in Figs. 3 and 4. Knaysi, Baker, and Hillier (*1*) have described the endospores of *bacillus mycoides*, which show similarities to some of these fossils. Variations of the discoids include some having up to four perforations. We advance no hypotheses as to the nature of these objects. Possibly a mycologist may recognize them.

Besides the fairly numerous discoids, a number of other typical shapes were seen. A great many rod-like objects were observed, some of which were very probably minerals. Halloysite is known to have a rod-like crystal habit. The rods of halloysite observed by us have all had sharp edges, however, and many of those seen in the shales were rounded. They may actually be fossilized bacteria, but we cannot be certain. One of the rod-like types is shown in Fig. 5.

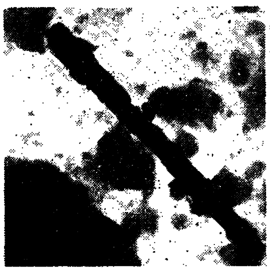

FIG. 5

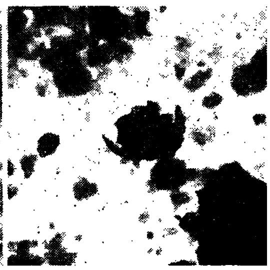

FIG. 6

A few other distinctive shapes are more rare. One of these is shown in Fig. 6. Several such shapes were found. There were also a few surprising shapes which we have seen only once as yet.

Although a considerable number of objects have been observed which may be microfossils, none has been found which was sufficiently characteristic of a particular formation or part of a formation to identify the formation from which it came. Not enough work has been done as yet to conclude that such markers do or do not exist. A great many samples must be examined and correlated from numerous localities in order to compile a catalog of electron microfossils which will be a useful tool in paleontology.

The technique must be examined critically at all stages, from the collection of the sample at the well to the final correlations. The ever-present possibility of contamination must not be overlooked. This contamination may come from the drilling mud or from careless handling of the samples after collection. The sample preparation, including the crushing and dispersion, should be standardized to allow workers in this field to exchange data on the same basis.

The work reported here is a small beginning on the problem. As in any new field, interest in the technique must at first be academic until enough data are amassed to make it useful. It does offer a possibility of making geologic correlations not now feasible.

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The Aerobee Sounding Rocket—A New Vehicle for Research in the Upper Atmosphere

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During the past two and a half years the captured German V-2 rockets have found wide and fruitful application as vehicles for the transport of research equipment into the upper atmosphere (*3*). The firings of the V-2s have been conducted by the U. S. Army Ordnance Department at the White Sands Proving Ground near Las Cruces, New Mexico.

From the beginning it was realized that the available supply of V-2 rockets was limited and that the expense of duplicating them in this country for application solely to research studies was probably prohibitive. Furthermore, the complexity of the control equipment and other necessary accessories required a large technical field group in preparation of the rockets for firing.

Early in 1946 the Applied Physics Laboratory of Johns Hopkins University initiated a program for the development of a small, relatively inexpensive sounding rocket to make possible exploratory as well as comprehensive studies of phenomena in the upper atmosphere, far above balloon altitudes, on a continuing, long-term basis. Support of this development was undertaken by the Navy Bureau of Ordnance with the assistance of the Office of Naval Research.

The Aerojet Engineering Corporation and the Douglas Aircraft Company have now successfully accomplished this development under the technical direction of this Laboratory. The immediate engineering basis for this new rocket was provided by the work of the Jet Propulsion Laboratory of the California Institute of Technology in the development of the WAC Corporal (*2*). In spite of the success of the WAC Corporal, its small payload and small useful volume severely limited its usefulness as a research vehicle.

A schematic outline of the Aerobee, as presently being built, is shown in Fig. 1. The payload of instruments is contained in a thin, pressure tight, ogival nose cone at the forward end of the rocket.

The basic diameter of the rocket is 15″, and the overall length, 226″; the nose cone is 88″ in length. Propulsion is in two stages: a solid fuel booster brings the velocity up to about 1,000′/sec, then falls away. The sustaining motor continues to propel the missile for about 45 sec. At the end of the powered period, the velocity of the rocket is about 4,100′/sec, and the altitude, about 95,000′ (as launched on a near-vertical trajectory). Typical summit altitude is over 70 miles, with a useful payload of 150 lbs of equipment. Payloads of 100–250

[1] Operating under contract NOrd 7386 with the U. S. Navy Bureau of Ordnance.

lbs can be carried with correspondingly greater or lesser maximum velocities and summit altitudes. The Aerobee contains no guidance or control equipment. It possesses arrow stability by virtue of its three fixed tail fins and by virtue of proper location of its center of mass. Control of its trajectory is accomplished by tilting the long (140′) launching tower in accordance with wind data from meteorological balloon runs. The applicable windage theory has been developed by the Ballistic Research Laboratories of the Aberdeen Proving Ground and by this Laboratory.

Data which the instruments yield in flight are "captured" by two methods: (a) radio transmission from a compact 85-mc telemetering set developed by this Laboratory, and (b) physical recovery from the impact wreckage. A great improvement in the success of physical recovery is provided by explosive separation of the tail-fin structure from the remainder of the rocket at a suitable altitude on the descending branch of the trajectory. The tailless missile is aerodynamically unstable and tumbles to earth with a velocity in the order of 150′/sec. Impact shock is thus greatly reduced; for example, photographic film contained in heavy-walled metal casettes is recovered intact.

Firings of the Aerobee are conducted by the U. S. Naval Unit at the White Sands Proving Ground. The Physical Science Laboratory of the New Mexico College of Agriculture and Mechanic Arts provides essential assistance in the operation of telemetering equipment, in other field work, and in the reduction of data.

Following preliminary firings of three dummy missiles, containing no sustaining motor, the first live Aerobee was fired on November 24, 1947. Due to an excessive initial yaw, it was necessary to terminate the thrust of the motor by radio command at 35 sec flight time in order to avoid impact outside of the military range. The resulting summit altitude was, therefore, only 190,000′. The second live firing was on March 5, 1948 and was thoroughly successful. Equipment for measuring the directional intensity and angular distribution of cosmic rays above the appreciable atmosphere was transported to 372,000′ and yielded valuable new data (*1*).

On April 13 a flight of similar summit altitude occurred. Measurements of the earth's magnetic field were accomplished by means of a total field magnetometer apparatus prepared jointly by the Naval Ordnance Laboratory, the Department of Terrestrial Magnetism of the Carnegie Institution, and this Laboratory.

A fourth live round was equipped by this Laboratory with a set of aerial reconnaissance cameras (and with two classified experiments) and fired on July 26. The flight was again normal, with peak altitude over 70 miles. A large number of high-quality aerial photographs of large areas of the earth's surface and of cloud formations in the lower atmosphere was obtained by physical recovery of the film. The potentialities of rockets for reconnaissance over inaccessible areas were again clearly demonstrated. Detailed information on the angular motion of the missile was obtained.

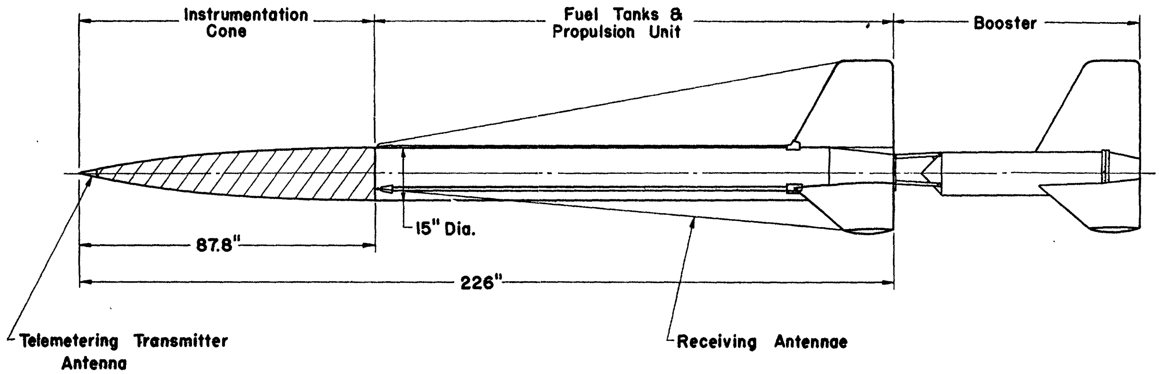

FIG. 1

A series of further experiments is being prepared by this Laboratory for the coming year.

The Naval Research Laboratory, under its sponsor, the Office of Naval Research, is receiving 5 of the original order of 20 Aerobees and has conducted one set of experiments in a flight of August 5.

The simplicity of the rocket and its relative inexpensiveness (as compared to the elaborate V-2) will, it is believed, make possible a wide variety of investigations in the physics of the upper atmosphere. Comprehensive studies of high-altitude phenomena at different seasons of the year, at different times of the day, at different latitudes and longitudes, etc. are now within the range of feasibility.

Detailed reports on diverse aspects of the Aerobee program and reports on results of individual experiments are under preparation by various authors and will be submitted to appropriate journals.

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