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Public understanding of science: The example of astronomy at the Observatoire de Paris

(1) Introduction

The present paper is based on the fifty years during which different sorts of contacts with the public were made in the field of astronomy. After considering the various domains of the contacts, some considerations on the acquired experience on this subject, are given.

(2) Guided tours for the public

Tours for the general public were organized, in 1879, by the Director of the Paris Observatory, then the admiral Ernest Mouchez (1821–1892). Of course, they were interrupted during the two World Wars, but as soon as it was possible to show the Observatory, once per month (currently the first Saturday of the month), the public went again at the 61, avenue de l'Observatoire, in the 14th arrondissement in a part close to Montparnasse.

From 1879, the organization was changed according to the evolution of the instruments, the garden, the possible places to visit, ... Due to the request, more guided tours had to be organized, not only on the first Saturday of the month, but also during week days. Also due to the dimension of places visited, groups are limited to thirty people.

In the fifties of the 20th century, each time a new young astronomer came, he or she was immediately asked to follow older colleagues to learn, as quickly as possible, how to manage!

In some cases, the older astronomers had to guide specialized tours; it is still true but such tours are outside the scope of the present subject.

During the past fifty years many sorts of tours have been experienced but it was always a pleasure to describe the Observatory, its astronomers, their works and discoveries to visitors. There is one exception: The young having sixteen – eighteen years old who, apparently, are always very tired ...

(3) Conferences

The experience is limited to the public interested in the subject of astronomy. Most probably for that reason, the audience was always very attentive to the talk and raising particularly appropriate questions. Nevertheless it has to be noted that in the case of conferences, the public represents a large variety of professions, sometime very far from any scientific field.

Other types of conference have been recently given, including different members of the Paris Observatory staff. The occasions were recent news operations: “Journées du Patrimoine”, “Science en fête”, “Portes ouvertes”,... In that case a large public come to the Observatory, the main attraction being its larger dome.

(4) Articles in magazines

Astronomers are very often requested to write papers in magazines sometimes of general character. They concern, mostly, limited subjects for which the Observatory and its astronomers have played a rôle. Recent examples are, in 1991, the centenary of the unification of time on the solar mean time at the Observatory meridian, in France, in 1891. From 1988, the metric system due to the various events which occurred during the last decade of the 18th century and the following ones, was often, and still is, requested.

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Two magazines have published more numerous papers; both have a committee to examine the submitted papers constituting some sort of “referees”.

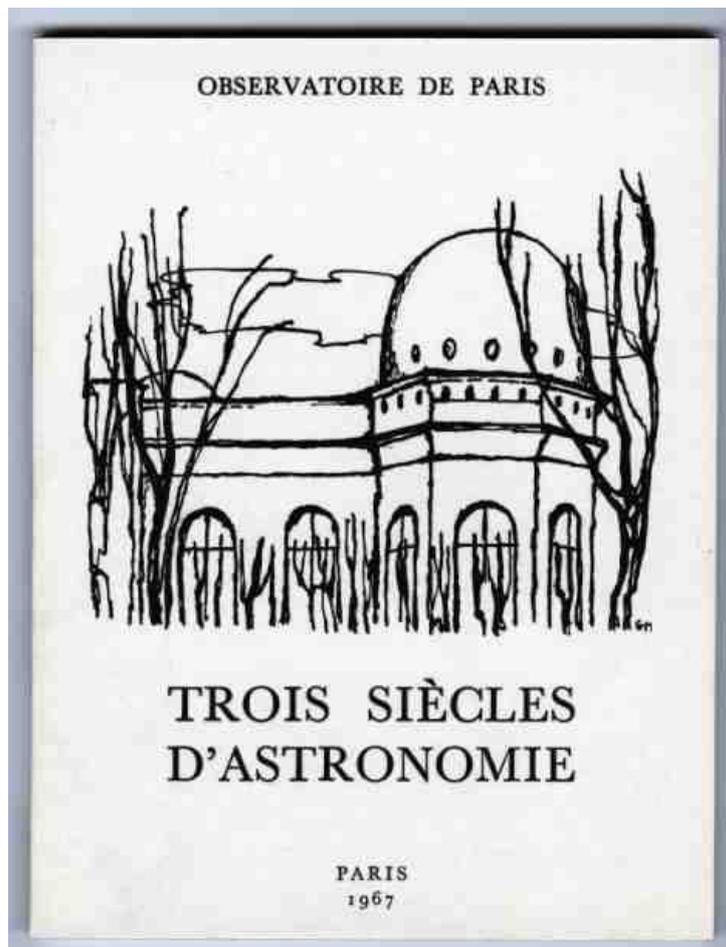
One is *XYZ*, published by the Association Française de Topographie, in which articles related to geodesy, of historical character, have appeared.

The other one is *l’Astronomie*, a magazine for amateurs, published by the Société Astronomique de France, founded by Camille Flammarion (1842–1925) by the end of the 19th century. Apart from the papers published in this magazine, mostly from historical character, the function of editor-in-chief was added during six years, from 1976 to 1982.

In that case contacts came from the authors, but also — and often — from the readers. The most surprising experience came from a questionnaire sent to the readers to get their opinion about the published papers. About one third of them answered. The last question of the questionnaire was related to the article they had appreciated the most and the article they would reject. It is incredible, but it is true, every one answered the question; the number of people against was the same as those in favor. What can be done in such a case?

(5) Exhibitions of the Paris Observatory

Exhibitions have been organized by the Paris Observatory, mostly from 1967. That year, marking the centenary of the Observatory, a professional international meeting was held and an exhibition for the public was opened showing its activities and mentioning the observatories in France.



«Bibliothèque de l’Observatoire de Paris / Gilles Murique»

The same double organization occurred in 1987 on the occasion of the centenary of the launching of the international enterprise named *Carte du Ciel*, upon the influence, in 1887, of Gill (1843–1914), then director of the Cape Observatory, and admiral Mouchez.

Meanwhile, other historical events had given to the Observatory, the opportunity to organize exhibitions and meetings: on the occasion of anniversaries for persons or events, in some cases exhibitions only. Such were the centenaries of Roemer (1644–1710) and the velocity of light (1976), Picard (1620–1682) in 1982, the new definition of the length of the meter given in 1983 (1984), Newton and the *Principia* (1987), the total solar eclipse of the Sun visible in France (1999), the change of century and millenium (2001), the last Venus transit (2004).

Contacts with the public were established through the fact that a scientist of the Observatory was always present in the exhibition room and there were also guided tour to give a rather short presentation before a free visit left to the visitors. This was mostly the case of the exhibitions “Temps mesuré et temps démesuré” (2001), “Le miroir et le pendule” (2002) after Foucault (1819–1868), “Arago et l’Observatoire de Paris” (2003) one hundred and fifty years after the death of Arago (1786–1853).

Contacts with the visitors have shown that modern aspects of the subject, following the historical part, was appreciated by the public.

(6) Public understanding of astronomy

From these different contacts with the public some difficulties were perceived. The language with usual words, such as “dust” applied to “stars”, “black” and “hole” associated in “black holes” or the expression Big-Bang created for fun were used for ideas very far from their difficult acception. In France it is often used by politicians. Other words, not very common, can also mask other difficult concepts; such are space and curve in “curved space”. The words “temperature” or “mass” concern other type of difficulty, when they are employed for millions or milliards of degrees for the stars or for their mass of the order of 10^{39} kilogrammes in a tiny volume.

The images given on TV screens represent astronomers watching something through a telescope while visual observations are less and less in use. Most of the observations are made with photographic plates, photometers, spectroscopes and, nowadays, from space. The offices of the astronomers are mostly equipped with a small computer and, in some cases, they order their observations through it.

Very often, during interviews, the astronomers are asked to be close to an old and obsolete instrument, very often nicer than more modern ones. Unless they are very long, large and high. It is impressive, of course, but does it bring information on the corresponding research.

The modern results are nowadays difficult to explain to the general public. As examples may be mentioned:

- transfer of clocks for test related to fundamental physics,
- discovery of Neptune,
- detection of gravitational waves,
- 3K radiation, Newton’s gravitation,
- general relativity,
- thermodynamic equilibrium.

Sometimes the public considers that scientific research is more or less a mystery such as radio-astronomy for which nothing can be seen, being related to radiowaves.

The knowledge of the man (or woman) in the street is sometimes far less under what was known by the scientists at the end of the seventeenth century, sometimes from the Antiquity: is the Earth the center of the world or not, in other ways is the Sun rotating around the Earth or the Earth rotating around the Sun?

Discoveries made during this 17th century, such as Galilean satellites and Saturn ring division, are better known due to space images but, of course, the fundamental bases are not. In that case, optical astronomy appears to be suffisant for the public understanding.

For the following discoveries, such as theory of celestial motions, spectral analysis and classification of stars, can be presented through simple general notions. For better understanding cultural minds or some specialized scientific knowledge are needed.

Some places, like the Palais de la Découverte created in 1937 in the center of Paris, are well oriented in pedagogic presentation of science. In many other museums, there are often what we call in French “presse-bouton”, in English may be “press-button”, such as laser-beam, CCD cameras; this is a pure manipulation without showing what is behind. The repetition of old experiences, as made in some

centers, leads to a better comprehension of some in cause phenomenon; but it cannot be seen as “doing science”. For example some persons say that they are “doing astronomy” while they are watching or photographing celestial bodies. Do they say that they are “doing atomic research” while they can look at any time atoms and molecules around them arranged into all what is in our universe?

After such remarks it is possible to come to use historical views in astronomy showing the evolution of knowledge in this domain. In France a TV show, under the title “Tours du monde, Tours du ciel” based on historical aspects up to modern research, has had an extended success.

(7) Broadcasting astronomy through its history

When speaking, from historical facts, to the public, up to a certain evocation of the modern aspects, the astronomer follows the evolution of the research in this domain. In Paris Observatory, which represents an experiment, this was made under the influence of Jacques Lévy, deceased from 2004, an astronomer having ended his carrier in the field of history of astronomy, after the closure of the programme in which was his previous domain of activity.

During the 1980–1990 decade a renewing for the guided tours was undertaken in collaboration between several astronomers and the curator of the Observatory. This evolution concerns several fields.

- Historical visits for the public, which duration is of the order of two hours.

The Paris Observatory houses instruments from those employed at its beginning up to the end of the 19th century. From sometimes the end of the tours was a model of the Canada-France-Hawaii telescope plus photographs of modern equipment being not yet historical. Each year the show-cases of the rooms to be visited, include themes related to some historical fact up to some of its modern aspects. As examples may be mentioned:

- 1988: Delisle (1688–1758) in reason of a transit of Mercury over the Sun;
- 1989, 1995 and 1999: from the revolutionary meter up to the definitive value of its length;
- 1994: the Dreyfus “Affaire” and astronomy;
- 2006: instrumentation from the collections related to several domains developed at the Observatory.
- Historical publications for the public, among others:
 - 1963: “Observatoire de Paris — Son histoire 1667–1963”,
 - 1987: “La comète de Halley — Hier, Aujourd’hui, Demain”,
 - 1987: “Petite histoire de la Carte du Ciel”.
- Exhibitions, for example:
 - 1982: “Jean Picard et la mesure de la Terre”, year of the tercentenary of his death (1682).
 - 1984: “Longueur et temps — De la vitesse de la lumière à la définition du mètre” motivated by the new realisation of the length of the meter in 1983, to which the Paris Observatory collaborated with four other laboratories.
 - 1987: “La mesure du ciel — De la plaque photographique aux techniques spatiales”, during the time an IAU Symposium was held in Paris on the subject “Mapping the Sky” which beginnings occurred in 1887, launched in Paris, the end being related to the astrometric satellite Hipparcos to be launched in 1989.

Among more recent exhibitions can be mentioned:

- 1996: “Neptune et les mondes extrasolaires”, 150th anniversary of the discovery of Neptune, from the bodies of the solar system through Uranus, Neptune up to the modern instruments both on the ground and in space leading to several discoveries of new bodies in the solar system and elsewhere.
- 1997: “Cassini-Huygens — Le temps d’un voyage” on the occasion of the launching of the Cassini-Huygens space programme ; “Mémoire d’argile — Mémoire vive”,
- 1998: Calculations from tablets to the modern computers.

- 2001: “Temps mesuré — Temps démesuré” concerning the 1st year of the 21st century and 3rd millenium with historical and very modern aspects of time.
- 2002: “Foucault — Le miroir et le pendule” about works of Foucault, his pendulum and the silvered mirror, plus the modern mirrors of large telescopes.
- 2003: “Arago et l’Observatoire de Paris” on the occasion of the one hundred and fifty years of his death, mostly related to the various fields of research developped upon his suggestion.

(8) Conclusion

The introduction of history of astronomy as well as other different actions has given to those who participated, the feeling that the public has a better perception of the developments of astronomical research and its evolution. It has to be considered that there was always, at least, a recent aspect related to the past. From this experience some remarks can be added.

The historical brochure, 1984 reedited 1990, was sold up to the time it was out of print, many years ago; it was sold at that time at the level of one for ten visitors. The Comet Halley with three editions was sold at 8000 within 15 months. The historical and modern exhibitions with pedagogical aspects have retained attention of both the public, pupils and students in relation with the numerous questions raised to the scientists present in the Observatory. The Kit-EXPO issued in 1988 was bought by teachers and French embassies, 700 exemplars went within one year and a small brochure included in it but also sold alone went at about one thousand.