half of its radius. By the time it descends to an altitude of 100,000 ft., the speed is only 1700 miles/hr. and the frictional heating is negligible.

A sphere with a radius of 5 ft., under the same conditions, loses about 7·8 in. The ablation stops at an altitude of roughly 50,000 ft. where it is still travelling at 2000 miles/hr.

The entry of cometoids into the atmosphere is more complicated. In general, the ice matrix will be inhomogeneous, the materials with higher vapour pressures, or higher radical concentration, tending to volatilize first. The entities will therefore gradually hollow out, leaving a connected network of vesicles, or cavities. At the same time, the outer parts which have lower vapour pressures, *e.g.*, water, will tend to melt and refreeze to form a solid, glassy shell.

Gases from the interior will be heated from radical recombinations and by atmospheric oxidation. The gas temperatures will be at least as high as the temperatures found for molecular gases ejected by comets. Gas molecules have been observed[3] to leave comet nuclei with speeds of 1–3 km./sec. This corresponds, for example, to temperatures of 1000°–3000° F. (540°–1650° C.) for methane. Thus, the very cold cometoid is probably filled with very hot gases. The lifetime in the Earth's atmosphere is therefore very limited.

Several mechanisms are discussed which produce lift forces, including the hot-air balloon effect.

The emission of light can be predicted on the basis of laboratory experiments.

Finally, a discussion of the Siberian impact has been included since this appears to be an example of a large, retrograde cometoid which hit the ground.

II. UNUSUAL FIREBALLS

Fireball, as used here, applies to meteors with intensities comparable to the brighter planets. At night they produce noticeable shadows. The increased brightness is ordinarily associated with the added frictional heating, ionization and fragmentation resulting from higher speeds. For example, the von Niessl-Hoffmeister fireball catalogue lists 79% of the 611 entries as possessing hyperbolic velocities.[4] Although Fisher has shown that these velocities are overestimated they are still near the parabolic end or high end of the velocity spectrum.[5]

Brightness of objects seen visually is also associated with wavelength. That is, the eye is not equally sensitive to the different wavelengths in the visible spectrum. Under identical conditions of brightness, a yellow-green fireball radiating 5550 Å. in daylight will appear brightest to most people. However, in dim light the eye becomes more sensitive to green or blue-green light in the neighbourhood of 5050 Å. Thus the peak sensitivity shifts over a range of 500 Å., depending on ambient light intensity. It is not surprising therefore that many bright green fireballs have been seen. The common, greenish-coloured meteor tends to have a pale yellowish tint.

Size also has a direct bearing on brightness. However, in the case of the slow fireballs discussed here, energy stored in the fireball must be responsible for the light emission rather than size or speed, as such. The ability to radiate light while travelling at speeds comparable to aircraft, or less, sets these objects apart from the more common fireballs. In fact, their characteristics seemed for many years to be at variance with accepted behaviour, and observations were seriously questioned and usually omitted from scientific journals. On the other hand, these same characteristics result in such sensational and weird phenomena that they fascinate the public, and observations have always appeared in the popular press.

Many of the objects reported in older journals and books cannot logically be placed in any other known category. The sightings appear to come during a brief period of a few days, or weeks. There are some indications that semiannual or annual returns may occur for a time. Several decades may pass before another grand display. Sporadic sightings are also observed. During July and August in 1952 the U.S. Air Force investigated hordes of unidentified flying objects.[6]

Analysis of fireball observations permits us to distinguish between ordinary fireballs and the type discussed here. An ordinary fireball will usually burn out at an altitude between 25 and 125 miles. The rarer varieties, caused by meteorites, will often reach low altitudes of 10 or 15 miles where they may drop meteorites to the ground, or land intact.

The slow, green fireballs seem to display a variety of novel characteristics. Some of these are listed below.

Brightness.—They appear too bright for their speeds to attribute the intensity to incandescence or to excited states in the stagnation region. Aeroplane pilots have observed "blinding" lights from large, slow objects.

Colour.—The colour of the bright green objects is often a shade of green near 5200 Å. or more. A red halo or red tint has occasionally been observed in the wake. At least one object ended its flight in a silent green flash of light. The nuclei are usually enveloped in a coma which has the shape of a green teardrop or flame.

Size.—They often appear to be quite large, of the order of a few feet to many feet in diameter.

Trajectories.—The flight paths below a few thousand feet in altitude have appeared to be roughly horizontal, indicating some kind of a lift mechanism.

Flight Characteristics.—They have been observed to change course or have an erratic flight path. The altitudes are often less than a few thousand feet although they are rarely accompanied by audible sounds or shocks.

Material Evidence.—Careful searches of areas where flights terminated or where the objects should have hit the ground have never revealed debris of any kind. Falling droplets have been seen after the passage of a fireball.[7]

Up to now there has not been an adequate explanation of these phenomena.