# BUILDING THE WISE OBSERVATORY

Written at the occasion of the 50th anniversary of the Wise Observatory inauguration

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## Preface

In 1965, after being awarded a PhD degree in physics by the Hebrew University, I obtained a two year grant from the US National Research Council to conduct-post-doctoral research at the NASA, Goddard Space Science Center in Greenbelt, Maryland. The research topic involved the study of the Solar Atmosphere using spectrographs launched on rockets and satellites. As the two years were coming to an end, I approached Professor Yuval Ne'eman, the head of the Tel-Aviv University Physics Department and inquired about a job. After an exchange of letters, I was hired with the goal that I will continue in the same line of work at the Tel-Aviv University.

In late-1969, while I was still struggling to establish a laboratory, Professor Ne'eman called me to his office and informed me that he decided to fulfill his long-time dream of building a major observatory in Israel. To help actualize his dream he secured from the president of the Tel Aviv University, George Wise along with his wife, Florence, a donation of $330,000 to cover the cost of a modern 40-inch telescope that was already in construction. With help from Dr. Myron Lecar, an American scientist from the Smithsonian Observatory in Cambridge, Massachusetts, he succeeded in securing a $500,000 grant to equip the observatory with instrumentation. With some 40% of the money needed for the observatory at hand, he formed an observatory committee that included himself, Myron Lecar, and John Bahcall, a professor from Caltech. Professor Ne'eman told me that in their first meeting, they decided to ask me to become the observatory director. Being overwhelmed by the offer, I asked for a day to consider the offer to which he obviously agreed.

In order to make an intelligent decision I had to ask myself the following: a) Do I have the qualifications to do a good job? b) What would be the effect of building an observatory on my family? c) What would be the effect of the new assignment on my professional career?

The first issue did not worry me much. Although I knew very little about astronomy or astrophysics since no such subject was taught at the Hebrew University at the time, I did not think that it should be a showstopper. More importantly, in contrast to most Israeli youth I graduated from Shevach, a mechanical vocational school, and as a result I felt comfortable dealing with mechanical equipment. In addition, prior to attending the University, I worked for over a year with my father constructing a fairly large commercial structure. Thus, I thought that my previous experiences would help in the design and construction of the observatory building. My dear wife, Dalia, thought that if a great opportunity came my way it should be accepted. She

did not believe that being very busy constructing the observatory would adversely affect her or the children. Although I expected building the observatory will have a significant effect on my professional career naively I decided not to worry about it. After a sleepless night, I informed Professor Ne'eman of my decision, and shortly thereafter he named me as the First Director of the Wise Observatory and a member of the observatory committee. After a meeting or two it became clear that it was up to me to make all the decisions, significant and insignificant alike.

In Israel at the time, construction of public facilities used to start, but were rarely completed on time or within the appropriated budget. My first decision was that this will not be the case with the observatory. From start to finish it will take but two years and nothing will stand in the way. Although it was inevitable that fights will erupt along the way, I did not foresee their extent. During the two years of construction, and despite the endless stream of complaints that reached Professor Ne'eman's desk, he never wavered from backing me.

# The job of the first observatory director

## I. Finding the best site for the observatory

The first major decision as the observatory director was to decide on the general location in which it should be built. Israel is not a big country, and not too many promising sites are available. During the 1967 war, Israel conquered the Golan Heights and part of Mount Hermon from the Syrians. From the Egyptians, Israel took the Sinai Peninsula. Many in the country were euphoric about the recent conquests and assumed that they would remain forever under Israeli control. Some suggested considering Mount Hermon as the site of the observatory since the mountain was high and far from big cities. Others in the department thought that a Sinai Peninsula peak would be a good observatory site and had already begun conducting site surveys there. I rejected the Mount Hermon idea on security grounds. It did not seem reasonable to build an expensive observatory where people would have to spend nights all alone near a hostile border. The Mount Sinai idea was also rejected because, although it was far from the Egyptian border, it was amid a hostile population. In addition, it was not obvious that the Sinai would remain forever under Israeli control. The third possibility was to build the observatory on a hill not far from Jerusalem. Again, this idea was rejected because it was obvious that during the expected lifetime of the observatory, the area near Jerusalem would become populated and lights from future communities would interfere with observations. The only logical site that remained was on a high peak in the Negev. At that point the question was reduced to finding a good location there. Typically, people conduct site surveys that last at least a few seasons; however, in not having that privilege it became obvious to me that the decision on the best location to build the observatory would have to be done on other considerations.

### I.1 Learning from the master

In 1969, the best and largest observatory in the world was on Mount Palomar located in southern California. In order to get an idea on how to embark on constructing an observatory, John Bahcall arranged a meeting for me with Dr. Ira S. Bowen, the retired director of the Mount Palomar observatory. Dr. Bowen was the director of the Mount Palomar and Mount Wilson observatories since 1948. He was in charge of the installation of the 200" telescope and running it for the next 16 years, until retirement. On December 8, 1969, I left for Pasadena, California to

meet Dr. Bowen in his small office at the headquarters of the Mount Palomar Observatory on Santa Barbara Street. As it turned out, I met with Dr. Bowen for about ten hours over several days. He taught me not only about how to select an observatory location that ensures good seeing, but also about many other issues relating to astronomical observatories. In time our conversation drifted to subjects other than observatories.

During each session he continued to emphasize the importance of seeing and described the types of terrain where decent seeing conditions could be attained once the sun sets. During our discussions, I heard incredible stories of successes and failures of observatories around the world. Each story was accompanied with a detailed analysis of the causes of the success or the failure. As the hours passed, I became more and more confident that a site with reasonably good seeing could be located in the Israeli desert just by analyzing the local terrain.

One of Dr. Bowen's most fascinating stories involved the BTA-6, the 6 meter Large Altazimuth Telescope that the Russians erected on the Caucasus Mountains in southern Russia. For quite some time, he described mistakes they made with the telescope and observatory construction. However, the worst of their mistakes, according to him, involved the expected seeing conditions which determine the image quality. According to Dr. Bowen, they will seldom, if ever, obtain sharp images since the telescope was constructed down-wind form several mountain ranges where the air flow is bound to be very turbulent. And, indeed he was right. I do not believe that the BTA-6 observatory ever amounted to much.

Over the years, I was privileged to meet many interesting and wise people, but not many of those were as impressive as Dr. Ira Bowen was. I am certain that the hours I spent in the small Santa Barbara Street office had a significant impact on the observatory. They guided my decisions about the observatory construction and the modes of operation that were implemented once the observatory began its operations. As a bonus they also influenced me on other issues.

## I.2 Deciding on the observatory site

In early January 1970 after a month in the US, the time arrived to start with the observatory construction project. To help with the administration, Professor Ne'eman recruited Mr. Isy Gilham, to become the observatory administrator and Mrs. Zvia Toisch to be the observatory secretary. Not long thereafter, Mr. Rafi Farchi, a very capable mechanical technician was added to the team. The Physics Department owned a Dodge pickup truck that was also put at my disposal.

The first task was to locate the observatory site; a site that will be as far as possible from the country's borders and sufficiently close, but not closer than five kilometers, to a settlement. This was to ensure that cost for the construction of a road, and installing electric, telephone, and water lines will be within the allotted expected budget. The most important requirement was to select a location where at night, heavy cold air from hills will stream down into a lower terrain, creating the desired laminar flow above the telescope. As such the most obvious location was a hill next to a crater's edge.

The sleepy town of Mitzpe Ramon, the only settlement near the rim of the large crater named "Machtesh Ramon", appeared to be a possible choice of an observatory location. After several hours of driving on the nearby hills, a small peak, five kilometers from the small town and close to the northern edge of the Ramon Crater, appeared to be a reasonable option. To ensure that the seeing conditions were acceptable, I invited Dr. Nisim Vidal, a trained astronomer, to help evaluate this at the selected hill. Using a 3.5" Quester telescope, the two of us spent time studying the night seeing conditions and concluded that they are on the order of 2-3 seconds of arc. We also looked at the statistical records and found that on average, there are approximately 200 clear nights a year in the area.

To mitigate problems that may arise from the town's light pollution, I met with the town's mayor and other dignitaries to explain the concerns and ask for their cooperation. The request was that all streetlights and other exposed lights be shielded from above to minimize the town's effect on the observational conditions. After the mayor agreed to cooperate and promised to pass a town ordinance stating that all streetlights and other exposed lights will have to be installed with covers on top, the site location was finalized. The following day, I met with Professor Ne'eman, informed him of the decision and asked that the University obtain the title of the selected tract of land.

As expected, the staff members that wanted to build the observatory on Mount Sinai opposed the decision. Some even became hostile towards me for ignoring their opinion. My duty was to select the best possible site location, and, if asked, to explain the logic that led to the selection.

# II. The Observatory building

My goal was to erect a structure that will be not only functional and safe, but also, and in contrast to the many existing dull looking observatories around the world, beautiful and inspiring to young people that will visit it. A big telescope is a magnificent looking machine that nonscientists, just by looking at it could understand its operation. Furthermore, it is perhaps the only scientific instrument that young people, when looking through its eyepiece, will be able to appreciate the incredible beauty of the night sky. Thus, to fulfill that vision, and foster public awareness and good will, the observatory building, in which a sizeable amount of public money will be spent in its construction, should include a visitor gallery. The hope was when the moon is visible and meaningful observations could not be done, groups of school children will come to the observatory to see the telescope and observe with it the moon, planets, and anything else visible at the time. To avoid burdening the university with the cost of guides, I envisioned that trained volunteers would lead tour groups on the occasions when the observatory will be open to visitors.

In addition to the goal of inspiring the young, I also thought that it would be extremely beneficial to foster groups of observatory enthusiasts that could be enlisted for support when difficulties will occur as they always do.

## II.1 Selecting the architect

With a site secured, the next step was to select an architect. Before meeting with the

potential architects I prepared a set of detailed specifications for the future observatory. The plans included the number, size, and orientation of rooms, and bedrooms to be used as a resting place for the observers during the non-observing hours. Electrical and other utility requirements were also specified. To preserve the building in very good condition for many years to come, much of the building, including the exterior and inside walls were to be made of concrete. During the late 1960s it was common that terrorists from Egypt or Jordan would enter the country. To ensure that the observatory would be a safe place, it was specified that when needed the building could be securely locked, i.e., it was to be constructed as a fortress.

The three finalists were Mr. Zalman Enav, who had worked for the Smithsonian Observatory in Ethiopia, and two others who were recommended by two professors from the Physics and Astronomy Department. Each of the architects was given copies of the specifications and was asked for comments. After the interviews, I concluded that in order to meet the set timetable, Mr. Enav should be chosen. I informed Professor Ne'eman of the decision and proceeded with the design. As with the earlier site selection, this decision was not popular with everyone.

To facilitate the design phase and ensure that it moves smoothly, a permanent "Thursday morning meeting" was established and held at the University Engineer's office. Each Thursday morning, for about a year until the observatory was finished, those who were involved in the particular day's agenda met. The system worked like a charm, deadlines were always met and often with time to spare.

Mr. Enav suggested that we model the observatory on the 1927 design of the Einstein Observatory (tower), in Potsdam, Germany, which was designed by the famous Jewish architect, Eric Mendelssohn. After agreeing to the concept, Mr. Enav began the design and after a few iterations, the design was satisfactory completed.

## II.2 The construction phase

With the design phase over, Yuval arranged that the Israeli government would pay a public company, named Mekorot, to construct the observatory, pave the four kilometer road, and install electric and water lines between Mitspe Ramon and the site. The university also employed an inspector to ensure that the construction is executed according to the design requirements. However, I often had to step in and perform the inspector's duties. During critical times in the construction phase I traveled twice a week, often accompanied by Isy or Rafi, to the observatory site, a one-way drive of 3-4 hours, to verify that the design was strictly followed and help resolve any problems.

The pedestal to support the telescope included a number of bolts to be installed in a very precise pattern that will correctly point the telescope to the north. One night, just before the pedestal concrete was to be poured, Rafi and I drove to the observatory site to make sure that the bolts were indeed placed in the proper location.

## II.3 The observatory dome

The construction of the observatory's large diameter dome became an issue, since no other

dome of its kind had been previously constructed in Israel. To help solve the problem, Professor Ne'eman suggested I should travel to Greece and learn from the director of the Penteli station observatory on how they solved the problem on their recently constructed observatory. The observatory director told me that the dome was constructed by Cook and Son, a British company. He expressed his dissatisfaction with the process, particularly because they did not hold themselves to the agreed upon time table. After unsatisfactory inquiries that were made with the British company I decided to construct it in Israel. Rafi took the matter into his hands, found a local mechanical engineer to design the dome and a local machine-shop to construct it. Once the dome was installed on the observatory roof, it had but a few problems with its wheels that were in time replaced.

As with any large project, unforeseeable problems were a common occurrence. As an example, the moveable floor of the telescope's room required extra-long pistons which were not available at the time in Israel. Since ordering them from abroad would require a long delivery time, I asked that two short pistons be welded to form a longer one, and once done to re-grind and re-plate the welded longer piston.

## II.4 The 1-meter Ritchey–Chrétien telescope

The 1meter telescope that was purchased is of the Ritchey–Chrétien design, a variant of the classic Cassegrain design. A classical Cassegrain design which employs a parabolic shape, primary mirror, and a convex secondary with a hyperbolic shape suffers from coma. To overcome the coma aberration, the Ritchey–Chrétien design includes a hyperbolic primary and a quite large convex hyperbolic secondary. The purchased telescope is a twin of a telescope designed by Dr. Ira Bowen for the Carnegie institute observatory on Cerro Las Campanas in Chile.

The telescope was constructed by Boller and Chivens, a manufacturer that was located in South Pasadena, California. Once the construction of the telescope was completed, Rafi Farchi left for four weeks to the Boller and Chivens manufacturing site to learn about the telescope's mechanical structure and how to maintain and fix it if needed. Early in 1971, I also left for California to perform an acceptance test on the optical quality of the telescope. According to its declared specifications it was supposed to produce image qualities of better than 1 arcsec. The "Hartmann Test" was the method that was used to test the optical performance of the telescope. The test involved placing an opaque plate with a large number of holes distributed in a grid pattern at the front opening of the telescope. With the plate installed, the telescope was pointed toward a bright star and two exposures were taken on glass plates. One of the exposures was recorded while the plate was placed in front of the focal plane and the second behind it. The plates were taken to the Mount Palomar observatory laboratory where I carefully measured the positions of the hole images on both plates with an X-Y comparator. With Dr. Bowen's help, the measurements were analyzed, and to the surprise of us all, it appeared that the optical performance was not as good as expected. After some extensive discussions it was concluded that an error must have occurred in my measurements. Luckily, the Southern hemisphere telescope was the first of the two to be installed and after the first images were recorded it was discovered that my measurements were actually correct. As it was later discovered, the support

to the large secondary mirror that Boller and Chivens designed was defective. To correct the problem they sent a crew to Chile to fix it; and once the telescope was installed in Mitzpe Ramon a Boller and Chivenes crew arrived to fix it.

## II.5 The observatory operation and rule for allotting observation time

The observatory construction was finished well before the December 1971 deadline. Because the handling of the telescope and the other observatory equipment is quite delicate and just one mishap can severely impair the observatory operation, a technician was hired and trained to run the telescope and oversee the overall maintenance.

The observatory started its operation in the fall and the results were promising. With the start of the operation, it was realized that an observatory had a lot of little problems that a director needed to solve. Some involved technical problems, while others involved human relations issues. Technical problems I could tolerate, but with those involving human relations I was at a loss. Knowing that the first period of operation would pave the way for the future, and based on practices used in big observatories, I established a set of rules for obtaining observing time. The rules were meant to ensure that the observatory will be used for studies that are in the forefront of the field. Being the observatory director and having the complete backing from Yuval, the rules were enforced despite objections and resentment from some that asked for special privileges.

## III. Joe Jaffe's fatherly advice

Professor Joe Jaffe, a friend of Professor Ne'eman was an Englishman that worked as a physicist in England during World War II. In 1948 Dr. Weizmann recruited him to join the Daniel Sieff Institute that later was renamed the Weitzman institute. In 1968 Professor Jaffe left the institute to form one of Israel's first hi-tech companies, Machshiray Rehovot. When Professor Jaffe, an expert in optics learned about the future observatory he asked Professor Ne'eman to arrange for him a visit. As expected, Professor Ne'eman complied and asked that I invite Professor Jaffe to join me in my next trip to the observatory.

During several occasions while the construction was progressing, Professor Jaffe accompanied me on trips to the observatory and became very impressed with all that he saw. In time, we became friends. He and his wife visited us, and we were invited to his magnificent house in the old city of Jaffa. During one of the trips to the observatory Professor Jaffe decided to express in a fatherly way his feelings toward my job and my future scientific career. He said, "Building an observatory in the wilderness is a commendable undertaking but just running it when completed would be a job for an old scientist who has lost his creativity." For weeks to come, I thought about the statement, and with time, I realized its depth and truthfulness. I interpreted his statement as follows: experimental scientists can be divided into three categories: those who build things, those who manage things, and those who do their research on facilities that others erect. The people who build things can point to whatever they built and get satisfaction from their accomplishment. If what they built becomes successful, then those who use it may appreciate what was done. In most cases, they will be forgotten within a short time. Directors have some power to influence whatever is done with the facility, but for the most part they squander their time dealing with mindless issues. Unless they use their facility for their own

research, they soon forget their professional skills and become useless. The third group of people is those who use the facility for scientific research, and those are the true beneficiaries. They are the ones who write the scientific papers, and in the long run, become associated with the facility. Simply stated, they reap most of the benefits from the investment of others. Not being trained in astronomy or astrophysics, I felt that by building the observatory I had paid my dues to the scientific community, and once it became operational to my satisfaction, I would resign my job as director. In the future, I decided that I should always strive to do research in my field of expertise on facilities constructed by others.

## IV. The dedication

The last thing I did before the dedication of the Florence and George Wise Observatory was to place a plaque on the building. The plaque mentioned the contributions made by Professor Ne'eman and Dr. Myron Lecar to the observatory, but it did not mention mine. Although the observatory reflected my vision and I had worked hard to build it and was proud with the outcome; I was too young to see my name engraved on a marker. When Professor Jaffe saw that my name was missing from the plaque, he scolded me. According to him, my name should have been the most prominent among the names on the plaque.

On an October day in 1971, two months earlier than I planned, the observatory was dedicated in front of dignitaries from around the world. During the ceremony I made some opening remarks and Professor Ne'eman said a few words. Then speeches were given by Professor Fred Whipple, the director of the Smithsonian Astrophysical Observatory, and by several other internationally renowned scientists.

Among the dignitaries attending the dedication were Drs. Allen Berman and Herbert Friedman. Dr. Berman was the Director of the Naval Research Laboratory (NRL) in Washington, DC, and Dr. Friedman was the Superintendent of the Space Science Division of NRL. After the ceremony, Dr. Berman, whom I did not know at the time, approached me and introduced himself and asked all sorts of questions related to building an observatory in the wilderness. I talked with him for a long time. I told him about the difficult technical problems I faced. I told him about some of my human relations successes and failures. He questioned me in a simple, direct way and I answered in the same manner. My accomplishment must have impressed him because by the end of the conversation he invited me to spend my next sabbatical leave at NRL. Without hesitating, I accepted the invitation, and with Dr. Friedman on hand; we all agreed that I would start my NRL sabbatical stay during the fall of 1972. Several months later when I began to correspond with NRL regarding my sabbatical employment, I was offered the grade of GS 15, the highest regular grade on the U.S. federal employment payroll. In the final account, it appeared that my two years of hard work were bearing benefits in ways I could not foresee.

## V. The First year of operation

During its first year of operation, the observatory needed special attention. Technicians that operated the observatory had to be trained, and scientists that used the observatory had to be thoroughly familiar with operational procedures. And the telescope and various pieces of equipment surrounding it needed to be fine-tuned. Generally speaking, it was a full-time job that consumed most of my time.

Once the construction phase was completed, attention was shifted toward a future top-rated staff of astronomers and astrophysicists that would run it. Not being able to identify such among the existing faculty, it became obvious that a few promising young graduates would have to be sent abroad to be educated. Professor Ne'eman succeeded in securing a grant from the Rothschild Foundation for this purpose and asked me to select three promising young graduates for their education in reputable institutions abroad to be funded by the Grant. Two of the students I selected to benefit from the grant were Hagai Netzer and a second student whose name escapes me. Hagai was sent to the Royal Observatory, Greenwich/Sussex University in England, and I believe the second was to be educated at the Leiden(?) University in Holland but left the field shortly thereafter. As I recall the third grant beneficiary was Elia Leibowitz who was being educated at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts.

As the fall arrived, I began to look forward to the opportunity of spending a sabbatical year at the Naval Research Laboratory in Washington, DC.

## VI. Concluding remarks

After the dedication ceremonies were over, I reflected on the two long years that I spent building the observatory. My concerns before accepting this task that had to do with my qualifications to do a good job were not an issue. I believe that I was qualified for the job. The consequences of the last two years on my scientific career were not as easy to assess. I definitely learned a lot from building the observatory. To work for Professor Ne'eman, by far the most accomplished person that I worked for was an invaluable experience. The hours that I spent with Dr. Ira Bowen are etched in my memory and will never be forgotten, and Professor Jaffe's fatherly advice was truly priceless.

Although, I worked for and met with some outstanding people, I completely ignored my profession. For nine years, I worked hard and long to become a physicist at which time Dalia and I took many chances; yet, during the last two years, I completely ignored my profession and devoted little time to scientific inquiry. In this respect, my behavior was childish. Fortunately, Professor Jaffe awakened me in time. While construction the observatory I wrote only one paper and it was not on a physics subject but on the meteorological conditions in Mitzpe Ramon. By building the observatory I gained little professionally and could only hope that during the sabbatical at NRL I would make up for the losses.

In 1982, the Wise Observatory published a report on the first ten years of operations. Among those who agreed to contribute were Myron Lecar and John Bahcall. In his reflection on the founding of the Wise observatory, Myron wrote "…***Yuval, John Bahcall and I were calling the shots, and our first decision may have been our best: We convinced Uri Feldman to become the first director of the new observatory. When Uri took over, it was not an observatory but just an idea, but he devoted himself completely to this undertaking, and with courage and determination he got the observatory built.*** …" John Bahcall in his essay wrote, ***"…The observatory was built under the direction of Uri Feldman, who designed an observatory that was both beautiful and functional. He displayed, in order to complete the design and***

***construction all in one year, a disarming honesty, a fierce stubbornness, and an unlimited capacity for work. Uri would shout at contractors and soothe scientific egos, some times in the same sentence. Throughout the first summer in which we lived at Mitzpe Ramon, Uri supervised the technical work and inspired all of us associated with the observatory with his enthusiasm for creating something new in Israel***

A number of years after the dedication of the observatory I attended a scientific session paying tribute to astronomy based on observations made by the 200" telescope of Mount Palomar. Although practically every one that used the telescope was mentioned during the session, no one found it necessary to even mention the name of Dr. Ira S. Bowen or any of the incredibly innovative people that made it all possible.