On the history of the Hamburg Observatory

Stefan K.G. Dahmke[1]
[1]Hamburger Sternwarte, Gojenbergsweg 112, D-20219 Hamburg, Germany

DOI: http://dx.doi.org/10.3204/DESY-PROC-2016-05/42

This contribution aims to provide an overview of the history of the Hamburg Observatory from its early days up to the present. It highlights some of the notable individuals as well as a select few projects that played major roles for astronomy and astrophysics in Hamburg.

1 Introduction

During the Magellan Workshop 2016 in Hamburg its participants were invited to visit the *Hamburger Sternwarte* (=Hamburg Observatory). This article is intended to give a brief summary of the century-long history of the observatory as well as some additional information on its current instruments. While this by far is not the most detailled possible analysis of the institute's history, it hopefully provides our international visitors with a quick overview, especially since most of the sources and literature so far are only available in German.

2 Establishment of the observatory

The history of the Hamburg Observatory does not begin in astronomical science but instead in the very down-to-Earth business of surveying. The Swiss expert Johann Casper Homer was conducting surveys of the Weser, Elbe and Eider rivers in northern Germany in the beginning of the 19th century. As he tried to find suitable optical instruments to help his work, he met with a certain Johann Georg Repsold, founder of a workshop for precision instruments and chief of the Hamburg fire brigade, who was capable of providing valuable assistance in constructing new surveying equipment. Repsold's interest in optical instruments grew rapidly and quickly led to an interest in astronomy. Thus he built his first own observatory in 1802, which he owned and operated privately for several years before French occupation under Napoleon put an end to it. [10]

Shortly after, in 1820, Repsold could convince the senate of Hamburg to grant permission to build a new and larger observatory at the Millerntor, not far from the city centre. Initially the observatory was again a private endeavour and was largely funded by being also working as a navigators' school. This is a very tight link between astronomy and seafaring, which would continue to play a significant role in the history of the observatory for more than a century. [10][11]

After Johann Georg Repsold, who had continued his work in the fire brigade of Hamburg, died in the line of duty on January 14th 1830, the senate decided to keep the observatory and officially opened it as a state intitute in 1833. Christian Carl Ludwig Rümker became the first

Figure 1: The Millerntor observatory. [1]

director and using a Fraunhofer refractor telescope built by the Repsold workshops - which were now operated by Repsold's sons - he published a catalogue of stars, comets and asteroids which earned him a gold medal from the Royal Society of London in 1854. When Rümker retired in 1857 he, too, was succeeded by his son, who faced a major challenge in modernising the aging equipment of the observatory. [10]

In 1867 the observatory acquired a 26 cm refractor built on a modern equatorial mount from the Repsold company. This telescope still exists and remains functional. Despite this the observatory lost influence in Germany as Georg Rümker, contrary to trends of astronomy in Germany, had little interest in studying galaxies and instead kept the research focus on comets, asteroids and astrometry. [10][11]

3 Time ball

As already mentioned, there has always been a strong tie between astronomical observations and maritime navigation in Hamburg. This is due to two reasons, which also formed two of the major tasks for the observatory for a very long time: firstly, ships trying to fix their position by means of the stars need sufficiently precise stellar charts to know the coordinates of bright stars and consequently compare these to their own nightly observations. Secondly, to find their current longitude, ships had to know the exact time of a reference point (like Greenwich or their own homeport) indicated by a clock to be compared to the culmination of the sun or bright stars.

This method of determining one's position in longitude was introduced by the Yorkshire-born carpenter and tinkerer John Harrison who not only understood how knowing the time at a reference point was the key to solving the longitude problem, but also managed to build the first clocks that would provide this time aboard a ship with reasonable precision. Despite many astronomers' resistance - Sir Isaac Newton maintained up to his death in 1727 that it was utterly impossible to build an accurate shipboard clock - it became a standard method of navigation during the 19th century and again involved astronomers with the task of providing precise time to ports, where ship captains would correct their shipboard clocks. [3]

In 1876 a *time ball* was erected in Hamburg. Figure 2 shows a technical drawing of the structure. A roughly 2 m diameter leather ball was raised up in the tower and at precisely 12:00pm GMT, 12:43 local time, dropped back down to its original position, released by an electric mechanism which was actuated via telegraph from the observatory. As the time ball was located on top of a large storehouse, this visual signal could be made out from all over the harbour, enabling the navigators and captains to adjust their own clocks. Today a fully functional scale model built by Heinz-Otto Kult, who meticulously researched its history, is on display at the Hamburg Observatory. [7]

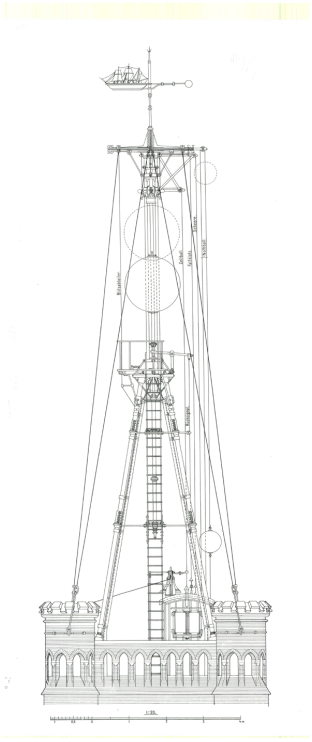

Figure 2: Schematic drawing of the time ball. The whole structure was located on top of a warehouse. [1]

The main instrument used for the determination of time was the Meridian Circle, a type of special telescope which does not traverse but strictly looks along the North-South-Meridian in variable altitude. The apparent movement of the stars as induced by the rotation of the Earth then makes stars pass through the field of view at different times. Noting these times and comparing them to stellar catalogues enables the observer to correct for errors in the observatory's own clocks, of which several were in operation in a well insulated room underneath the library. The advent of widespread telephone and radio networks rendered the time ball less and less important after the turn of the century and in 1934 it was finally demolished. Despite this the precise measurement of time remained a major task for the observatory up to the 1960s, when atomic clocks which allowed for even higher precision than astronomic observations were established. The Meridian Circle in Bergedorf remained in use until the 1970s when it was shipped to Australia to take part in observations in preparation for the Hipparcos space mission. [4][5][7]

4 Bergedorf

As has been noted before, the influence Hamburg Observatory had on the astronomical community declined during the second half of the 19th century. Besides the research focus shifting away from general trends in Germany and Europe at the time and the fact that the observatory was in need of modernising instruments and equipment, a major factor in this was the location. The Millerntor site was located near the harbour, which sometimes hampered observations due to vibrations and smoke from the increasing number of steam ships. Also from 1882 onward Hamburg introduced electric street lighting which further worsened the observation conditions. [10]

To combat these circumstances Georg Rümker and Richard Schorr, who in 1900 would become the next director, drew up plans to move the entire observatory away from the city. The navigation school had already split from the observatory in the 1860s for administrative reasons. The current site in Bergedorf was chosen for its relatively high elevation of 40 m, its distance from densely populated areas and the fact that the town of Bergedorf was already connected to Hamburg via railway. After 1900 construction of several seperate buildings began and new instruments were ordered, making Hamburg one of Europe's largest observatories when the Bergedorf site was officially opened in 1912. Among these instruments were a new Meridian Circle, the *Great Refractor* measuring 60 cm in aperture and built by Respsold, the 1 m reflector (*Meterspiegel*) built by Carl Zeiss and the *Lippert Astrograph*, a 34 cm refractor built by Carl Zeiss and donated by the local merchant Eduard Lippert. Also the 26 cm *Equatorial* refractor was moved from the old observatory. Each of these telescopes was housed in a seperate building and could thus operate independently. This followed a new trend of keeping living quarters and offices away from the telescopes to reduce air turbulence related to heating. [6][10][11]

Figure 3: The dome housing the *Great Refractor* during construction. [1]

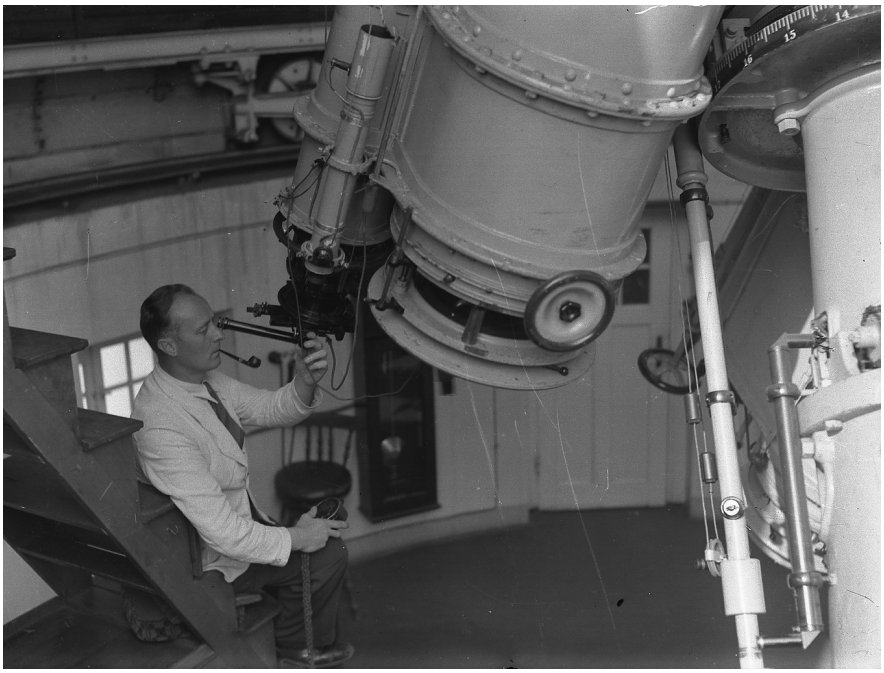

Figure 4: Arthur Arno Wachmann at the *Lippert Astrograph.* [1]

Now equipped with state-of-the-art equipment, Hamburg observatory gained new importance. In the 1920s multiple survey programmes began, among them the *Bergedorfer Spektraldurchmusterung* (=Bergedorf spectral survey) by Schwassmann und Wachmann (seen in figure 4), who used the Lippert Astrograph to obtain spectra of more than 160,000 stars. Also the *Astronomische Gesellschaft Katalog 2* (=Astronomical Society Catalogue 2), or AGK2 for short, a major astrometric catalogue, saw significant contributions from Bergedorf, even though it could not be published until 1951 due to the outbreak of the war. In 1920 also Walter Baade joined the observatory. He started out observing comets, planets and asteroids but then, towards the end of the 20s, became increasingly interested in the study of galaxies. [6][10]

In 1927 the probably most famous character arrived in Hamburg, when Bernhard Schmidt accepted an offer by Schorr to repair a horizontal telescope that Schmidt had originally built. This was a favour to Schmidt who had fallen on hard times and only received a small fee plus free lodging at the observatory at first. He anyway quickly made himself indispensable as a skilled optical engineer. [6][9][10]

During an expedition to the Philippines in 1929, in which both Baade and Schmidt participated, Bernhard Schmidt conceived his most famous invention: trying to tackle the problem of image abberations of telescopes with short focal lengths he first used a semi-spherical mirror instead of the commonly found parabolic one. Then he counteracted the rising spherical abberation by introducing an additional optical element. The *Schmidt Corrector Plate* was an aspheric lens with convex and concave parts put in front of the mirror, at the center of the mirror's sphere shape. This lens was carefully shaped to counteract the abberation. The following year a complete telescope based on Schmidt's principle was built in Hamburg. The

Figure 5: Bernhard Schmidt in his workshop at Hamburg Observatory. [1]

Figure 6: The original Schmidt telescope as seen in 1932. [1]

instrument, shown in figure 6, immediately was a resounding success. [2][9]

While Bernhard Schmidt himself died in 1935, telescopes of his design quickly became popular in astronomy. The Palomar Observatory near San Diego opened in 1936 with an 18 in Schmidt camera. The Mount Wilson Observatory near Los Angeles began construction of a 1.2 m Schmidt telescope. Walter Baade, who already had hoped to work at Mt Wilson prior to joining the Hamburg Observatory moved to the United States in 1937, while financial and organisational problems delayed Hamburg's *Great Schmidt Mirror* until the outbreak of the war. The instrument could only be built in 1954 and then was put to use on the new AGK3 project, for which Bergedorf mapped most of the northern Sky. The 1.2 m Schmidt Telescope was operated in Hamburg until 1969, when plans to move the telescope to Calar Alto Observatory in Spain came up to make use of the more favourable weather there. [2][10][11]

The fact that Walter Baade, who had left Hamburg in 1937, had been Richard Schorr's favourite candidate as a successor meant that somebody else had to be named as next director. There were several candidates and the decision was not very easy, as Schorr's preference was Otto Heckmann, who despite having joined the nazi party and successfully having used some of their structures to further his own work in Göttingen, had fallen out of favour with the politics due to his keen interest in cosmology and Einstein's theory of relativity, which he officially defended. Heckmann became director of the Hamburg Observatory in 1941 regardless. [10]

5 A word on ESO

Otto Heckmann as director of the Hamburg Observatory attended several international conferences in the early 1950s. These conferences concerned themselves with finding ways to strengthen astronomy and science in Europe in the economically difficult times. One promising idea was to concentrate efforts throughout Europe by starting a joint observatory, thus splitting the costs of building and operating it. [8][6]

Figure 7: Otto Heckmann (r) at the *Great Schmidt Mirror* 1.2 m telescope. [1]

This idea, alongside the realisation that studying our own galaxy in detail would require a large and advanced observatory in the southern hemisphere, led to the Leiden Declaration in January 1954. This declaration states the intent of constructing a joint observatory including a 3 m mirror telescope and a 1.2 m Schmidt camera in South Africa. It was signed by leading astronomers from six countries (Heckmann and Unsöld from Germany, Burgeois from Belgium, Couder and Danjon from France, Redman from the UK, Oort, Oosterhoff and van Rhijn from the Netherlands, Lindblad, Lundmark and Malmquist from Sweden) and intended to gain more support from their respective governments. [8]

Scouting for a suitable location started in late 1955 and soon extended to South America, accounting for the troublesome political situation in South Africa. Finally, on October 5th 1962, the *European Southern Observatory* was founded. From the six countries involved in the Leiden Declaration five became founding members - the United Kingdom did not join. A month later Otto Heckmann was named as first director of ESO and offices for the newly founded organisation were prepared in the town of Bergedorf, not very far form Hamburg Observatory, where Heckmann remained director until 1968. By that time ESO required so much of his attention, that Alfred Behr relieved him as director of the observatory. By this time construction of the ESO site in La Silla, Chile was well advanced, two telescopes exceeding 1m in aperture diameter were already installed. Later in the same year the journal *Astronomy and Astrophysics*, which remains one of the most influental journals for the astrophysics community, was founded with the help of ESO. [8][6][10]

Since Heckmann no longer had to divide his time between ESO and Bergedorf, the vicinity of the headquarters to Hamburg Observatory wasn't as much of an issue anymore from 1968

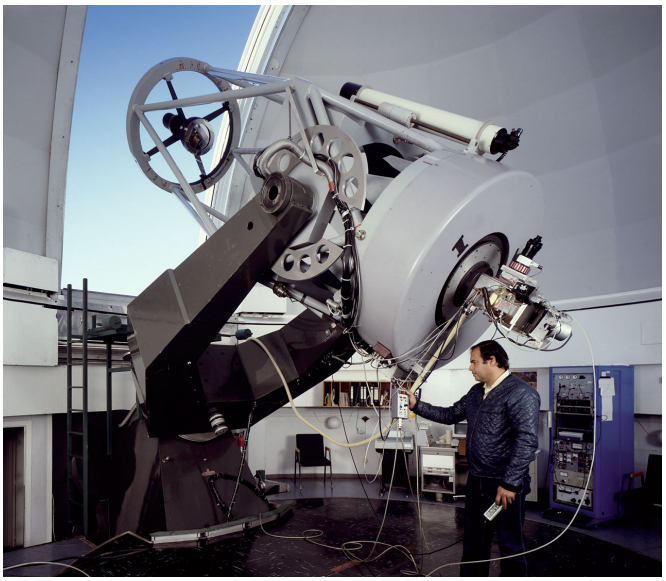

Figure 8: The 1-metre Telescope was the first instrument to operate at the La Silla site. Its *first light* was in the night of November 30th 1966. Image courtesy of ESO.

onwards. Also the old offices soon proved to be inadequate in size and plans for a new ESO site in Europe were drawn up. The planning of the new buildings lasted until the late 1970s, when finally construction began in Garching, near Munich, which not only allowed for much more extensive buildings, but was also easier to reach for the ever increasing number of astronomers from ever more European countries. When the Garching headquarters were finally inaugurated in 1981 Belgium, Denmark, France, Germany, The Netherlands and Sweden were already part of ESO; Italy and Switzerland joined shortly afterwards. [8]

While Otto Heckmann retired from the post of director general of ESO in 1970, his successor at the Hamburg Observatory kept close ties to the international organisation. Observations from Hamburg became less and less important, but Behr was involved in building instrumentation for ESO, including a polarimeter. That concludes the era of major contributions of the Hamburg Observatory to ESO, although of course scientists from Hamburg remain involved in projects up until today. [8][6]

6 Hamburg Observatory today

Hamburg Observatory has been a part of the University of Hamburg since 1968. This resulted in tremendous changes to the organisation of the observatory. Nowadays the majority of staff is made up by students of the university who specialised their studies of physics towards astronomy and astrophysics.

In 1969 Prof. Alfred Weigert joined the observatory and founded a workgroup concerned with stellar evolution and the modelling of the interior of stars. Both of these topics remain strong suits of the Hamburg Observatory up to the present, having expanded into two seperate groups. Prof. Peter Hauschildt keeps expanding on the renowned stellar atmosphere simulation

code *PHOENIX* while Prof. Robi Banarjee continues work on stellar evolution.

Soon after, in 1972, Prof. Heinrich Wendker founded his workgroup on extragalactic astrophysics and made efforts to extend observations to both radio and X-ray wavelengths, the latter of which of course had to be conducted from space. The extragalactic work later developed into one of the major achievements of the 1980s, the *Hamburg Quasar Survey*, for which photographic plates taken with the *Great Schmidt Mirror* at Calar Alto as part of the *All Sky Objective PrismSurvey* were scanned and analysed with the help of computers. Work on extragalactic astrophysics is still ongoing under direction of Prof. Marcus Brüggen and Prof. Annalisa Bonafede, including the observatory's involvement in the *LOw Frequency ARray*, LOFAR, which consists of more than 48 stations across all of Europe.

Observations in wavelengths ranging from infrared to X-rays continue both in utilising Bergedorf's own telescopes and analysing data obtained at other observatories in the workgroup of Prof. Jürgen Schmitt, who specialised in stellar activity as well as characterisation of exoplanets through spectroscopy and photometry.

The work of Prof. Alfred Behr and others before him in designing new astronomical instruments is currently being carried on by Prof. Günter Wiedemann, who especially concentrates on spectroscopy and solar physics, as well as observations in optical and infrared wavelengths. For these projects a seperate 70 cm telescope, designated *G1*, has recently been set up at Bergedorf.

The *Great Schmidt Mirror*, which was shipped to Spain, left Hamburg with an empty telescope dome. In 1975 the new *Oskar Lühning Teleskop* commenced observations. The 1.2 m mirror telescope remains the primary telescope for scientific observations in Hamburg today, in no small part thanks to a major effort of modernising the control system. The whole telescope is computer controlled, can be remotely operated and features modern CCD detectors since 2000.

Also in the mid-1970s the *Lippert Astrograph* underwent major changes and now features a 60 cm aperture mirror, effectively matching the *Great Refractor*. The telescope is manually controlled and can be used for both visual observations and camera exposures. While it's only used for scientific observations occasionally, it is used extensively for teaching purposes as well as for public outreach.

The historic *Great Refractor*, the *Meterspiegel* 1 m mirror telescope and the *Equatorial* all remain in varying degrees of restoration. The mirror telescope has widely been refurbished in recent years. A project to restore the *Great Refractor* is currently in planning, as the telescope itself is in fully operational condition, but the building around it and especially the dome mechanics are in bad repair prohibiting any use of the instrument. The *Equatorial* is still functional after almost 150 years, but has a seriously impaired field of view due to nearby trees. All three of these instruments are in no scientific use anymore and are mostly of historic and public interest today.

References

[1] Photographic Archive of the Hamburg Observatory

[2] Mark Christensen, *Schmidt - The Man and the Camera*, The Fox Valley Astronomical Society, 2000

[3] Rupert T. Gould, *John Harrison and his Timekeepers*, Lecture recorded in The Mariner's Mirror Volume 21 Issue 2, 1935

[4] Erik Høg, *Astrometry lost and regained - from a modest experiment in Copenhagen in 1925 to the Hipparcos and Gaia space missions*, Lecture held at Kroppedal Museum, 2010

[5] Erik Høg, private communication

[6] Jahresberichte Hamburger Sternwarte, Annual Reports of the Hamburg Observatory

[7] Heinz-Otto Kult, private communication

[8] Official ESO Timeline, http://www.eso.org/public/about-eso/timeline/

[9] Richard Schorr, *Bernhard Schmidt* †, Astronomische Nachrichten, 1936

[10] Jochen Schramm, *Sterne über Hamburg*, 2nd edition, Initiative zum Erhalt historischer Bauten, 2010

[11] G. Wolfschmidt, A. Seemann, D. Kühl, *Hamburger Sternwarte - Geschichte und Erhaltung*, Förderverein der Hamburger Sternwarte e.V., 2001