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The Theatre of stars

M. Cavedon and F. Peri

Civico Planetario Ulrico Hoepli di Milano, corso Venezia 57, 20121 Milano, Italy
e-mail: `Fabio.Peri@comune.milano.it`

Abstract. Planetariums are special instruments in education and didactics of Astronomy and Astrophysics. Since 1930 the Planetarium of Milan, the most important planetarium in Italy, has played a fundamental role in outreach to the public. Italian tradition always preferred didactics in "live" lessons. Now technology expands the potential of the star projector and the theatre of stars is a real window on the universe, where you can travel among the stars and galaxies, to reach the boundaries of space and time.

1. Introduction

Professor Mario Cavedon, who has been the mainstay of the Milan Planetarium for over fifty years, will talk about this instrument and in particular about its importance in the didactics of astronomy.
Fabio Peri, scientific curator of the Planetarium, will then illustrate the contribution of new technologies and the activities of an institution of this kind.

2. Didactics of the Milan Planetarium

(Mario Cavedon)

The planetarium projector of the German firm Zeiss is a teaching instrument conceived and produced in the twenties of the last century; it reproduces, accelerating them, the movements of the sun, moon, planets and stars, as seen at any latitude of the globe. The Planetarium illustrates in the most clear and evident manner the "program" of astronomy taught at that time in European and Italian schools. Ulrico Hoepli, who donated the Zeiss instrument to the city of Milan, included in the act of donation the clause that all fifth grade students of Milan were to attend a lesson at the Planetarium at least once a year. This commitment, respected before the war, was resumed after the Second World War. Therefore, the most numerous visitors to the Planetarium in that period were students, while in general the public lectures were attended by the curious few and a limited group of amateur astronomers, who had formed an association within the Planetarium.

Things changed in 1952, when even the newspapers spoke of the suddenly doubled dimensions of the universe. The curious (students of the scientific lycee in particular) wanted to understand, and came to ask for explanations. At the same time astrophysicists proposed new ideas regarding the evolution of the stars, and the interest for the sciences of the sky increased rapidly. There was consequently a substantial modification in the titles of public lectures, which passed from themes of celestial mechanics to those of astrophysics, while lessons of astronomic geography continued to be held for some years for the schools.
Obviously the planetarium instrument is not of great help in illustrating theories on the life

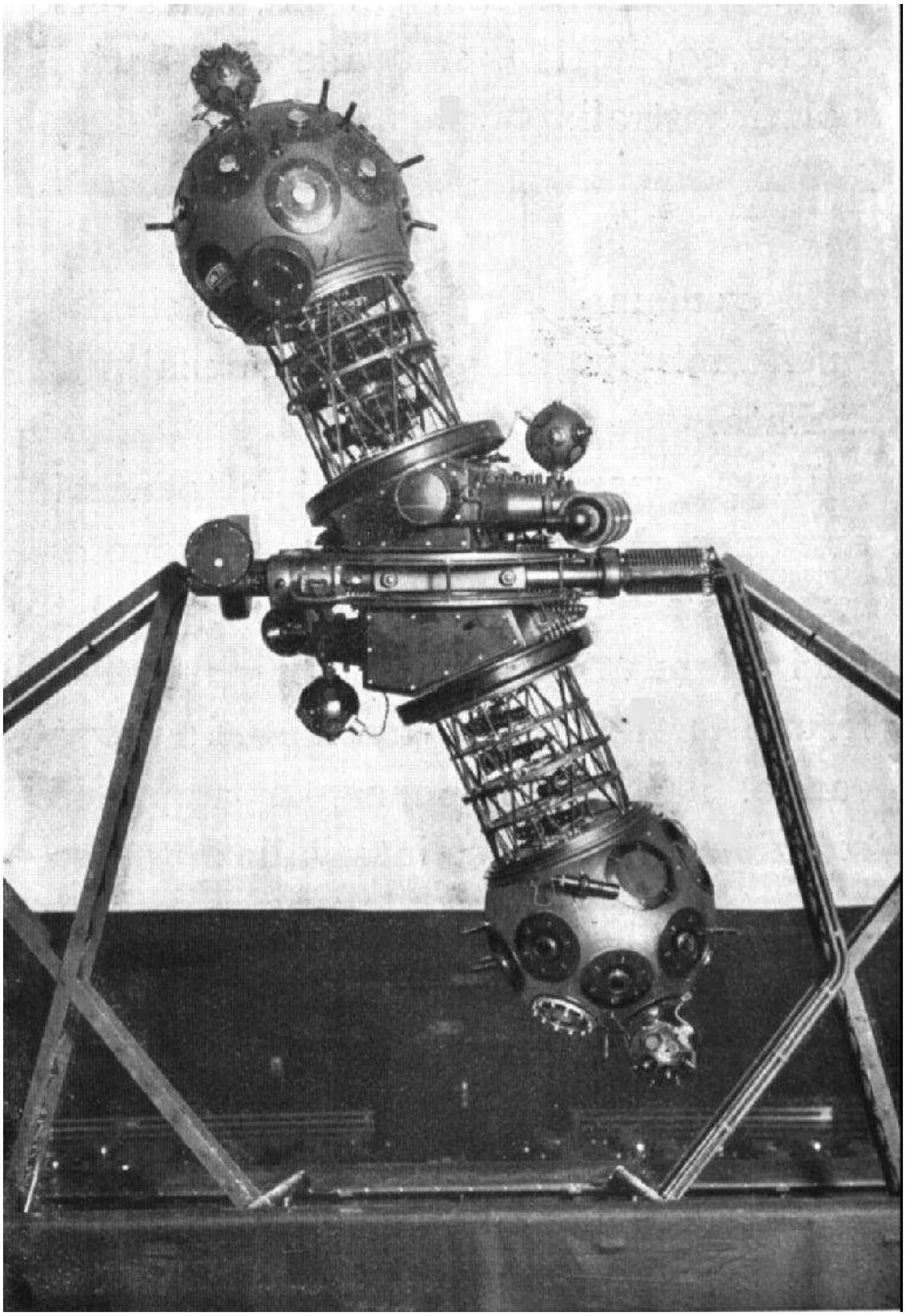

Fig. 1. The first projector, from the German firm Zeiss, model Zeiss II.

Fig. 2. The sky theatre.

and death of the stars or in making known the first results of radio astronomy; slides and an overhead projector were needed. On the other hand the Planetarium had to be able to answer the questions of those who could not be assisted by the universities or observatories (engaged in research), nor obtain an answer in class from science professors unprepared in general to handle these subjects. In those years the lecturers of the Planetarium were engaged in continuous updating, and in efforts to translate into simple language the results of astronomical research published in newspapers, not an easy matter when they began to speak about quasars, pulsars and black holes. Correcting the errors and fantasies of articles and radio and TV programs constituted (and still does) a sizeable task.

The great boom in attendance of the public lectures came with the launch of the first artificial satellites, and then of space probes. The race to the moon was followed moment by moment, also using films provided by USIS (The United States Information Service). The research in the physics of the planets conducted by probes aroused the interest of many, and the amateurs increased in number. The "scholastic programs" were gradually modified, and consequently our lessons for the various types of schools also changed. At this point the Milan Planetarium felt the necessity of introducing new auxiliary instruments.

Fabio Peri, to whom I now give the floor, will tell you about these.

3. Window to the universe

(Fabio Peri)

To exploit the images, increasingly spectacular, provided by the planetary probes and, in more recent years, by the Hubble space telescope, computers and video projectors have been acquired, enhancing the planetarium tool and rendering the lessons even more absorbing. Progress in computer science, with the possibility of using films, animation (often produced by the Planetarium itself), multimedia presentations and "special effects", has profoundly changed the structure of the lectures. These instruments make it easier to handle the complex arguments of astrophysics (stellar formation and evolution, theory, classic

and relativistic mechanics, radio astronomy and high energy astrophysics, structure and evolution of the universe....), rendering them interesting and comprehensible to the lay public, but always rigorously scientific.
For example, thermonuclear fusion becomes accessible at the Planetarium even to children, through the story of a curious little star who asks it's mama nebula how it was born and why it shines.
2ith multimedia means the sky of the Planetarium has gradually turned into an "immersible virtual reality", a universe made not only of stars and planets, but also of galaxies, nebulas, black holes, and radiation. Everything is projected on the dome; the spectator is captured by the lecturer who adapts language and style to his audience, leading it by the hand to the discovery of the secrets of the universe.

3.1. Discovering the sky

Fewer and fewer people, however, have a direct knowledge of the sky. Few stars, only the most luminous, can be seen in cities, where streetlights and those of advertising and store windows keep us from seeing the weaker celestial bodies. It is the problem of light pollution, especially serious for astronomers, but also for the public in general, deprived of the sight of the stars. At the Planetarium all the city lights can be turned off to admire the celestial vault, as it would appear in a completely clear atmosphere. The sky and its stars are never lacking in the Planetarium. Everything begins and returns there. This is its special quality, its uniqueness. Stars, constellations, planets, the precision of their movements, the possibility in particular of accelerating or halting these, and even of going back in time contribute to involving even the simply curious, and it is the passion for the sky that drives astronomers, researchers and simple enthusiasts to dedicate themselves to the study and knowledge of the universe. Take, for example, the precession of the equinoxes, faithfully reproduced by the planetary instrument: viewing in the space of a few dozen seconds the effects of this movement of over a thousand years of the entire celestial sphere is fascinating as well as didactically useful. It is appreciated also (I should say, especially) by professional astronomers, who have often had to take it into account in their calculations. The precession is seen, it does not need to be imagined, or interpreted through formulas: the Planetarium renders it clear and evident.

3.2. Astronomy for all

There are over 80 planetariums in Italy, most of which located in schools; only a limited number are open to the public. The main public planetariums are found in Milan (with a dome of 19.6 m), Rome (14 m), Modena, Naples (10 m), S.Giovanni in Persiceto (9 m), Ravenna, Reggio Calabria, Venice (8 m). The emotion of the sky and stars, faithfully reproduced by the planetarium instrument, its versatility of use, the skill of the lecturer make these institutions particularly suitable for the spread and teaching of astronomy. Italian tradition, in Milan in particular, has always preferred didactics in "live" lessons, exploiting direct contact with the expert, in contrast with the American tradition, much more inclined to theatrical reconstruction. Both scholastic lessons and public lectures are held by experts. This allows us to offer the public close to a hundred different subjects every year, versus the two to three "documentaries" presented abroad. This cultural wealth is one of the strong points of the Planetarium: it allows the public to interact with questions, to request information about recent discoveries, to draw on sure and prepared sources of astronomical research. For over seventy years the Milan Planetarium has engaged in this constant work of education and updating of schools and the general public, offered to over 100,000 visitors a year. It is the leading planetarium in Italy, and the oldest one.

Tuesday through Friday are dedicated to the schools, from nursery to high school, with lessons adapted to different age groups. There are fundamentally two different kinds of lectures for the general public: guided observations of the sky, and evenings dedicated to specific themes. The former are offered Saturday and Sunday afternoons, and generally the first

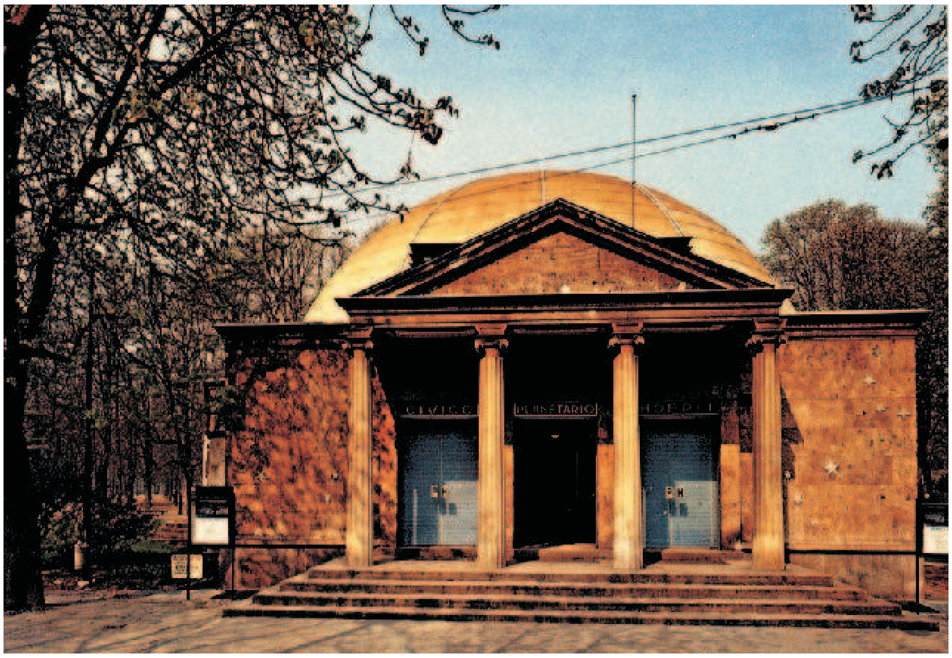

Fig. 3. The Milano Planetarium, donated by U. Hoepli.

evening of activity of every month. They are based on the observation of the sky (reproduced by the planetarium instrument), identification of the principal constellations, and the basic phenomena of astronomy. The latter take place Tuesday and Thursday evenings. They are dedicated to specific themes of astronomy, with the presence of Italian and foreign specialists, and are addressed to those who wish to increase their knowledge of astronomy.

From the planets to the galaxies, from stellar evolution to cosmology, all the major matters of astronomy and astrophysics are treated in a simple manner, accessible to non-experts. For particular astronomical events, such as, for example, the opposition of mars last year, programs have been organized in collaboration with the Astronomical Observatory, the University and other scientific institutes. With decided success: over 11,000 people in 4 days attended the lectures and projections, while images of the Red Planet, taken with the historic Merz telescope of Schiaparelli, passed on the large screen.

The public Activity of the Planetarium is completed with the organization of special programs involving, together with astronomy, music, art, theater, literature, and philosophy.

3.3. And in the future...

A sweeping technological updating is planned for the coming years. This includes substitution of the star projector and expansion of its multimedia capacities (for an estimated expenditure of about 8,000,000 Eur). The entire dome will become the scene of a fantastic trip among stars, nebulas, and galaxies to reach the limits of space and time. This modernization will place the Civic Planetarium of Milan in the lead worldwide both technologically and scientifically. In the future this institution will also be enriched by another didactic exhibition structure, a cosmic Exploratorium, natural complement and integration of its activity. With these improvements the Planetarium will continue to be the sky of the Milanese, the theater of the stars in which we return, like children, to marvel at the spectacle of the Universe.