Toxic Waste Disposal a Growing Problem

EPA may put midnight dumpers, gypsy haulers out of business, but it has little power to clean up existing problems

The Ward Transformer Company of Raleigh, North Carolina, paid $75,000 to Robert Burns, owner of Transformer Sales Company, to haul away and dispose of 31,000 gallons of transformer fluid containing highly toxic polychlorinated biphenyls (PCB's). Instead, according to a grand jury indictment, Burns dumped the chemicals along the side of 270 miles of North Carolina roads. The state is now trying to find a site to dispose of 30,000 cubic meters of contaminated soil.

Small firms throughout Kentucky hired the late A. L. Taylor to haul away toxic wastes generated during the course of their business. What they did not know, according to the Environmental Protection Agency (EPA), was that Taylor was dumping the barrels of waste on a 17-acre field at Stump Gap Creek, about 20 miles south of Louisville. When environmental officials discovered the site last year, it contained more than 100,000 steel drums, many of them rusted, dented, buckled, and riddled with gunshot holes. Federal officials estimate that it will cost $100 per drum to analyze their contents and dispose of them, but there is no money available.

This is the first of a series of four articles on the problems of disposal of hazardous wastes. The subsequent articles will discuss the technology of waste disposal.

The highly publicized leakage of toxic wastes from industrial landfills such as the Love Canal area in Niagara Falls (see box) is only part of the story of toxic wastes. Legal dumpsites gone awry, tragic as they may be for the individuals involved, may not be the most serious problem with disposal of hazardous wastes. Illegally dumped wastes and incomplete and unsecured dump sites throughout the country represent a far more severe hazard, both because they are so numerous and because people who live near them are generally unaware of their existence.

It has become almost commonplace for investigators to find drums of chemicals of unknown ancestry hidden in abandoned warehouses, stored on small lots in rundown sections of cities, stashed under elevated roadways or in open fields beside them, poured onto the ground on vacant lots or rented farms, or simply dumped into municipal sewers and private wells. A substantial number of otherwise adequate industrial landfills have also been inadequately secured so that their integrity is highly questionable.

Hazardous materials at such sites can produce fires and explosions, contaminate ground and surface water, pollute the air, accumulate in the food chain, and produce poisoning, birth defects, and tumors. EPA has documented more than 400 cases of damage to health and the environment due to improper management of hazardous wastes, and that is but the tip of the iceberg; many times that number could undoubtedly be documented if EPA did not have such extremely limited manpower. EPA has been given broad new authority to regulate hazardous waste disposal under the 1976 Resource Conservation and Recovery Act (RCRA), but critics argue that the agency has been slow to wield that authority. EPA officials, in turn, argue that great care must be taken in promulgating regulations for hazardous waste disposal because the subject is so different from anything that the agency has dealt with in the past. RCRA, furthermore, is oriented primarily toward regulation of new wastes and waste disposal sites and gives EPA only limited power to deal with existing situations.

Hazardous wastes—defined by EPA as those that are ignitable, corrosive, reactive, or toxic—account for 10 to 15 percent of all industrial wastes, or about 35 million metric tons per year. The total has been growing by about 3 percent annually. About 12 million metric tons of hazardous wastes are produced by the chemical industry itself, but significant amounts are produced by virtually every type of industry.

Some of the solid waste is recycled, some is burned, and some is dumped at sea (although that option will no longer be permitted after 1981), but most of it is simply buried in one of what seem to be innumerable landfills. There are now some 18,500 sites for disposal of municipal solid wastes, 23,000 for disposal of sewage sludge, and more than 100,000 for industrial wastes; uncounted others have already been closed. About 75 percent of hazardous wastes are disposed of on the property of the companies that generate them; the remainder is handled by waste disposal companies. Only 10 percent of all hazardous wastes are disposed of in a manner consistent with proposed federal regulations, according to EPA estimates. Nearly 50 percent is disposed of by lagooning in unlined surface impoundments, 30 percent in nonsecure landfills, and about 10 percent by dump-

Drums of toxic chemicals lie undisturbed under a skyway in New Jersey. [*Photo: Joe Dunphy,* Chemical Week]

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"An Environmental Time Bomb Gone Off"

Landfills for chemical wastes have frequently been called ticking time bombs. It is no surprise, then, that Love Canal has been called "an environmental time bomb gone off." The bomb analogy is particularly appropriate because, today, the Love Canal area of Niagara Falls looks like a war zone. The 235 houses nearest the landfill are boarded up and empty, surrounded by an 8-foot-high Cyclone fence that keeps tourists and looters away. Still other houses outside the fenced area are also boarded up and deserted, their owners having fled the unknown. Here and there throughout the surrounding neighborhood, newly erected green signs mark the pickup points for emergency evacuation in case there is a sudden release of toxins. An ambulance and a fire truck stand by in the area at all times as construction workers struggle to seal off the flow of chemicals and render the area once again safe—if not exactly habitable. The scene offers mute testimony to the hazards of improper storage of toxic wastes.

Love Canal takes its name from William T. Love, a 19th-century visionary who attempted to create a model city and industrial area near Niagara Falls to take advantage of the area's cheap hydroelectric power, which at that time could not be economically transmitted over long distances. The keystone of the project was to be a navigable canal connecting the Niagara River above and below the falls. His vision was shattered by recession and by Louis Tesla's discovery of a cheap way to transmit electric power long distances. All that remained of his vision was a partially dug section of canal in the southeast corner of the City of Niagara Falls.

Industry was also attracted to the area by the abundance of electric power and water and, in the 1920's, the partially excavated section of canal became a chemical and municipal disposal site for several chemical companies—most notably the Hooker Chemical Corporation—and the city itself. About 21,800 tons of chemical wastes were deposited in the canal before it was closed and covered with a clay cap in 1953.

The seeds of tragedy were sown in the late 1950's when about 100 homes were erected immediately adjacent to the landfill and an elementary school was constructed on top of it. Excavations associated with the construction and the underground installation of utilities apparently damaged the integrity of the cap. Water from the heavy rains and snows of the last few years filled the clay basin holding the chemicals to overflowing, and the chemicals began oozing to the surface and seeping into basements of the adjacent homes. Residents of the area began to notice pools of thick, black sludge on the ground surface, noxious odors, and symptoms of respiratory distress.

Their protests finally caught the attention of authorities and, last April, after investigators had found evidence of toxic chemicals in several homes, then-state health commissioner Robert P. Whalen ordered a complete study of the area. These studies showed that hazardous levels of many toxic chemicals existed in the basements of homes adjacent to the site—but fortunately not in the living areas of the houses—that young women in certain areas around the canal had as much as three times the normal incidence of miscarriages, that children born to families in the same area had as much as 3.5 times the normal incidence of birth defects, and that many of the adults showed incipient liver damage.

On 2 August, Whalen declared an imminent health hazard in the area, closed the elementary school, and recommended the evacuation of children under the age of two and pregnant women from the ring of homes surrounding the canal. A week later, New York Governor Hugh L. Carey announced that the state would purchase the 235 homes nearest the landfill, evacuate the families, and find new homes for them. Subsequently, President Jimmy Carter declared the zone a disaster area, qualifying the families for federal assistance; this marks the only time such a proclamation has been issued as the result of a chemical disaster. All of the families in the immediate vicinity of the canal were moved by the end of the year, and subsequent studies have shown that the liver damage has been reversed and that the individuals are generally in good health.

As the studies have continued, investigators have found evidence that more than 300 chemicals are present in the soil and homes and have identified more than 100 of them. David Axelrod, the present state health commissioner, estimates that as many as 10 percent of the chemicals may be mutagens, teratogens, and carcinogens. Traces of the chemicals have been found as far as several blocks from the site and in the Niagara River on one side of the site and the Black Creek on the opposite side. Some chemicals are believed to have flowed to these locations through underground stream beds that crossed the site, some may have been tracked by vehicles, and some contaminated soil may even have been dumped in the creek during construction in the area. In view of these findings, Axelrod recently recommended evacuation of all children under the age of two and pregnant women who live within six blocks of the site. Other investigators, such as Beverly Paigen of Roswell Park Memorial Institute, argue that a much larger evacuation should be carried out because of the potential hazard.

The scene offers mute testimony to the hazards of improper storage of toxic wastes.

Meanwhile, public health authorities are digging trenches 2 to 4 meters deep along both sides of the canal and installing perforated drainage pipes surrounded by gravel. These pipes will collect groundwater contaminated by the chemicals and direct it to an onsite facility where the chemicals will be adsorbed onto activated carbon. The entire landfill is also being capped with a new layer of clay to prevent any more water from entering the basin. The cost of the cleanup is estimated at more than $30 million, but lawsuits resulting from the incident now total more than $2 billion. The fate of the elementary school and the houses closest to the landfill has not been decided yet, but it seems likely that they will be either moved away or leveled. Even if the landfill should be secured, it is not likely that anyone will want to occupy the buildings again.—T.H.M.

ing into sewers, spreading on roads, injection into deep wells, and incineration under uncontrolled conditions.

There is no clear indication how many of these sites are dangerous. A recent report prepared for EPA by Fred C. Hart Associates, however, estimated that potentially significant health and environmental problems may exist at anywhere from 1,200 to 34,000 sites across the country. Health problems, including "illnesses, injuries, poisoning cases, and deaths," were found at 232 sites studied by the Hart team in detail. They also found that 75 percent of all landfill sites are in areas "particularly susceptible to contamination problems"—in wetlands, on floodplains, and over major aquifers. The study estimated that it would cost more than $44 billion to eliminate totally the potential health dangers associated with the sites.

The haphazard management of dump sites must be considered especially astonishing in view of the potential longevity of many of the wastes. It is true that some of the more reactive chemicals will be degraded after a few months or a few weeks of storage. But the more stable materials, such as PCB's, may retain their chemical identity—and their toxicity—for decades, perhaps for centuries. Still other toxic materials are permanent hazards—a cadmium atom or a beryllium atom will remain that forever. From this perspective, the much-bruited half-lives of radioactive wastes from nuclear power plants seem almost transient. The volume of nuclear wastes also seems small in comparison. Only about 5000 metric tons of nuclear waste have been accumulated since the beginning of the nuclear era, four orders of magnitude less than the amount of toxic wastes generated in 1 year.

The design of most of the landfills now in use is not inherently bad. In essence, the approach is to construct an impoundment such that any liquids contained within cannot get out and external waters such as rain and groundwater cannot get in. In practice, this is achieved by enclosing the wastes in a basin with walls, bottom, and cap constructed of 3 meters or more of very dense clay; such clay has a permeability to water of about 1×10^{-7} centimeter per year. Such a vault should be very secure if it is not breached. Unfortunately, breaches seem not to be rare. An undiscerned crack in the clay, for example, can provide a much less resistant pathway for the migration of various chemicals. Earthquakes and other natural phenomena can produce cracks in the vault after it is sealed. Man's activities can also destroy the vault's integrity, as apparently was the case at Love Canal.

Far more threatening to life and the environment, however, are those chemicals that don't make it into secure landfills. Many of the activities of midnight dumpers, gypsy haulers, and some small companies border on the incredible:

▶ The Union Carbide Corporation contracted with Nicholas Fernicola for disposal of 4500 55-gallon drums of organic wash solvents, distillation residues, and other organic wastes. Fernicola abandoned the drums on a former chicken farm near Toms River, New Jersey, EPA says, telling the owners from whom he had leased the lot that the drums were empty. The owners subsequently discovered that the barrels were leaking chemicals into the ground. Two years after the barrels were removed to a secure landfill, traces of the chemicals were found in the aquifer that supplies local wells. Cleanup at the site and replacement of the water supply have so far cost Carbide $100,000 and the EPA more than $400,000. As in most other cases of this sort, civil lawsuits are still pending.

▶ William J. Carracino, president of Chemical Control Corporation of Elizabeth, New Jersey, and other officers of the company have been convicted of, among other things, emptying a tank truck containing chemical wastes into Elizabeth Creek and into a sewer that leads into Newark Bay; abandoning drums of chemical wastes at various locations; and saturating dry garbage with toxic chemical wastes and hauling the contaminated garbage to landfills intended only for municipal garbage.

▶ Salisbury Laboratories, which produces veterinary pharmaceuticals at a plant in Charles City, Iowa, has been dumping chemical wastes, principally arsenic, onto a 7-acre site since 1953, EPA says. Arsenic from the site is now being leached into the nearby Cedar River. The estimated cost of digging up the landfill and moving it is $30 million. The total worth of the company itself is only $5 million.

▶ A plant producing fungicides and other mercury compounds operated for years, under several different owners, at a site about 2 miles north of the Meadowlands Sports Complex in New Jersey. During the manufacturing process, EPA investigators have found, as much as 2 kilograms of mercury per day was slopped onto the floor and washed into the swampy area outside the plant; much of it eventually entered Berry's Creek, which flows into the Hackensack River. A recent state investigation at the site showed concentrations of mercury as high as 123,000 parts per million in the creek and surrounding land; a dose of 160 parts per million is generally considered lethal and EPA restricts mercury concentrations in drinking water to less than 1 part per billion. Robert M. Wolf, a New Jersey realtor and land developer who bought part of the site in 1974 without knowing about the contamination, has already spent more than $2 million trying to contain the mercury, and it appears that a complete cleanup will cost at least another $6 million.

Thousands of containers leak their contents into the soil at the "Valley of the Drums" in Tennessee. [*Photo: copyright © 1979, Louisville* Courier-Journal, *reprinted by permission*]

EPA's only authority to deal with such existing situations, says Steffen Plehn, deputy assistant administrator of EPA for solid wastes, comes under the "imminent hazard" provision of RCRA. The agency can act only if there is an immediate danger to public health, he says, and such a danger is often difficult to prove. Furthermore, he adds, the agency has only very limited funds for work at such sites, and most of those funds were expended at Love Canal and in removing drums of chemicals from floodwaters at Stump Gap Creek.

Critics such as A. Blakeman Early of Environmental Action and Leslie Dachs of the Environmental Defense Fund, however, argue that EPA has been reluctant to use its authority because top administrators at the agency have had no clear conception of how existing problems should be handled and because they have been more interested in developing regulations for the future. At the very least, such groups argue, inactive dump sites should be identified and the owners of the sites should have to meet at least minimum requirements for site security, monitoring, and postclosure care. Particular attention should be paid, Dachs says, to those existing facilities that would close down shortly before the proposed regulations take effect, and would

thereby under the currently proposed rules be freed of future responsibility for the sites.

Plehn readily admits that the pressures of correcting errors committed in the past while at the same time trying to prevent future ones has often seemed to be beyond the resources of the agency, but he notes that the agency was specifically directed by Congress to address future storage problems. In the aftermath of Love Canal and other highly publicized discoveries of hazardous dump sites, however, EPA has had little choice but to become more vigorous in its attack on errors of the past.

The first fruits of that renewed vigor appeared in February when the Justice Department, in conjunction with EPA, filed suit against three companies, charging that they improperly dumped hazardous wastes at the Kin Buc Landfill in Edison, New Jersey, before the landfill was closed in 1976. The suit seeks $1.6 million in damages and penalties, permanent closing of the landfill, and action to halt leaching of the chemicals into the nearby Raritan River. The defendants in the suit are: Scientific Inc. of Scotch Plains, New Jersey, which operated the site through subsidiaries; Inmar Associates Inc. of Scotch Plains, which owns the land; and SCA Services of Boston, one of the companies that used the facility.

In a second suit, brought this month, the Justice Department has charged Eastern Rubber Reclaiming Company of Chester, Pennsylvania, and ABM Disposal Services Company with improperly storing hazardous wastes at a site in Chester. The suit would force the companies to clean up the site, at a cost estimated to be between $1.5 million and $3.5 million, and would prohibit further storage of hazardous wastes on the site. At about the same time, EPA deputy administrator Barbara Blum announced that EPA and Justice would join forces for investigation of about 300 dump sites per year, and that this could result in as many as 50 prosecutions per year. EPA is asking Congress for $131 million for 190 new personnel to investigate and do the legal legwork.

State governments are also beginning to move into the vacuum created by lack of EPA action. New Jersey has been in court trying to force Ventron Corp., a subsidiary of Thiokol Corp. of Beverly, Massachusetts, and Velsicol Chemical Corp. of Chicago, former owners of the plant near Berry's Creek that produced the mercury, to pay for the cleanup. Late in February, Michigan filed a multimillion dollar lawsuit against Hooker Chemical Corporation in an effort to make the firm clean up wastes from its pesticide manufacturing plant in Montague. Chlorinated hydrocarbons from the dump, Michigan contends, have contaminated some private water wells and are seeping toward nearby White Lake. These states and others are said to be contemplating similar suits to force cleanup of other disposal sites, and some sources within the chemical industry speculate that the industry may be facing an onslaught of lawsuits unlike any ever seen before.

Congress may also take action against existing sites. At a February meeting of the Manufacturing Chemists Association, Representative James J. Florio (D-N.J.), chairman of the House Subcommittee on Transportation and Commerce—which has jurisdiction over RCRA—told the group that he will "convene hearings, summon witnesses . . ., and present a Congressional proposal" for cleaning up and minimizing the danger from inactive dump sites. More recently, Representative Robert Eckhardt (D-Tex.), chairman of the House Commerce Committee's Investigations Subcommittee, sent out very detailed questionnaires to the 50 largest U.S. chemical manufacturers to attempt to learn where inactive sites are located and what they contain. The subcommittee wants the information by the end of June.

Congress may also act to provide funds for cleaning up abandoned sites. One proposal favored by EPA, environmental groups, and some members of Congress would create a "superfund" from taxes on petroleum products and chemicals. In one proposal, refineries would be charged up to 3 cents per barrel of oil received, chemical-processing facilities would be charged as much as 60 cents for each barrel of refined petroleum products used (or for an equivalent quantity of natural gas), and companies that ship materials such as arsenic, mercury, and chlorine would be charged as much as $5 per ton. Other proposals would place taxes on companies that dispose of hazardous wastes. In any case, the fund would grow at a rate of $300 to $400 million per year until it reached $6 billion. The fund would be used, however, only if the cost of cleanup could not be recovered through lawsuits and other recourses.

As pressing as the problems of existing hazards may be, it is perhaps even more important to ensure that future hazardous wastes are handled in an acceptable manner. To that end, EPA has during the past year proposed seven major sets of regulations and guidelines for disposal of hazardous wastes. These cover: definition of hazardous wastes; standards of operation for generators and transporters of such wastes; standards for storage, treatment, and disposal facilities; a permit system for companies that transport, treat, store, and dispose of hazardous wastes; guidelines for development of hazardous waste programs by states; and establishment of a notification system for wastes.

The heart of the program involves what is known as "cradle-to-grave" monitoring of hazardous wastes. Any company that produces more than 100 kilograms of hazardous wastes per month will be required to provide manifests for all hazardous materials that are to be disposed of offsite. Any company that transports the waste must carry the manifest with the wastes, get it signed at the disposal site, and send a copy back to the generator. The company that disposes of the wastes must do the same. In this fashion, the waste generator will be able to follow the progress of the material to ensure that it is properly disposed of, and EPA will be able to monitor the whole operation. Critics such as George Kush of the National Solid Wastes Management Association, however, argue that this proposed rule is too lenient, and that it should be extended to cover all companies that dispose of wastes offsite.

Other provisions of the new regulations require operators of disposal sites to monitor them continuously during their operation and for 20 years after the sites are closed. The operators must also assume liability for as much as $10 million in damages for any incident resulting from operation of the site. Regulations covering this type of financial liability are a new concept for both EPA and the federal government, Plehn says, and the deliberations involved in creating them were part of the reason it took so long to issue the regulations.

EPA estimates that the cost of the new regulations for the 17 major industries affected will be $750 million, or about a third of a percent of their total sales. Some industry sources contend the cost could go as high as $25 billion, but that figure seems clearly to be exaggerated. Whatever the ultimate cost, EPA clearly hopes that an increased cost of waste disposal will lead to a decreased generation of wastes and to increased recycling of the valuable materials found in wastes. It should also enhance the attractiveness of other, more acceptable disposal techniques, such as controlled incineration, chemical and biochemical treatment, and solidification. EPA's goal, Plehn says, is that disposal in land-

fills should be used only as a last resort.

Enforcement of the new regulations will not begin until mid-1980. A coalition of environmental groups had filed suit in federal court seeking speedier implementation, but the judge ruled that EPA had been proceeding in good faith and as fast as practicable. Meanwhile, some 41 states have sought, and are expected to receive, interim authority to conduct their own hazardous wastes programs under a section of RCRA that allows EPA to delegate much of its authority. A few have already enacted their own laws. New Jersey, California, and Illinois, for example, already operate manifest systems for hazardous wastes, and New Mexico is expected to begin one soon. New York and Michigan are also considering construction of state-operated disposal facilities, and New York recently established a commission to select sites for landfills.

Regulations in other states are generally less stringent, however, and that is creating problems for both the states and the industries. Industrial facilities in states with restrictive laws on waste disposal suffer a competitive disadvantage, says New York State health commissioner David Axelrod, because their counterparts in states with less restrictive rules can manufacture products more cheaply. The states are also hurt, he adds, because industries will gravitate to states with fewer restrictions. EPA administrator Douglas Costle, however, argues just the opposite. He thinks industries will build their new facilities in states with restrictive disposal laws in hopes that this will limit their potential liability if their disposed wastes should ever become an environmental or health hazard.

In any case, disparities in the law will probably lead to a greatly increased transport of toxic wastes—with the attendant hazards. Already, hazardous materials that require the most expensive disposal techniques in states like New York and New Jersey are being transported to states such as Ohio with less restrictive requirements. Rhode Island, says Ronald Buchanan of New Jersey's Department of Environmental Protection, "has become the Mecca for hazardous and chemical wastes disposal" in the East because it will accept all types of waste for landfills at minimal cost.

The states are thus pushing for EPA to accelerate implementation of its hazardous wastes regulations. Industry has the same goal because it would like to operate under uniform laws throughout the country. Legitimate waste disposal companies favor the new regulations, and would like even stronger ones, because the laws can only increase their business. All three groups would like to see EPA extend its authority even further in some cases; in particular, they would like the agency to take some of the heat off local governments by giving its imprimatur to new landfill sites. About the only groups that think the new regulations are too restrictive are the midnight dumpers and the gypsy haulers.

—THOMAS H. MAUGH II

New Breed of Telescope Born in Arizona

Delayed by harsh winters and flooding, the revolutionary Multiple Mirror Telescope finally begins routine observations

The astronomy community is watching with anticipation as a new type of telescope begins operation on Mount Hopkins in Arizona. The Multiple Mirror Telescope (MMT) is particularly intriguing because it may be the prototype for future telescopes more powerful than any yet built. A joint project of the Smithsonian Astrophysical Observatory (SAO) and the University of Arizona, the MMT will test the feasibility of making a large telescope by combining the light from several small telescopes at a single focus. This revolutionary concept is already under consideration for very large telescopes, such as the 10-meter reflector in planning at the University of California, that would be prohibitively expensive to build using conventional designs.

The MMT will do more than just test the multiple mirror concept. It is the largest telescope specifically designed for use at infrared wavelengths, and as such, is expected to provide unparalleled opportunities for astronomers interested in comparatively cool celestial objects—for example, dust clouds enveloping stars.

As an added bonus, the MMT is designed to make particularly good use of its light-gathering ability in spectroscopy at visible and near-ultraviolet wavelengths. Thus it should be easier to study very faint celestial bodies such as distant galaxies and to examine the unusually faint spectral lines of distant quasar-like BL Lacertae objects.

Conventional telescopes usually contain one large parabolic mirror—the "primary." A much smaller "secondary" mirror receives the light gathered by the primary and, with the help of other mirrors, directs it to some location for observation. In essence, the MMT consists of six conventional telescopes, each with a primary mirror 1.8 meters in diameter. All six are mounted in a hexagonal array that can be swiveled horizontally and tilted vertically to track celestial objects. By combining the light from all six telescopes at a single focus, the MMT achieves the light-gathering ability of a conventional 4.5-meter telescope.

A small (0.76-meter) telescope mounted in the center of the array is used to aim the MMT. Light entering this "guide" telescope from a reference star (not necessarily the object being studied) is focused on a group of photodetectors linked to a computer. The computer steers the whole array so that the guide telescope remains pointed directly at the object under investigation.

A feedback system keeps the individual telescope modules in focus and pointing in the same direction as the guide telescope. Errors in focus and alignment are corrected by small movements of the individual secondary mirrors.

Part of the MMT's advanced capability in the infrared is due to the special care taken to minimize infrared radiation entering the telescope from its own structural components. Less than 1 percent of the MMT's field of view is obscured by support structures.

Another part of the MMT's infrared ability derives from the use of special lightweight secondary mirrors that can move very rapidly. Each telescope module has one such mirror, and all six secondaries can be moved in synchrony. Thus the infrared detector at the shared focus for all the telescopes sees either the object of interest or a patch of night sky without celestial sources. In this

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