

# LIGHT POLLUTION AT THE ASTRONOMICAL OBSERVATORIES IN MEXICO

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## INTRODUCTION

There are three astronomical observatories in Mexico working on research programs. The oldest one is located at Tonantzintla, Puebla; the largest is at San Pedro Martir, Baja California; and the youngest, not yet in full operation, at Cananea, Sonora. The one at Tonantzintla suffers, by far, the largest light pollution problems; that at San Pedro Martir has the darkest skies but is relatively close to regions of potential touristic and mining developments. In this paper we summarize the existing and potential polluting problems arising from manmade light sources near those observatories, and suggest some possible steps to be taken in order to minimize their adverse effects on astronomical observations.

## THE TONANTZINTLA OBSERVATORY

This observatory has two main instruments: a 1 m telescope and a 66x76 cm Schmidt Camera. The telescope belongs to the National Observatory, a branch of the Institute of Astronomy of the National University (UNAM), and the camera to the National Institute of Astrophysics, Optics and Electronics (INAOE).

Being about 20 km away from downtown Puebla City, a nearly one million population urban zone, and surrounded by several smaller towns, the Tonantzintla Observatory was dedicated in 1942; the light pollution problem became important about 25 years later, when the City of Puebla expanded due to modern industrial settlements. Its proximity to Mexico City (100 km west, across a high volcanic range) made it a convenient site for research projects involving not very weak astronomical objects, but the light pollution problem there has grown hopeless because of the fast growing industrial areas in the State of Puebla and the consequent increase of population with electric power facilities.

The relocation of the astronomical instruments is now being considered. In the meanwhile, efforts should be made in order to lower the high pollution levels of the street lamps, specially in the two towns adjacent to the observatory grounds. For example, some of the lamps that have been placed too close to the telescopes can be easily moved farther away and replaced with better illuminating facilities. In the surrounding towns, public lighting can be gradually

changed from mercury to low pressure sodium lamps, properly shielded.

### THE SAN PEDRO MARTIR OBSERVATORY

This is the main observing site of the National Astronomical Observatory and is equipped with three telescopes of 2.12, 1.50 and 0.84 m apertures. In 1975, by presidential decree, the National Park where the observatory is located, was assigned to the care of the UNAM, in order to secure good environmental conditions for research in astronomy and other sciences. Being near the center of this National Park, the observatory is surrounded by at least 15 km of ecologically preserved territory under the custody of the National University.

Located at the eastern crest of the San Pedro Martir Sierra, 2800 m above sea level on the Baja California Peninsula (about 140 km wide in that zone), the observatory is indeed far from large cities or other bright light sources. To its northern side stands a populated zone of the Mexico-USA border: the Tijuana-San Diego urban area is between 270 and 210 km away from the observatory; the low population density, but very extended agricultural complex, bounded to the north by the Cities of Mexicali, Calexico, El Centro, San Luis Rio Colorado and Yuma, and to the southeast by the Colorado River, is between 130 and 210 km away. Though far from the observatory, their night glow might increase due to the fast population and industrial growth already taking place along the border. Only the easterly side of the agricultural area along the Colorado River can be directly seen from the observatory site; all the other cities are not, including Ensenada, a small port on the Pacific Ocean 150 km northwest of the observatory, where the Institute of Astronomy has a research center, as well as the observatory's administrative headquarters.

A matter of special concern is the probable touristic development of the coastal areas, specially at the Gulf of California. The small town of San Felipe, located in the desert, by the Gulf coast, only 60 km east from the observatory, is the worse danger, together with the possible touristic developments on the Sonora shore across the Gulf, 130 km further. On the Pacific coast, the San Quintin Bay, about 80 km southwest from the observatory, also deserves attention. Though San Felipe can not be directly seen from the observatory, its feeble night glow is, and it is predictable that its growth might seriously endanger the still excellent dark skies of the observatory. Another threatening possibility is also the future agricultural and mining development of the regions towards the Pacific coast, west from the observatory, like the sudden and recent apparition of the Ejido Sinaloa and the astonishing growth of Colonet and San Vicente. These small towns are about 50, 75 and 85 km west from the observatory, respectively.

We are at a proper time to initiate actions in defense of dark skies in the North of Baja California. Beginning some years ago, a number of cities on the USA side of the border have been approving and enforcing laws in order to protect astronomical observations. It should be easy to convince the Mexican authorities of the border cities to emulate such positive measures, specially now that public facilities like street lamps are not yet available everywhere in those places. The touristic centers should grow with the idea that the region is particularly attractive because of its "wilderness", and that includes the old pleasure of enjoying dark skies in crystal clear nights. In most new and old agricultural developments around the National Park, the only electric supply

available is yielded by private power plants and there is little or non exterior illumination; in the near future public electric facilities will probably be available. By then the population there should have been made conscious about the feasibility of good public lighting with little light pollution. They must be convinced of the importance that such measures have for astronomy and for the best interest of humanity.

## THE GUILLERMO HARO OBSERVATORY

Short after the recent death of Professor Haro, the observatory he constructed in the State of Sonora, nearby the old mining town of Cananea, was named after him. It is part of the INAOE, an institution founded also by Haro. Equipped with a 2.15 m telescope, still being tested, the observatory is about 17 km away from Cananea and 150 km from Tucson, Arizona (Kitt Peak Observatory is some 20 km farther). Other regular size towns in the area, with population larger than 10 000, are Nogales and Agua Prieta-Douglas, both border towns at about 65 km from the observatory but in almost opposite directions, and Magdalena de Kino, 90 km away. Besides, Hermosillo, capital of the State of Sonora, is a city with some 400 000 inhabitants located about 240 km south by southwest from the observatory.

Due to the actions that the Kitt Peak National Observatory has taken, Nogales (both at the USA and Mexican sides) and Tucson are already reducing their light pollution levels. Hermosillo and Magdalena are not yet a serious problem and important developments in these towns are not foreseen in the near future. Clearly, the main source of light pollution for this observatory is Cananea, a nearly 30 000 inhabitants town that has barely grown in the last decades. Because of its proximity to the observatory, urgent measures should be taken in order to lower both the direct light and the glow from the town. The immediate shielding of street, advertising and security lights is a must. Future change to low pressure sodium street lamps should be planned. Recently, Agua Prieta has been connected by paved road to Chihuahua and, hence, to large commercial regions of the country; its rapid growth is quite probable, so care should also be taken regarding the proper installation of future public lighting.

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