

# **SITE PRESERVATION AT PALOMAR OBSERVATORY**

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**ABSTRACT** Palomar Mountain was selected as the site of the 200-inch Hale Telescope in 1934. Since then, and especially over the past decade, the population growth of southern California has had a growing adverse impact on the observatory's environment. In 1981, a very active program was initiated to work with the local governmental agencies to prevent further deterioration of the conditions as the area continues to become increasingly urbanized. The character and scope of the program are described in the paper, as well as more general observations relating to the site preservation process.

## **INTRODUCTION**

The Palomar Observatory, like many of the major optical observatories in the world, is faced with the prospect of increased man-made interference. The most obvious form of this interference is sky glow, or light pollution, from artificial lighting, but the effects of air pollution, aircraft operations and radio frequency interference are also important. To meet these threats, Gerry Neugebauer (the Director of Palomar Observatory) and I have had to expend a greater fraction of our resources to protect our facilities.

The aim of this paper is to describe the situation at Palomar and to share our experience. To be sure, the different local conditions make the situation at each observatory a unique case, but there certainly are elements of this issue that are common to all.

## **HISTORICAL BACKGROUND**

Palomar Mountain is located in the northern part of San Diego County, about 70 km (about 45 miles) from the city of San Diego and about 160 km (about 100 miles) from the Los Angeles basin to the west-northwest. Following an extensive search for potential sites, it was selected in 1934 to be the home of the 200-inch Hale Telescope because of the large percentage of clear nights, good seeing and, at the time, isolation from urban areas and city lights.

The observatory buildings and the telescope structure were constructed before the entry of the United States into World War II, but completion of the 200-inch mirror was delayed until 1946. The mirror was installed in the telescope

in 1947 and the telescope was dedicated in 1948; it has been in use ever since.

According to the United States Census, the total population of San Diego County in 1930 was about 210,000 people. Riverside County to the north had a population of 81,000; Los Angeles and Orange Counties had a combined total of 2,327,000 people. Since then, southern California has experienced an astounding degree of growth. By 1980, San Diego County had a population of about 1,862,000, nearly a ninefold increase since Palomar was selected for the 200-inch; the population increases in Riverside, Los Angeles and Orange Counties has also been accelerating greatly. Much of this increased population has been accommodated by the urbanization of previously undeveloped agricultural areas, especially in Riverside and San Diego Counties near Palomar.

By the 1960s, light pollution was already evident at Palomar. Mercury emission lines, largely due to street lighting, were seen in spectra taken at the 200-inch. Spectra taken at Las Campanas Observatory in northern Chile, representing a pristine condition, show that the sky at Palomar is about 0.75 magnitude brighter than the natural background.

In 1981, Riverside County began a program to replace its existing mercury vapor street lights with more efficient sodium vapor lamps. In trying to decide between high-pressure and low-pressure sodium, the County Planning Director asked us to comment. This marks the beginning of our continuing program to mitigate light pollution and other environmental problems affecting Palomar Observatory.

## THE PROGRAM

### General:

In working with the communities around Palomar Mountain, we divided the light pollution problem into two parts: street lighting and all other sources.

An important element in our program to control light pollution is to restrict the use of continuum and quasi-continuum types of lighting to the greatest degree possible. We recommend the use of low-pressure sodium (LPS) lamps in as many applications feasible, especially street lighting.

### Street Lighting:

In southern California, a community can either own and maintain its street lighting system or pay the local utility company for this service. The distinction was very important at the beginning of our program because the two utilities in our area, the Southern California Edison Company and the San Diego Gas and Electric Company initially strongly opposed our recommendations regarding the use of low-pressure sodium lights. In 1981, neither company would allow the use of LPS on company-owned lighting systems and strenuously resisted our efforts in this direction. Fortunately, for a variety of reasons, this situation has improved markedly.

Working with a community to enact a street lighting policy requires many meetings, first to elicit the support of the city staff, and then of elected officials, a process that requires a fairly thorough knowledge of current lighting practices and technology.

Our achievements in the area of street lighting are, in brief:

Riverside County - All new street lights installed within 30 miles of Palomar since 1983 use LPS. Southern California Edison was allowed to convert its existing 5000 mercury vapor (MV) lights in that zone to high-pressure sodium (HPS).

San Diego County - All new street lights in the county since 1984 use LPS.

City of San Diego - The entire system of 27,000 lights is being converted from MV and HPS to LPS.

City of Escondido - All new lights are LPS.

City of Poway - All new lights are LPS.

City of Hemet - All new lights are LPS.

City of Vista - All new lights are LPS.

City of San Marcos - All new lights are LPS.

Caltrans - About one-third of the interchanges along Interstate 15 south of the San Diego County-Riverside County line have been converted from HPS to LPS.

### **Other Forms of Lighting:**

Control of other forms of lighting is achieved by means of ordinances within the individual jurisdictions. Although the ordinances in each of the communities differ in detail, they all share several essential features.

We define three classes of outdoor lighting applications:

Class I - These are cases in which color rendition is not an essential element. In such instances, low-pressure sodium lights are required. Examples of applications in this category include roadway, walkway, parking lot, and security lighting.

Class II - Cases in which good color rendition is an essential part of the application fall within this class. Examples include illumination for outdoor sales areas, recreational facilities, advertising, equipment maintenance yards, etc. The ordinances impose strict shielding requirements on these lights and they must be turned off after 11:00 p.m. unless facility is actually in use.

Class III - This class consists of lighting used solely for decorative effects, such as illumination of building facades and landscape illumination. These lights are subject to strict shielding and luminosity requirements, and they must be turned off at 11:00 p.m.

The ordinances enacted in San Diego and Riverside Counties have the added feature of an inner zone 15 miles in radius and centered on Palomar Observatory (in the San Diego version, a similar zone is centered on the Mount Laguna Observatory) within which the requirements are somewhat stricter. For example, no decorative lighting is allowed within this zone.

Except for the curfew requirements and for major modifications to existing lighting systems, these ordinances apply only to new lighting installations and will therefore have their greatest effect in newly developing areas. Enforcement is primarily by means of the building permit process, although a complaint procedure is included.

So far, ordinances have been adopted in San Diego County (covering the entire county), Riverside County (covering the area within 45 miles of Palomar), the cities of San Diego, Escondido, Vista, Poway, and Hemet. The city of Perris is in the process of adopting an ordinance and I plan to contact the city of Lake Elsinore within the next few weeks.

**Zoning:**

Even with these ordinances in place and enforced, it is essential to the future of Palomar Observatory to maintain the rural character of the immediate surrounding area, especially Palomar Mountain itself. To that end, we are working with the San Diego County Planning Department and with the local residents on a review of the Regional General Plan, the county's guideline for future development in the area. The plan, which is to be presented to the County Planning Commission before the end of this month, is constructed to maintain the rural environment in the area and includes explicit provisions for protecting the observatory. Furthermore, we have opened discussions with the county to amend the zoning ordinance to make it very difficult to obtain major use permits that allow exemptions to the provisions of the General Plan.

**Aircraft:**

Aircraft interfere with the observing programs at Palomar, especially those in progress at the wide-field 48-inch Oschin Telescope. The losses at the Oschin Telescope, currently engaged in the Second Palomar Observatory Sky Survey, can be substantial; the value of each ruined plate must certainly approach \$1,000.

Both high-level commercial and low-level private aircraft operating above Palomar are essentially out of our control. A restricted air zone around the observatory could not be enforced, even if the FAA would agree to create it.

Aircraft from the United States Air Force, operating out of March Air Force Base and Norton Air Force Base (both to the north of Palomar Mountain), frequently fly over Palomar at low-level, frequently with landing lights on. In the past, the Air Force agreed to divert their flight paths 5 miles to the east of Palomar, but these ad hoc agreements seem to break down every 5 years or so and need to be renewed.

**Radio Interference:**

As one of the highest points in San Diego County, Palomar Mountain is a choice location for telecommunications facilities: radio telephones, vehicle dispatching stations, etc. Several low-power transmitters have already been installed about 3 miles to the south of the observatory.

It is necessary to limit expansion of these facilities because of the adverse impacts they can have on the observatory. First, radio transmissions can interfere with the sensitive electronics employed at the telescopes; the situation at Mount Wilson Observatory is an extreme example of this problem. Second, any lighting used on the transmitters and their associated buildings can be a source of light pollution. Third, the presence of the transmitters erodes the rural character of Palomar Mountain and paves the way for future growth.

Several years ago, San Diego County adopted a policy regulating telecommunications facilities that includes, at our request, a requirement that an applicant for a new transmitter within 6 miles of the observatory and radiating 5 KW (ERP) or more must first prove it will have no effect on our instruments.

**Air Pollution**

The air at Palomar Mountain is essentially free of the smog that is otherwise characteristic of southern California. Recently, however, San Diego County has announced plans to open a new solid waste landfill in the north county area; the six candidate sites are within 32 km (20 miles) of the observatory; the closest is

only 16 km (10 miles) away. Dust from grading at the landfill (which, by law, is required daily) and pollution from the vehicles hauling trash (130 trucks a day, each carrying about 25 tons of material) threaten to increase the amount of airborne particles in the atmosphere over the observatory, thereby decreasing the atmospheric transparency and increasing the light pollution.

## CONTINUING TASKS

Adoption of a lighting ordinance does not mark the end of our involvement with a community. On the contrary, to make these measures truly effective and to address new problems as they arise requires a continuing relationship between the local governments and the observatory. This is necessary, at least in part, because of the high turnover of personnel, both elected and staff, within the city and county governments. Furthermore, continued contact with government officials provides a means of conveying our constant interest in the environmental problems facing the observatory. We also try to keep open our links to the local utilities and to the national and local lighting industry, since actions in these areas can affect the observatory.

The full effectiveness of the light pollution control measures can be realized only with the informed support of the public. To build a public awareness of the significance of astronomical research and of Palomar Observatory, we support an active public information program, including news media relations, lectures to local civic organizations, and special tours of the observatory, especially for city and county officials.

## SUMMARY AND CONCLUSIONS

The situation at Palomar Observatory is serious but not hopeless.

On the whole, we have received excellent support from the local governments, as evidenced by their adoption of street lighting policies and lighting control ordinances on our behalf. In the few years we have been active in this area, one can already see the effects, especially the widespread use of low-pressure sodium lighting in San Diego and Riverside Counties. Several communities have yet to join in this effort, but this is due to the limited amount of time I can devote to this program.

As it is, about 50 percent of my work now centers on these environmental issues. In this, I enjoy the full support, financial and otherwise, of the administration of the California Institute of Technology. The help of the Caltech Public Relations Office is absolutely essential. Yet, in a practical sense, there can be only one spokesman to represent the observatory on this issue, and this imposes a limit on the pace at which we can proceed.

Neugebauer and I agree that dealing with environmental issues has become a permanent part of operating the Palomar Observatory, and that, in the future, it will be necessary to devote a significant amount of time and money to work on these problems. We cannot say, with full assurance, that we will save Palomar by this effort, although I am optimistic. We can say, however, with full assurance, that without the gains we have made, the future of Palomar Observatory would have been bleak indeed.