*c*), the peaks are seen to be much more like pulses, rising as they do to four or six times the mean level.

Apart from the usefulness of such observations for the meteorologist, the implications of these intensity variations in astronomical photography and photometry must not be overlooked.

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Colour Reactions between Clay Minerals and Root Secretions

In the course of experiments designed to test the production by clover roots of a factor inhibitory to nodule formation, plants have been grown in the presence of a wide range of adsorbents including montmorillonite (Wyoming bentonite) and fuller's earth. Both these minerals, besides stimulating the formation of nodules, show strong colour reactions in the neighbourhood of the root.

The experiments in which this was observed were carried out with red clover, growing under bacteriologically controlled conditions, on agar slopes in test-tubes to which small quantities of sterilized bentonite were added at the bottom of the slopes. Normally, the plant cultures were inoculated with an effective strain of nodule bacteria; but the nodule bacteria are not themselves concerned in the reaction since colour is readily developed by uninoculated plants supplied with nitrate. Nitrogen-starved plants (either in uninoculated culture and without added nitrogen or inoculated with ineffective strains of bacteria) develop no colour in the presence of bentonite.

The colour first appears in the bentonite at the root surface after about two weeks growth, and later becomes more pronounced and extends outwards from the root to a distance of some 5 mm. after about three months growth. In acid and neutral media, colour varies from a bright greenish-blue to blue-violet; at an alkaline *p*H an outer brownish-pink zone sometimes appears.

The blue-green bentonite separated from the root darkens to a purple-brown on drying, but changes on acidifying with 10 per cent mineral acid to a bright jade green which is fast on drying. Treatment with alkali (10 per cent sodium or potassium hydroxide or ammonia) instantly discharges the colour, which may be again restored by acidifying. The colour is not affected by reducing agents (formalin, stannous chloride or sodium sulphite) or by oxidizing agents (hydrogen peroxide or potassium chlorate) or by moderate leaching in the cold with water, salt solution or organic solvents (methyl or ethyl alcohol, chloroform, acetone or ether). On heating at 100° C. the colour fades and disappears.

With fuller's earth, the colour changes are not so marked, the clay darkening slightly in the neighbourhood of the root. Only where the secretion is pronounced is a blue-green tint developed. No chemical tests have so far been made with coloured fuller's earth. No colour is found in the presence of acid-washed kaolin, silica gel or asbestos.

Individual clover plants differ considerably in the intensity of the colour induced on bentonite, and the few species of plants so far examined differ qualitatively in the reaction. Oats, rye grass and radish give no colour, flax gives a strong citron-yellow colour, lucerne a faint orange tint and a vetch (*Vicia hirsuta*) marked orange and brown colours.

Colour reactions have been described between bentonite and certain amino-compounds[1,2], and between bentonite and vitamin A and carotenoids[3]; the former is considered to be due to electronic resonance associated with the formation of a 'semiquinone' structure and the latter to salt formation. Failure to elute a coloured material from the bentonite in the rhizosphere in the tests reported above suggests that one or other of these kinds of reactions may be involved.

Work is being undertaken on the identification of the secretion and will be published in due course.

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Oct. 16.

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[3] Weil Malherbe, H., and Weiss, J., *J. Chem. Soc.*, 2164 (1948).