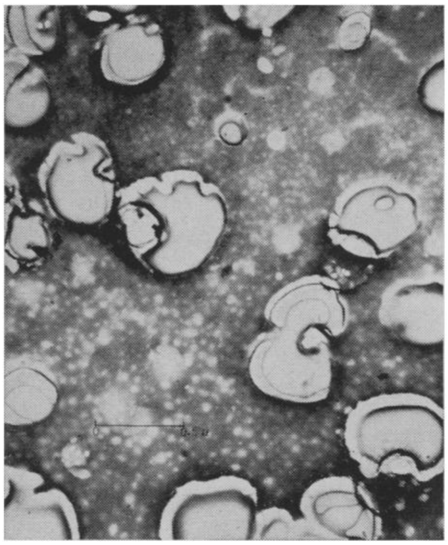

Fig. 3. Electron micrograph of type-III metallic spherule from Station 224, Antarctic Peninsula Traverse.

but most are separated from their neighbors by at least a thin wall. Most of the pits are about 0.5 μ in diameter, although a few shallower pits about 0.1 μ across are present. The larger pits often show an intricate internal structure. In many cases, a complex, deeper area is located near one side of the pits. In view of the random occurrence and diverse character of the surface pits, it would be difficult to maintain that they were produced by internal features of the spherules. Perhaps the pits represent impacts of submicroscopic particles upon the microscopic spherules while in space.

If it is assumed that the type-III spherules may have resulted from impact of smaller particles with the spherules, it is possible to estimate the diameter of impacting particles by the equation of Charters and Summers (*5*), using the measured dimensions of the pits and spherule density (*6*):

$$d_c = 2(2.28)\left(\frac{\rho_p}{\rho_t}\right)^{2/3}\left(\frac{V}{V_s}\right)^{2/3} \quad d$$

The diameter of impacting particles which could produce such pits was found to be about 0.04 μ. It is interesting that Hemenway *et al.* (*7*) found extremely small (about 0.01 μ in diameter), high-density particles, or "nanometeorites," to exist in large quantities at high altitudes over Antarctica. Particles of the proper size are thus present, but it remains to be proved that impact of these particles upon the surfaces of the larger spherules while in space could have produced the pits observed.

We consider it unlikely that terrestrial corrosion could have produced the surface features. These spherules were recovered from snows of recent age (less than 25 years old), which were kept frozen until processed in our laboratory. Corrosion would have been impeded by the short time that temperature-reduced chemical reactions could have proceeded. Furthermore, no reagent stronger than ethanol was applied to the spherules prior to examination under the optical microscope. Techniques employed in spherule manipulation or mounting could hardly be responsible for the surface features, because the instruments used were many times larger than the entire spherules. Abrasion of one spherule against another during processing could not have produced the surface textures. Because of their small size, a cushion of air would prevent contact and abrasion between spherules (*8*).

The smooth surfaces of type-I spherules were apparently produced by surface melting upon entry into the earth's atmosphere. Under Krinov's definitions (*9*), these would be considered *micrometeorites.* If, on the other hand, the surface details of type-II and type-III spherules were produced by erosion in space and were preserved during passage through the earth's atmosphere, these particles would be considered *cosmic dust;* their form being unchanged from what it was in space. However, type-II and type-III spherules are about an order of magnitude larger than particles normally considered cosmic dust. For these particles to have been preserved during entry, they must have traveled at low velocities and low-angle trajectories (*10*). It is possible that this requirement could have been satisfied, as low velocities of dust particles in the earth's dust cloud were demonstrated by Dole (*11*), and low-angle trajectories for atmospheric entry were described by O'Keefe (*12*).

If the surface details of type-II and type-III spherules were produced by space erosion, it would appear that surfaces in space may be considerably attacked over extended periods of time (*13*).

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13. Supported by grants from the National Science Foundation and the research committee of the University of Wisconsin Graduate School from the Wisconsin Alumni Research Foundation. We thank Prof. P. J. Kaesberg of the department of biochemistry at the University of Wisconsin for permission to use the electron microscope and the associated laboratory facility. This is Geophysical and Polar Research Center contribution No. 115.

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Late Twilight Glow of the Ash Stratum from the Eruption of Agung Volcano

Abstract. *Observation of the height of the dust layer responsible for the onset of brilliant sunsets in the 30°N zone since September 1963 gives evidence that the ash has diffused from the eruption of the volcano Agung on Bali. A height of 22 km is derived for the top of the primary stratum.*

Since early September 1963 the appearance of strong coloration of the clear sunset and sunrise sky has given evidence that the ash from the eruption of the volcano Agung on Bali (8°25′ S) has diffused into the northern hemisphere. We have had the opportunity to observe the growth of the brilliant gold sunsets from our surveillance of the twilight sky for noctilucent clouds, a task aided by the very clear atmosphere of the Southwestern states. The presence of the glow stratum became quite conspicuous late in September, particularly because of its asymmetry with respect to the position of the sun. On 29 and 30 September the glow was centered 10° to 20° south of the solar azimuth, observed from the McDonald Observatory, Fort Davis, Texas. The behavior of the dust layer was also observed after sunset on 2 October from an altitude of 30,000 ft over Ohio, although no definitive height observations could be secured.

On the evening of 5 October we timed the transit of the earth's shadow through the layer, which occurred at the true horizon 45 ± 1 minutes after local sunset. The appearance of the sunset glow is one of pure golden color, rather uniform in intensity up to a distinct pinkish gold upper boundary. The upper boundary describes an arc of a circle with a maximum height on 5 October about 5° south of the solar azimuth. Above the boundary the sky appears deep blue, but a fainter lavender glow with a less distinct upper boundary could be seen against the darkening sky. The time of disappearance at the horizon of the upper boundary of the fainter secondary glow was 69 ± 1 minutes after local sunset on this date.

On 6 October the secondary glow was hard to distinguish and on 7 October no trace was visible, although on the latter date the haze layer was so opaque that even the sunlit upper boundary of the primary glow could not be clearly distinguished. The twilight on 7 October, however, deepened quite slowly ending $1^h\ 30^m \pm 10$ minutes after sunset, apparently caused by multiple scattering in the ash stratum.

The times measured can be readily converted into a height of the boundary of 22.3 km (73,000 ft), for the brighter glow, and 52.6 km (173,000 ft), for the fainter. No correction for refraction was made since the times of sunset and occultation at the horizon were both measured directly. The effect of horizon screening is also assumed to be the same as that of the additional refraction of the illuminating solar rays in the computations.

It is well established that the presence of the ash from the eruption of the volcano Agung on Bali on 17 March 1963 became apparent some months ago at Mt. Stromlo Observatory near Canberra, Australia (32°S), where it has caused the photoelectric extinction coefficients to be significantly increased. Bok (*1*) has reported to us that the dust is readily visible as a disc of white scattered light extending 20° to 30° diameter about the sun. The intensity of the dust that has apparently diffused to 30°N is much less conspicuous, to date, and it is only readily visible after sunset and before sunrise.

It is interesting to note that the eruption of Krakatoa on Java in 1883 produced a glow stratum with an average height of 18 km (*2*) which lasted several years, producing brilliant sunrise and sunset glows even in the high latitudes of the northern hemisphere. Therefore, the height measured by us is in good agreement with that reported for Krakatoa. We would like to point out that some ash from Agung appears to have been injected into the thermal rise in the mesosphere since the height of the secondary layer of 53 km is well above the thin stratosphere at the latitude of Tucson, Arizona. A similar high layer (*2*) presented an appearance that was debated as a secondary reflection of the primary glow.

The intensity and detailed appearance of the sunset glow changes from day to day and a study of the appearance of the glow and height determinations over an extended period of time and from as many places as possible should be useful in the study of the circulation of the high atmosphere.

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Natural Kinin in Peach Fruitlets

Abstract. *An aqueous extract from peach fruitlets caused a kinin-like stimulation of olive callus in tissue cultures. Activity appeared only when indole-3-acetic acid was also used. The extract caused weight increase and growth characteristics similar to control cultures provided with commercial kinetin.*

Of the few known sources for plant extracts that are active in plant cell division (*1*), the most common are coconut milk, coconut meat, and maize endosperm. In 1959 Goldacre and Bottomley extracted such a fraction from apple fruitlets (*2*). Using tobacco pith they compared it with synthetic kinetin.

We extracted from peach fruitlets a highly active fraction that promotes cell division. One hundred grams of fruitlets 10 to 15 days old were autoclaved in water for 5 minutes immediately after picking and then homogenized. After filtration, the clear solution was frozen and stored in the dark.

This extract was added at various concentrations to a modified White's (*3*) culture medium (the inorganic fraction was doubled, and the *p*H was adjusted to 6.6). Indole-3-acetic acid (IAA) and kinetin were added to this medium separately and in combination. Olive callus, grown in vitro for six subcultures, was used as the test tissue. Two pieces, about 12 mg each, of 7-week-old callus, grown in the dark, were planted in each flask and grown under dim incandescent light at 26°C. Their weight after 49 days is shown in Table 1.

Table 1. Effect of aqueous extract of peach fruitlets on the growth of olive callus in vitro, in the presence and absence of the growth regulators IAA (2 ppm) and kinetin (0.2 ppm). Results are expressed in milligrams (fresh weight) per tissue. Each figure is the mean of ten repetitions.

No regulator	IAA	Kinetin	IAA and kinetin
	No extract		
7	19	30	152
	Extract from 250 mg of fruitlets		
19	268	32	274
	Extract from 1 g of fruitlets		
12	210	13	181
	Extract from 4 g of fruitlets		
14	9	13	13

Normal olive callus growth could be achieved in the control cultures only in the presence of both IAA and kinetin. However, with the addition of the extract, intensive growth occurred also when IAA alone was included in the medium.

High concentrations of the extract inhibited growth. This inhibition seemed to be due to interfering substances, for it occurred at the same concentration both with and without the addition of kinetin. The quality of growth of the cultures was about the same when both regulators were used without extract and when only IAA was used with extract. Thus extract compensated for the absence of kinetin in promoting growth. Hence a natural highly active, kinetin-like substance was present in the fruitlet extract (*4*).

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