Geo. W. Colburn Laboratory, Inc., 164 N. Wacker Drive, Chicago;
Eastman Kodak Co., Rochester 4, N.Y.;
E.D.L. Company, 5929 East Dunes Highway, Gary, Ind.;
General Film Laboratories, 1546 N. Argyle Ave, Hollywood;
Hollywood Film Enterprises, Inc. 6060 Sunset Blvd., Hollywood;
Hollywood Valley Film Laboratories, 12546 Ventura Blvd., Studio City, Calif.;
Solar Cine Products, Inc., 4247 S. Kedzie Ave., Chicago 32;
Technicolor Corp., 30 Rockefeller Plaza, New York;
Western Cine Service, Inc., 312 South Pearce, Denver 9, Col.

2. Animation, Inc., 736 North Seward St., Hollywood;
Castle Films, 1445 Park Ave., New York 29;
Colburn Film Distributors, Inc., P.O. Box 470, Lake Forest, Ill.;
Heath de Rochemont Corp., 9 Newbury St., Boston 16;
Franklin Theatrical Enterprises, 1454 Peerless Place, Los Angeles;
McGraw Hill Textfilms, 330 West 42 St., New York;
Movie Newsreels, 1621 North Cahuenga Blvd., Hollywood;
Sam Orleans Productions, 211 West Cumberland Avenue, Knoxville, Tenn.;
United Artists Associated, Inc., 620 Ninth Ave., New York;
Visual Education Films, Inc., 1211 Sherwood Road, Highland Park, Ill.
3. Castle Films have available in 8mm magnetic sound (black-and-white or color) films in various categories including Travel (*Gay Paris, Hawaii — State of Paradise, London Landmarks*, etc.); Adventure and Animal; Science Fiction; Comedy; Story Classics; Sports; News Parade; Cartoons; and Fairy Tales.
4. United Artists Associated (U.A.A.) lists about 30 films in 8mm sound mainly appealing to children (*Wabbit Trouble; Hare Force; Cagey Canary; Acrobatty Bunny*, etc.).
5. Colburn Film Distributors has a varied list, mostly educational, in 8mm color with magnetic sound, ranging in price from $210.00 for the 33-min *Crescent and the Cross* to $90.00 each for the 11-min *Animals in a Micro-Universe* and the 8-min *Story of Communications*.
6. Franklin Productions have a list of 8mm sound color films mostly in cartoons and short comedies in a price range of $15.00 to $25.00.
7. Nathan D. Golden, "8-mm sound film: new tool for world trade," *Business Screen Magazine*, May 1962.

From a Film: The Three R's of Aerospace Photography

By CHARLES O. PROBST

This paper is an outgrowth of a motion picture, *The Three R's of Aerospace Photography*, which was prepared from hold-takes and "dupes" of current research and development documentation efforts, photo instrumentation and stock footage, plus a little "self-documentation." The purpose of the film is to show program administrators, project engineers, budget planners and military and space administration personnel some of the values of motion pictures as progress reports, briefing and indoctrination films, and historical records.

For presentation at the Convention, a special version of the film was prepared, emphasizing photographic techniques and considerations which would be of particular interest to this group. We are not like the "shoe-maker's children going barefoot," rather, with the help of motion pictures, we hope to show some of the reasons why film is used more and more to support the aerospace industry — why General Schriever of Air Force Systems Command is able to refer to aerospace photography and instrumentation as a billion-dollar business. As stated in the opening of the original film:

"*The Three R's of Aerospace Photography* [are] the ability of film to *reveal* significant events often beyond the capabilities of the human eye; to *report* concepts and programs, bringing together events in time and space; to provide a *record* of events beyond the ability of human memory or written word to preserve."

Revealing by Film

Members of this Society, perhaps more than any others in the country, are aware of what film can reveal. We can watch a failing missile on the way to oblivion. Many of you have seen destruction scenes before, but the particular footage in *The Three R's* shows that this missile did not blow up on impact, but rather was destroyed above the surface.

The camera can reveal a sight few men have seen: the fiery destruction of the rocket package and the survival and re-entry of the glowing nose cone.

Revealing by Compressing Time

Society members are familiar with photographic compression of time. To reveal air traffic patterns for the Federal Aviation Agency, our camera studied a radarscope by filming one frame every 30 seconds, 24 hours a day, for 90 days. As screened at 24 frames/sec, the action was compressed 720 times. Studying the hundreds of "blips" revealed in complex patterns of accelerated movement it seems impossible that so much air traffic can be as well controlled, yet air traffic engineers seek ways to improve it!

Photographic compression provided a composite scene by superimposing the plane movements over the route structure, stretching the radar film so that one second on the screen is one minute of real-time. The print showed rush-hour traffic in bad weather conditions. Aircraft could be seen moving into the airport under radar control at the rate of about one every two seconds (or one every two minutes, as it happened). The communication value of such a piece of film is obvious. Could such a scene be described in words?

By compressing time, the camera reveals to the project engineer things he cannot see with the unaided eye. In similar research, time-lapse cameras were used to study ground-traffic movements at the airport. Everyone who sees the film (shot from the control tower, showing aircraft and ramp action accelerated 48 times) chuckles when it begins, but the research and development people can see things in it which cannot be seen even by those who spend hours in the control tower — for example, the effect of ground vehicles on the movement of the aircraft. In the one-hour's activity shown in one minute, typical actions include one aircraft so affected by ground traffic that it had to stop several times before reaching the end of the runway.

Reporting by Film

The ability of the film to reveal or communicate between the project and the engineer is extended when the engineer shows the film to his associates. Some film reports reach the highest government levels — the Congress, the President of the United States.

Film edited in the form of a report becomes much more significant than mere footage of an event. Professional

This paper was presented on October 25, 1962, at the Society's Convention in Chicago as a special motion picture prepared from various footage and accompanied by commentary by Charles O. Probst, Cinefonics, Cook Technological Center, 6401 W. Oakton St., Morton Grove, Ill. The original commentary had been rewritten to accompany selected still photographs to present something of the Convention presentation.

Fig. 1. Scientific film documentation records details of complex satellite instruments.

Fig. 2. Traffic model constructed to provide controllable traffic situations as if from helicopter simulates up to 11 cars moving in one scene.

lightweight documentary cameras and 16mm color emulsions have given the camera new portability and flexibility. Events widely separated in time and in space can be brought together in a film report, saving travel dollars and time for key management personnel. Photography of tests and of facilities, test equipment, for film reports is made from every kind of camera platform—from supersonic jet to helicopter. Film reports combine engineering photography and documentation, with organization and planning by a film team that understands the subject and the intended audience. Word images must be blended with picture images for efficient communication of ideas. The manner of writing the script, recording the sound and pacing the film add to the intelligence and the validity of the communication (Fig. 1).

Creative Exposition for Reports

Sometimes picture images are created for the presentation of concepts and abstract ideas. For example, we created images of traffic flow for a series of driver-education films.

A traffic model (Fig. 2) was constructed to provide traffic situations which were more controllable than those obtained by helicopter photography of actual roadways. Motive power for each auto was an H-O gage locomotive, carrying permanent magnets and weighted for traction. Compound systems of multiple tracks provided controllable movements of more than one car in the same traffic lane. Each of the cars carried a matching magnet and front wheels which swiveled, so that as the car was towed, it steered itself around the corner along the desired path (Fig. 3). Special tracks were laid for turning radius comparable to automobiles. We had our own form of traffic accident, though these were without "fatalities" and the "property damage" was quite low!

Glass roadways were finally selected after many unsuccessful trials with masonite, aluminum and other non-magnetic materials. Painted glass had a flatness and dimensional accuracy which permitted the magnets to function as a smooth drive system, without touching the roadway surface either above or below (Fig. 4). The young people hired to operate the system and run it for the cameras thought we were silly to *pay* them; but they soon learned that it was quite a task to drive by these remote controls, particularly to satisfy the director and the storyboards.

Photography was in 35mm CinemaScope; Fig. 5 is a still from one sequence, demonstrating left and right turn movements through the traffic signals at intersecting one-way streets. The traffic signals were exaggerated in scale, to provide emphasis for their light action.

Our attempts to park a car with this system led us back to full-size cars. We needed something a little higher than a camera dolly over a miniature — but we didn't use our helicopter. From a 75-foot vantage point on a snorkle, we could observe the action of the driver and also the movements of the front wheels in steering in and out of the parking place.

The car was stripped to the chassis, an outline tube in bright color represented its body and fenders (Fig. 6).

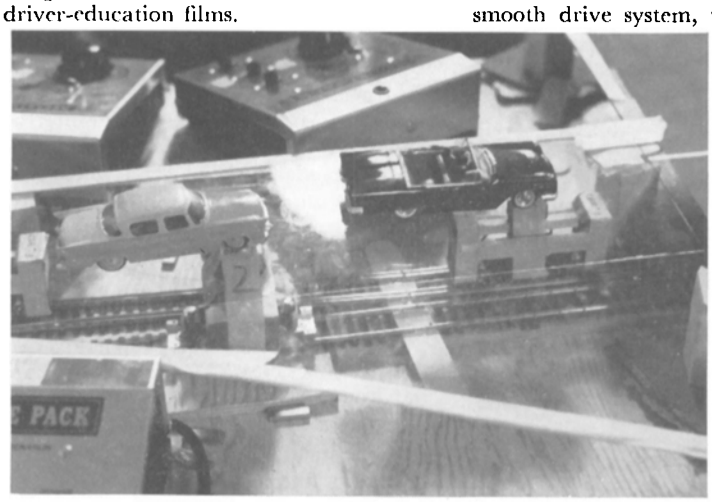

Fig. 3. Each car carriers a magnet; as the car is towed by electric locomotive with magnet it is steered by itself around the corner along the desired path; note glass roadways and special tracks.

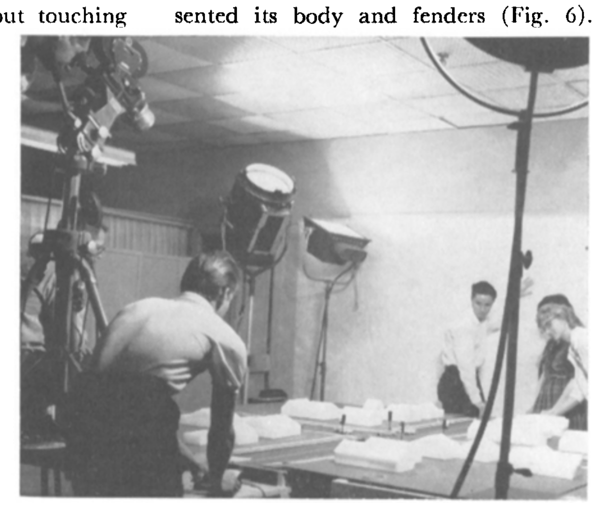

Fig. 4. Painted glass permits the magnets to function as a smooth drive system, without touching the roadway surface either above or below.

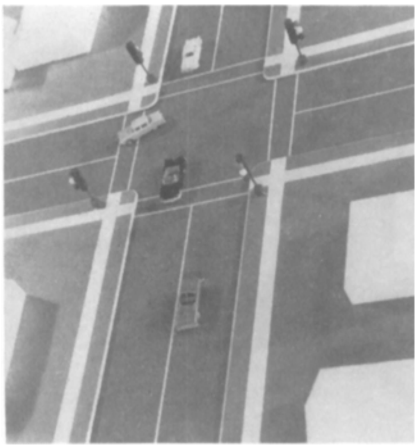

Fig. 5. One sequence in 35mm CinemaScope showing left and right turn movements through the traffic signals at intersecting one-way streets.

Fig. 6. Stripped car filmed from aerial platform "snorkel" demonstrates parking techniques, including driver's actions and wheel movements.

For some reason, photography of the full-sized stripped car seemed to give almost the effect of a miniature model, so the sequences were quite consistent with those made using the electric-train models.

Visualizing the Van Allen Belt

A film report made for the National Aeronautics and Space Administration dealt with exploration of the magnetosphere, or Van Allen Belt, by the satellite identified as "Explorer XII." To begin the film, iron filings on glass were transformed by a magnet into the classic pattern of magnetism around the earth. Documentation footage obtained at milestone points during satellite fabrication, assembly and check-out was combined with brief interviews with scientists in their laboratories.

To illustrate results, animation was used in combination with three-dimensional models. Our ten-inch model of the magnetosphere represents a nominal dimension of 80 thousand miles. It was shown in a space environment in a sequence intended to emphasize the radiation from the sun and its effect upon the earth and its magnetosphere. The scene which ended the film was combined with lettering, by aerial image techniques, to produce black lettering in the hot image of the magnetosphere.

How are these screen results obtained? Earth models in a variety of sizes were constructed and painted from color photographs made during the Mercury Man-in-Space Program. One earth model was 12 inches in diameter; another was just one-inch in diameter and was split on the earth's magnetic equator (Fig. 7). To this earth-model was cemented a balloon, selected after much experimenting — and not a few explosions! The balloon was inflated to a rather precisely determined diameter around the earth model. In the film, the Van Allen Belt was to show different sizes and irregular shapes as the solar wind energies change. To form the torus representing the shape of the belt, the two halves of the earth were squeezed together and held by a hollow-tube and collar arrangement. Additional inflation gave a symbolic shape and size, normally about ten times the size of the earth. The model gives the effect of magnetic particles being drawn toward the north and south magnetic poles of the earth (Fig. 8).

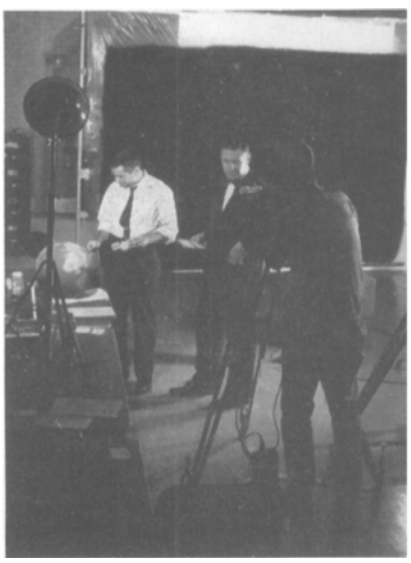

Fig. 7. Earth models constructed and painted for realistic appearance from space. Note that clouds are more obvious than continents.

Fig. 8. Dynamic model of Magnetosphere, simulated by balloon shaped as Torus, normally about 10 times the size of the earth (for a film report on Van Allen Belt).

The magnetosphere and its earth were mounted on a shaft in front of a model universe. Now, one important characteristic of the magnetosphere is its relationship to the earth's *magnetic* equator which is tilted about 11 degrees to the earth's *geographic* equator. In space, the magnetosphere wobbles on a 24-hour cycle.

We soon learned to handle the magnetosphere with gloves, as it just did not seem appropriate for it to show fingerprints! When we had it properly displaced, aligned and goboed (the shaft did not show) we were almost ready for photography.

For those interested in building their own universe, ours was mounted in front of a large sheet of seamless white paper. This reflected a uniform light through a sheet of transparent vinyl which was punctured and sprayed in black. Color patterns were sprayed on, representing galaxy formations.

As the satellite Explorer XII explored the belt of energy around the earth, it telemetered data showing that the outer edge of the magnetosphere has a rather sharp cut-off in space, with a wall thickness of something less than 60 miles in a sphere some 80 thousand miles across. Accordingly, we decided to photograph the model magnetosphere in a slight-soft focus.

When we tried to represent images of this size and perspective, we found that we were "trapped" if we tried to dolly or truck. Even though the camera may dolly or truck some (apparent) 50 thousand miles in space on the scale of the model, this will not have any effect on the images of stars (supposedly) hundreds of light years away. It's traditional to show movement in model and animation space scenes by passing stars behind them, but this is hardly realistic. For a scene showing earth tracking stations as seen from the moving satellite, we held the camera and universe and moved the revolving earth.

This, then, is one way of transmitting scientific findings in space science research. Sometimes sights are shown that men will never really see — but these realistic scenes contain information vital

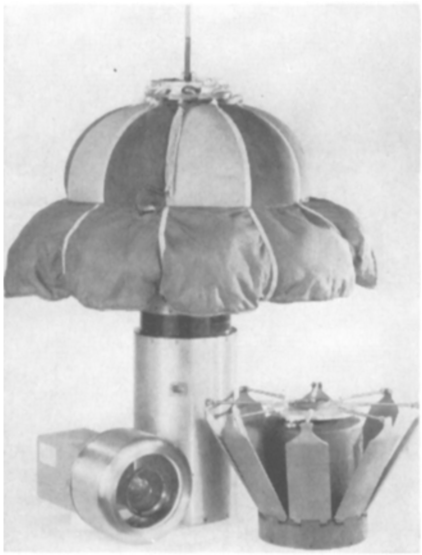

Fig. 9. The camera capsule re-enters atmosphere from space at 6000 miles per hour, slowed by stainless-steel drag brakes, then by paraloon.

to man's forthcoming trips into the space environment.

Sometimes, films taken on actual space flights look as though they were photographs of another of our models! The pictures of the "real thing" were made from Cook Recoverable Camera Capsules designed to protect film, lens and cameras from the hard-vacuum and hostile environment of space. Cameras were Milliken DBM 3, and the lens was a Periphoto, with 110° field-of-view. The pictures were brought back by aerospace recovery systems designed to eject the camera capsule from the missile in space. The capsule then soared through a separate ballistic trajectory of a hundred miles or more from the earth, re-entered at a speed of 6,000 mph and survived the heat of re-entry. It is lowered to the ocean and floated by a paraloon — a parachute-balloon combination. The capsule contains radio beacon, flashing light, marker dye and shark repellant (Fig. 9).

In a recent Atlas firing, two of these camera capsules were carried aloft. As the booster-engine section separated from the Atlas, about 50 miles in space, the camera mounted on the outside looked aft with a 110° field-of-view. The booster section can be seen as it separates and slides aft on its rails. Smoke from the booster engines obscures the silica glass view-port for a moment, but as it clears, the booster section can be seen falling away toward the earth. The cameras were operating at 400 frames/sec with 16mm Kodak Ektachrome ER Film, showing something less than 10 sec in the life of an Atlas — 10 sec which photo-instrumentation engineers have made available to aerospace engineers and scientists.

The Record — Film Archives

The third "R," the Record, is illustrated by archival footage of the original military airplane — the Wright Flyer, filmed in 1908 by a cameraman with a sense of history. Much of the engineering film made during aerospace research and development becomes a matter of record and belongs in the archives where it can be available for analysis, legal claims, and permanent record of research and development activities. For those of us who generate this kind of material and make these film reports, this means that "nobody cuts the original of documentation!" For the Society of Motion Picture and Television Engineers, this means that better *original* emulsions, better *master* emulsions and better processing are needed. Better printers to make *contact* masters are needed, as are *rapid*-processing techniques and good long-term storage of materials.

Conclusion

Progress in these areas in the last five years has been indeed fantastic. Improved laboratory work makes it possible to show third and fourth generation color prints, which a few years back would have impractical. As improvement continues, cameras and television equipment will travel ahead of man, to other planets in our solar system — for real "way-out" aerospace photography.