

## **The “Light House” on Mount Palomar**

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**I**N THIS fascinating but turbulent mid-twentieth century with its relentless, portentous American and Soviet race for bigger and better missiles and ambitions to conquer space, it is most gratifying to realize that America is far ahead in a most remarkable conquest of space. Her 200-inch Hale telescope on Mount Palomar in California remains far unchallenged. With artificial satellites almost crowding outer space and particularly with the Soviet photographic shots of the other side of the Moon, missile construction obtained an astronomical flavor and the man on the street who has no notion of the abstruse science of astronomy, nourishes the illusion that astronomy is in its crash advancement in these days. Indeed, if it comes to a technological consideration, “the race is pretty tight” as Dean Dunning of the Columbia University School of Engineering stated at a meeting of the American Physical Society.

Recently, I revisited the USSR, this time with an invitation from the Soviet Academy of Science to visit the two largest Soviet observatories, Sternberg Observatory of Lomonosov University in Moscow and the

larger Pulkovo Observatory near Leningrad. I could not help but be impressed with the sumptuous appearance particularly of Pulkovo Observatory and its world's largest staff of 400 astronomers, 60 of whom are beyond the Ph.D. level. By a special government decree at the end of World War II, the observatory was even more imposingly rebuilt, after its utter destruction during the 900 days siege and shelling of Leningrad. The social status of the astronomers carries a prestige equivalent in the USA only to the highest government officials. It implies financial and economic privilege that in bygone days was enjoyed only by the nobility.

Nevertheless, the Soviet Union with all the prestige built up by its Sputniks and Luniks has nothing like the Palomar 200-inch reflector. Russia's largest telescope is a 50-inch reflector in the Crimean observatory, taken from Germany after World War II. This Soviet 50-inch reflector is superseded by several instruments in the USA alone. There is the 120-inch reflector at Lick Observatory on Mount Hamilton, California, itself rather a by-product of preparatory experimentation leading toward the construction of the 200-inch mirror. Then there is the Hooker 100-inch reflector on Mount Wilson, California, which made epoch making discoveries after World War I, especially on the expanding universe phenomenon, in the hands of the late scrutinizing explorer, Dr. Edwin Hubble. Both Palomar and Mount Wilson observatories are jointly operated by the California Institute of Technology and Carnegie Institution of Washington. Then there is the excellent 80-inch reflector of McDonald Observatory of the University of Texas. The USA, in addition, possesses the world's largest refracting telescope, a real and familiar type of telescope with the largest lens ever made, 40-inches in diameter, owned and operated by the University of Chicago, located at Yerkes Observa-

tory in Williams Bay, Wisconsin. This telescope was completed in the previous century and as a marvel of telescopic astronomy was exhibited at the Columbian Exposition in Chicago as early as 1893. Forty years later, in 1933, it played the curious, ceremonial role of opening the Chicago Century of Progress Exposition when the 40-inch lens picked up the light of Arcturus, 40 light years distant, and by the mechanism of the photocell turned on the switch at Chicago, 75 miles away from the observatory, by means of the light that started its journey from Arcturus at the time of the Columbian Exposition 40 years before.

Yet, above all these giants of modern astronomical technique towers the spectacular Hale 200-inch reflector whose mirror, 200-inches in diameter, alone weighs 16 tons while the entire telescope's weight amounts to one million pounds or 500 tons. The Star Dust highway leads from the charming Pauma Valley and its old Pala mission, winding up the lofty elevated plateau until it reaches the observatory on one of the mountain tops of the Sierra, some 5600 feet above sea level. The years of planning, preparation, construction, grinding, polishing, installing and the final solemn dedication in 1948, is one of the greatest and most fascinating epics in the history of the royal science of astronomy. Amidst the tempestuous war years it is the most peaceful and cultural feat human searching intellect could have achieved and all this centers primarily around a quiet, perseverant and purposeful personality, the late Dr. George Ellery Hale, whose name is permanently associated with this magnificent instrument. Yes, in a true sense of the word, we are able to say "George did it."

It is not only the 200-inch Palomar telescope for which Dr. Hale is responsible. The fruitful and creative life of this prolific astronomer bequeathed a series of

telescopes, two of which in turn, for a period of years, carried the trophy of being the world's largest. Dr. Hale is the originator of the aforesaid Yerkes 40-inch refracting or lens telescope as well as of the Mount Wilson Hooker 100-inch reflector. Both of these telescopes alone, which at the time aroused the interest and admiration of the entire cultural world, represents a glorious chapter in the advancement of astronomy and the "conquest of space" long before this expression became the symptom of an era. These instruments continue to be the powerful tools in the modern astrophysical technique of recording multitudinous aspects of cosmic creation. It is always with radiant memories that I cherish the inspiring nights of spectrographic observation with the splendid Yerkes instrument under the kindly guidance of the late Dr. Edwin B. Frost, director of the observatory. Dr. Hale, however, did not rest. Following the end of World War I, the Hooker 100-inch started to reveal the structure of the universe into outer space some half a billion light years away. Likewise, at the end of World War II, in the midst of the ruins and blackout of our pulsating civilization, as a hopeful omen we witnessed the completion of the Palomar telescope, and its story is ever greater as an inspiring and glorious feat in the annals of man's intellectual achievements.

It is usually assumed that the initial impulse for the enterprise of the task stemmed from an article Dr. Hale wrote early in 1928 for "Harper's Magazine" in which he described the purpose and possibilities of larger telescopes. Although previously, in 1923, in "Popular Astronomy" he expressed his ideas on telescopes larger than the Hooker 100-inch reflector, which by that time was in successful operation on Mount Wilson, it was the article in Harper's that put the wheels in motion. Even before the article appeared Dr. Hale sent

the proof copy to Dr. Wickliffe Rose, president of the International Education Board of the Rockefeller Foundation. The result appeared a few months later when this Board appropriated \$6,000,000 to the California Institute of Technology to finance the construction of a 200-inch telescope. It was perhaps the predominating pacifist mood that was current in America following World War I that moved this unique decision so favorable to astronomy. In this connection it is indeed touching to think of the early attempts of the first famous American woman astronomer, Maria Mitchell, to secure humble support for such an "impractical" science—as astronomy was considered in the years when America was mostly interested in clearing the forests. It was surely of no interest to John D. Rockefeller, and when Maria Mitchell approached him, he was to say "I must ask you to pass me by." Little did he foresee that part of his fortune would one day be spent on the largest telescope in the world—the pride of cultural America.

What has happened in the history of Palomar telescope between 1928 and 1948, the year of dedication, can hardly be related in this space, not even in a most fragmentary account. After all, it is very well exposed in Helen Wright's book on "Palomar, the World's Largest Telescope." In 1948, there were actually two solemn dedications, the first on June 3, the second July 1. The first dedication which may be called actually the principal ceremony was arranged for the widest circle of all those who were participants or in some way responsible in the accomplishment of Dr. Hale's dream. On the platform were the elite of American science, leaders who had given the most time and thought to the building. We find there Walter S. Adams, Director of Mount Wilson Observatory, then Robert A. Millikan, first American born laureate of Nobel prize in physics,

Ira S. Bowen, now director of the joint Mount Wilson and Palomar Observatories. Stirring and historical addresses were given, among others by Lee A. DuBridge, president of the California Institute of Technology and Vannevar Bush, president of the Carnegie Institution of Washington. However, I like to return to the second dedication, on July 1, at which I was fortunate to be present. This historical ceremony of consecration was re-enacted at the occasion of a special joint meeting of two principal astronomical societies, the Astronomical Society of the Pacific and the American Astronomical Society. In Pasadena, there was also a concurrent meeting of the American Physical Society. The great historical event brought together a large gathering of scientific workers.

It was one of those radiant sunlit days in which the California sun shone bright over Pauma Valley, from which an endless chain of cars wound their way up to the green mountain top. Fragrant shrubs waving in the drifting wind, blue patches of lupines on the surrounding meadows rivaling with the blue of the heavens, offered a serene atmosphere at the gateway into the temple of the mythological goddess of astronomy, Urania. Some 400 guests, mostly astronomers, were seated under the telescopic giant and appeared to be a dwarf group between two colossal supporting pillars. There were also solemn addresses but they were exclusively for the astronomical audience. The slogans of our time "outer space" or "conquest of space" were not yet current, as they became popular after the first sputnik was fired, but the initiation of the Hale telescope on Mount Palomar was indeed an unprecedented dedication to the conquest of space "par excellence." This telescope, not missiles, will surely go down into the most glorious pages of man's history. The majestic panorama of the starlit universe and external galaxies approaching an

estimated number of one billion, that can be surveyed by the Big Eye of Mount Palomar, staggers one's mind. The mechanism of the giant instrument alone is the wonderful result of years of careful thinking of many gifted individuals who teamed their efforts and abilities until this magnificent upsurge sprang into being from the vast amount of hidden, scattered raw material. And what an amazing period of 350 years since Galileo's first little, fragile telescope that I observed in the science museum in Florence, Italy. I recalled an experience one July, 1928 night that I spent with Dr. Hubble at the Hooker 100-inch reflector on Mount Wilson when I remarked: "What should I admire first, the majesty of the universe revealed by this telescope or man himself, his intellect that has accomplished this orderly, obedient mechanical robot wherewith to magnify the power of man's sense perception? Indeed, it is here very proper to ask with the psalmist: 'What is man that Thou art mindful of him?'"

Yet, there is also a pathetic aspect in this single feat of human dream come true: The price of this telescope after all is only that of two B29 bombers of World War II which, by this time, are already obsolete, due to the emergence of long range missiles with nuclear warheads, in other words, a little farther than the javelins of Stone Age man. The astronomer who considers the majesty of the universe and the "speck of dust" as Sir James Jeans used to describe our own planet, cannot help but think of the welfare of humanity in a dedication that is different from the limited ambitions of politicians of earthly states. Raymond B. Fosdick, president of the Rockefeller Foundation, so very well voiced this sentiment in his dedicatory address on June 3:

"The towering enemy of man is not his science but his moral inadequacy. Around the world today, laboratories supported

by almost limitless resources are feverishly pushing their research in the development of physical and bacteriological weapons which overnight could turn this planet into a gigantic slaughterhouse. On what moral basis will the decision be made to use these weapons? What ethical restraints will have developed to curb the hysteria, fright and passion of men against such blind paroxysm of destruction? For if this final Nemesis overtakes the pretensions of modern man, it will not be his science that has betrayed him, but rather the complete prostration of his moral values. It will not be his telescope and all that it symbolizes that have led him to the doorstep of doom; it will be the impotence and immaturity of his ethical codes."

This is indeed a thought that a true explorer of the universe must carry into his laboratory or observatory. When in 1843 John Quincy Adams, 77 years of age, strenuously journeyed to what was then nearly the borderland of the wild west, Cincinnati, Ohio, to dedicate the first American observatory, he used an endearing name for an astronomical observatory "light house of the heavens." He said: "We have been so absorbed in the toil of converting the wilderness into a garden that we have been indifferent to the sciences, particularly to astronomy." This is ominously valid today as materialism is on the rampage and our gardens become desolate. The "light houses of the heavens" must radiate ever more in the darkness. The Palomar telescopic giant of George Ellery Hale is, after all, an extremely insignificant fraction of the annual military budget. Yet, these budgets are bound to fall into an inevitable oblivion but the "light house" on Mount Palomar, through the expansions of man's horizons, his universe and the realization of spacious cosmic commonwealth, will radiate ages beyond the telescope's own physical endurance.