Wainwright, M et al 2013 More Biological Entities from the Stratosphere Including a Diatom Fragment-Further Evidence for a Space Origin. *Journal of Cosmology*, 22, pp. 10267-10271, DOI: http://dx.doi.org/10.5334/jc.sl

RESEARCH

More Biological Entities from the Stratosphere Including a Diatom Fragment-Further Evidence for a Space Origin

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Details of stratosphere-isolated biomorphs are given, including a fragment of a diatom frustule and an inorganic particle-rich mass containing biological filaments. We argue that this mass which is around 300 micron in size is, like the other biological entities shown, too large to have been carried from Earth to the stratosphere. As a result, we conclude that the biological entities arrived from space, probably from comets, and their existence in the stratosphere provides *prima facie* evidence in support of the Hoyle-Wickramasinghe theory of cometary panspermia.

Introduction

We previously reported the isolation of a variety of biological entities from the stratosphere, ranging from several unusual biomorphs to a fragment of a diatom frustule as well as some biological filaments (Wainwright *et al*, 2013a, b). We discussed the origin of these biological entities and concluded that they arrive to the stratosphere from space, rather than Earth. Here, we provide a new selection of images of biological entities sampled from the stratosphere and use some of them to provide further evidence in support of our assertion that they cannot have originated from Earth.

Materials and Methods

A balloon-launched sampling device was released from Chester, NW England on 31, 7, 2013. The sampler included a drawer mechanism that could be automatically opened and closed at any desired height. The stratosphere sampler carried a video camera by which the opening and closing of the sampling drawer could be viewed, confirmed and recorded. The sampling apparatus was protected from downfall of particulate matter from the balloon by a cover. Prior to launch, the inside of the draw device was scrupulously cleaned, air blasted and finally swabbed with alcohol. New scanning electron microscope stubs were placed in rows inside the drawer with their top surfaces facing outwards so that when the draw was opened any particulate matter in the stratosphere would attach to them and they could later be removed for examination under the scanning electron microscope.

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The protective layer on the surface of the stub was peeled off just before launching under a cover to prevent any particulate contamination. After sampling, the apparatus was transported to the laboratory and opened under conditions which avoided exposure of the stubs to contaminating dust and the stubs were similarly transferred under cover to the scanning E/M. The stubs were then sputter coated with gold for 30secs at 30mA and then examined using a SEM (JEOL 6500F).

Balloon launch

The balloon was launched from an open field near Dunham on the Hill (near Ellesmere Port, Cheshire, England) during daylight hours and traversed to just south of Wakefield in West Yorkshire (England). The sampling drawer was opened for 17 minutes as the balloon rose from 22026m to 27008m. The sampling apparatus was returned to Earth (by parachute) undamaged and completely intact.

Control flight

A separate control flight was made to the stratosphere prior to the sampling flight, when the draw was not opened, but all other sampling procedures were observed. No particulate matter was found (using the SEM) on any of the unexposed microscope studs, showing that the draw remained airtight and that none of the stubs was exposed to particles at, or near, ground-level or at any height up to the stratosphere. These results also show that no particles contaminated the stubs during any of the sample processing procedures, thereby demonstrating that the scrupulous procedures used to prevent ground level contamination proved effective and that no such contamination occurred.

Results and Discussion

Fig. 1 shows a composite of four biological entities isolated from the stratosphere which at first sight could be mistaken for a single biological entity but which closer

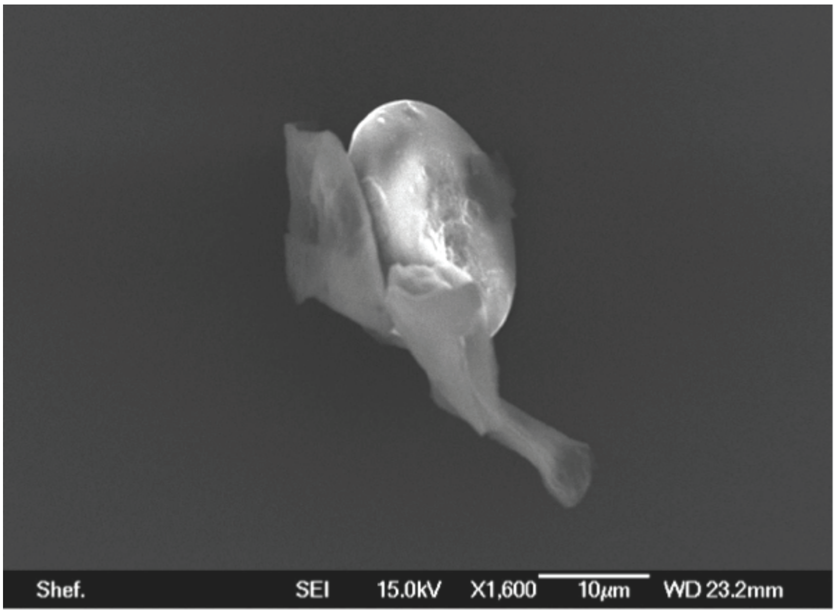


Fig. 1: Four presumptive biological entities isolated from the stratosphere.

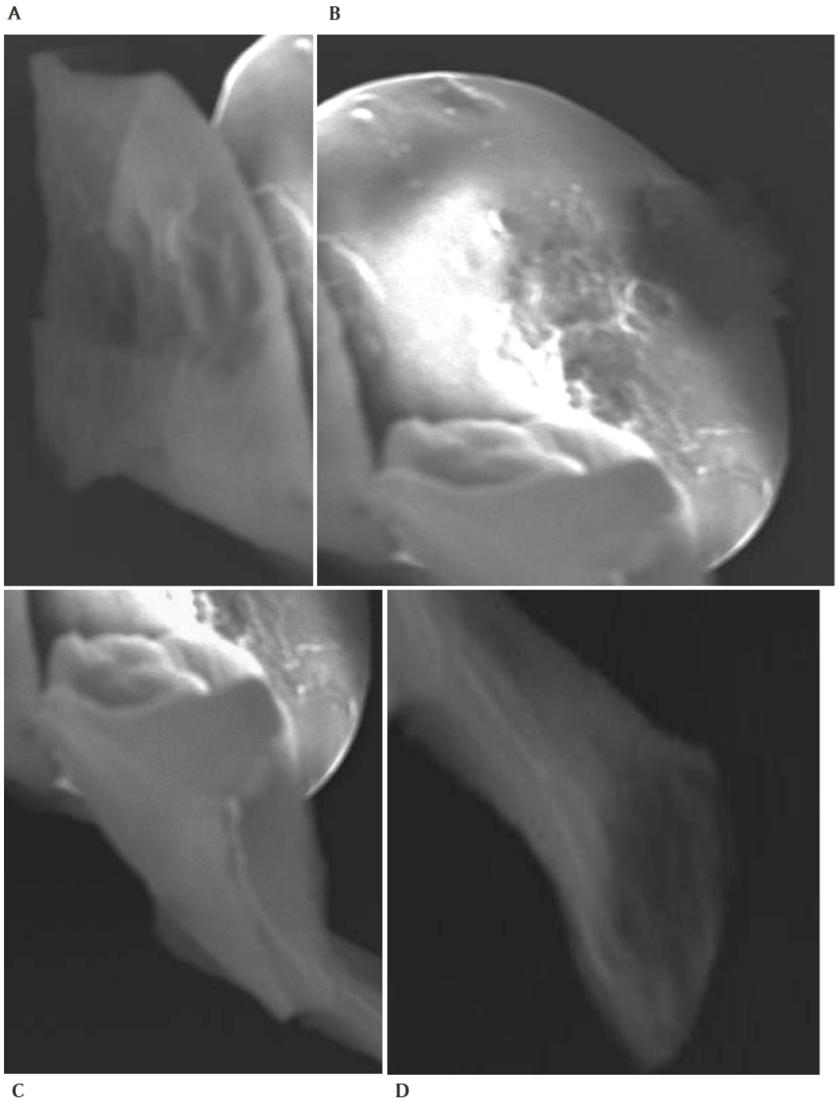
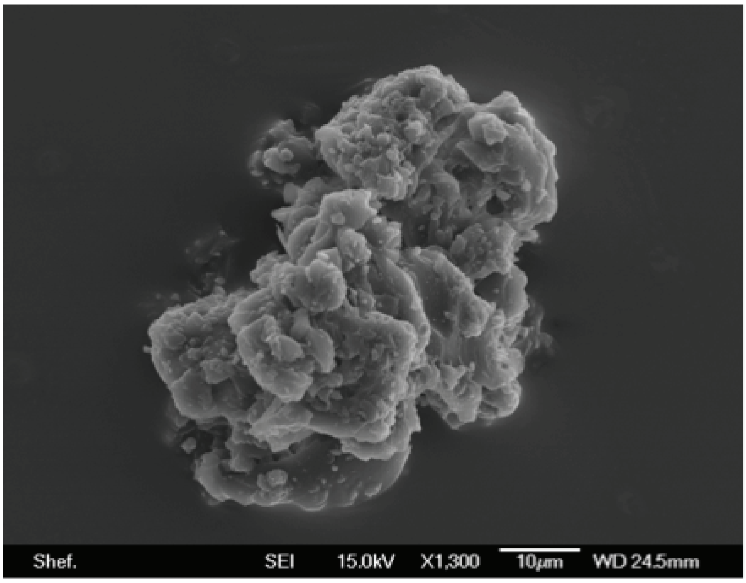
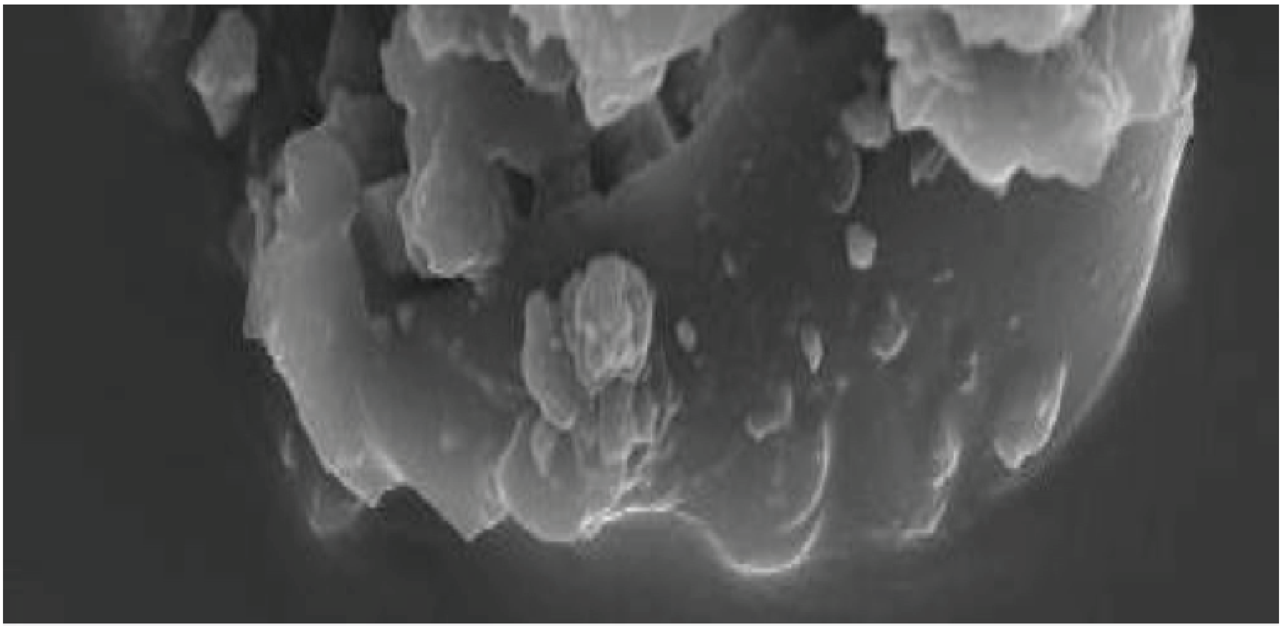


Fig. 2: Detail of the particles shown in Fig. 1.

examination shows is clearly made up of four separate components. These are shown in more detail in **Fig. 2**. On the left can be seen an entity with a flat sculptured surface which appears like a cell which has been flattened by the low pressure of the stratosphere or during E/M imaging (**Fig. 2A**); it also appears to have a small aper-



A



B

Fig. 3: A) An inorganic rich particle mass (approximately 60 micron across). **B)** Detail from the bottom left corner of particle mass; note regularly spaced diatom fibulae.

ture at the top. To the left of this is a large doughnut-like structure (**Fig. 2B**), having a large indentation towards its centre, which is similar to a Red Rain cell, or possibly a diatom (Louis and Kumar, 2006), although there are no further morphological details present to add weight to this suggestion.

Below this is a shield-like structure which, when the image brightness is adjusted, can be seen to have a forward facing secondary shield-like face and below an opening, guarded by what appear to be flaps (**Fig. 2C**). Finally, in the lower foreground can be seen a long tube-like structure possessing a fibre-like interior (**Fig. 2D**). These structures are clearly biological, but with the exception of noting that the doughnut–like entity is highly reminiscent of a Red Rain Cell, we are unable to suggest a relationship with known biological forms.

An inorganic -rich particle is shown in **Fig. 3**A, a detail of which (**Fig. 3B**) shows the presence of a distinct row of regularly spaced non-rounded holes. These we suggest are diatom fibulae, i.e. they are part of a diatom frustule, the boundary of which is not obvious. We have previously reported isolating a diatom frustule-fragment from the stratosphere (Wainwright et al., 2013a). However, the diatom fragment shown in **Fig. 3B** differs from the earlier isolate in being part of an inorganic particle mass and not, as was the former case, a freely existing particle.

Although the biological entities shown in **Figs. 1–3** exhibit interesting morphologies they do not provide any further information about the origin of biological entities in general in the stratosphere. In contrast **Fig. 4** and **Fig. 5** are highly significant and supportive of our view that the biological entities isolated by us originate from space.

Fig. 4 shows a very large particle mass isolated at a height of between 22–27km. This mass is made up of inorganic particles and significantly, filaments which when

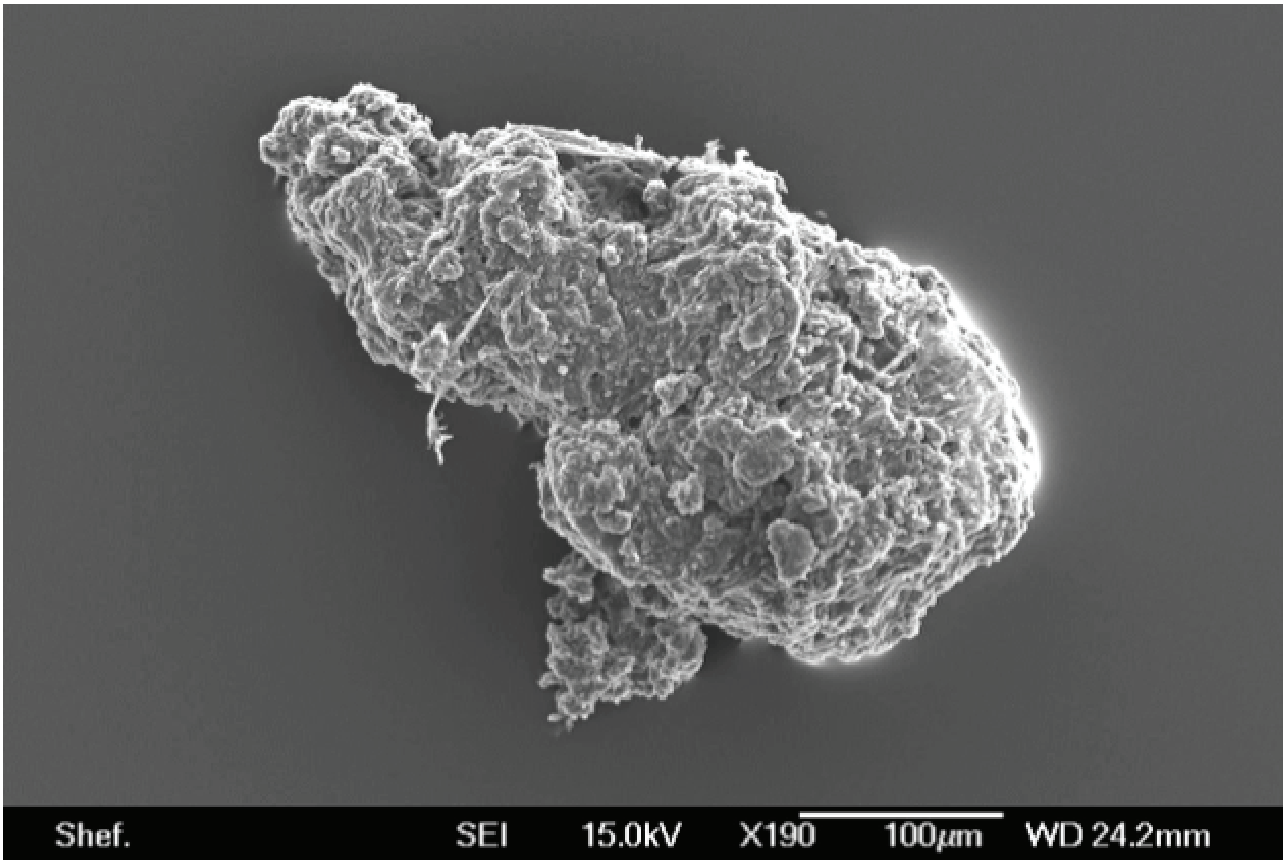


Fig. 4: A large inorganic particle and filament-rich mass isolated from the stratosphere.

analysed using EDX are seen to be rich in carbon and oxygen and are therefore not mineral particles. An interesting filament can be seen emerging from the particle mass (**Fig. 4**); this is shown in more detail in **Fig. 5**. Here we see that the end of the filament forms a swelling from which microfilaments arise and bend backwards. The hand–like structure is similar to spore-bearing structures seen in fungi. It is also noticeable that the filament behind the tip appears to be collapsed. This kind of flattening is probably the result of the low pressures prevailing in the stratosphere, or in the scanning E/M where fungi are often seen to undergo flattening during E/M observation. Such flattening and the results of EDX analysis showing the predominance of carbon and oxygen, exclude the possibility of the filaments being inorganic structures which show no evidence of low pressure flattening and are always rich in various combinations of metal ions, calcium and silicon, while lacking significant amounts of carbon. We conclude therefore that **Fig. 4** shows a large particle composed of inorganic particles and biological filaments.

The particle mass shown in **Fig. 4**, which we have seen contains biological filaments, is around 300 micron in size. Rosen (1969) states the widely accepted view that particles greater than 5 micron cannot be carried from the surface of the Earth, through the tropopausee and into the stratosphere, except possibly following an exceptionally violent volcanic eruption. No such eruption occurred within three years of our stratosphere sampling, during which time any particles of the size shown here would have fallen from heights above 22km. It also seems statistically highly improbable that the biological entities shown here could have originated from orbiting satellites or other man-made space objects. We note that recent news reports of unpublished work relating to the meteorite, which exploded at 23 km over the Russian city of Chelybinsk on February 15, 2013, projected minute dust particles into the high stratosphere and which then spread around the globe. Our sampling trip took place 5 months after this airburst, which it must be emphasised did not carry soil and water from Earth to the stratosphere and could not therefore have acted as the source of the biological entities shown by us, both in this and in our earlier communications.

We argue therefore that, based on established physics, there is simply no way that the particles described here (especially that shown in **Fig. 4**) could have been lofted from Earth to the stratosphere, as a result, we conclude that these particles must be incoming from space to the stratosphere and that biological entities are continuously arriving from space. Again we reiterate an observation made in our previous papers on this subject (Wainwright et al., 2013a, b), namely the remarkable fact that the stratosphere-derived biological entities are remarkably pristine and are not associated with dust or any other debris, including soil or cosmic dust.

The absence of the former militates against an Earth origin while paradoxically, the lack of an association with cosmic dust may at first sight exclude a space origin. The diatom fragment shown in **Fig. 3B**, however, provides an exception to this rule as it forms part of an inorganic

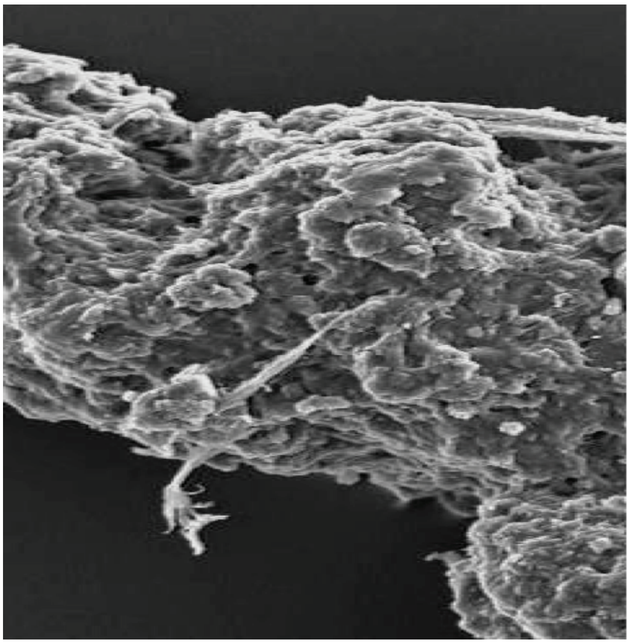


Fig. 5: Detail of the particle shown in Fig. 4. Note the flattened filament present in the centre of the image, the frond-shaped filament tip (bottom centre) and the two parallel filaments on the top right of the particle complex.

particle-rich mass. We explain this apparent impasse by assuming that the particles shown here have originated form an aquatic environment. Water spouts from Earth do not reach the stratosphere, so the only remaining likely aquatic source is provided by the vast amount of water present in comets.

We therefore conclude by suggesting that the biological entities shown here, and described in our previous reports, originated from comets and thus provide strong *prima facie* evidence in support of the theory of cometary panspermia (Hoyle and Wickramasinghe, 1981, Napier *et al*., 2007).

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How to cite this article: Wainwright, M, Rose, C, Baker, A, and Wickramasinghe, N 2013 More Biological Entities from the Stratosphere Including a Diatom Fragment-Further Evidence for a Space Origin. *Journal of Cosmology,* 22, pp. 10267-10271, DOI: http://dx.doi.org/10.5334/jc.sl

Accepted: 31 August 2013