Minor planet "Pizarro" moves in an elliptical orbit with a mean distance of 465 million kilometres, i.e. between Mars and Jupiter. One revolution takes about 5 ½ years. Once the orbit had been established by means of the observations in 1988, it turned out that images of this minor planet had also been measured earlier; a single observation was made already in 1969 at the Crimean Observatory. "Pizarro" measures about 10 kilometres across.

ESO'S EARLY HISTORY, 1953–1975

X. The Schmidt Telescope: Design, Construction, the ESO-SRC Agreement and the Onset of Survey Projects*

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"Erlaube mir die Anfrage, ob ihr vielleicht für Spiegelteleskope interessiren, ich – – – [möchte] mal sehen, was sich mit einem Spiegel fotografiren läszt, – – –"

From a letter of Bernhard Schmidt to Karl Schwarzschild of May 29, 1904 as quoted in Abhandlungen Hamburger Sternwarte Band X, Heft 2, p. 50.

As the last, but by no means the least, of the instruments of ESO's initial programme we turn to the Schmidt telescope. We review its history up to the time in the early 1970's when it began fulfilling its great mission: providing the astronomical community with the southern complement to the Palomar Sky Atlas. But first, a glance at its pre-history is in order.

Bernhard Schmidt and Early Developments at Hamburg Observatory

From the beginning, the planning of the Schmidt telescope was, beside the involvement of the Instrumentation Committee, very much a concern of ESO's Director Otto Heckmann himself. In the early 1950's, the Hamburg Observatory had obtained a Schmidt telescope in the acquisition of which Heckmann had been deeply involved. The observatory had special affinity to this type of telescope because it was here that Bernhard Schmidt's invention had been applied first, and thereupon it had deeply affected observational astronomy. Let me, therefore, spend a few lines on these early developments [1].

At the commemoration of Schmidt's hundredth anniversary in 1979, the President of the University of Hamburg in his opening address related that in 1904 Bernhard Schmidt approached the famous astronomer Karl Schwarzschild with the question whether his work in optics might be of interest for Potsdam Observatory and that he much impressed Schwarzschild – and that in 1916 Schmidt contacted the Director of Hamburg Observatory, R. Schorr [2]. Schmidt's ingenuity in optics led to continued association with this observatory under Schorr's direction and encouragement, and in 1931 produced the first instrument of the type we now call "Schmidt Telescope". In the *Messenger* of June 1979, Alfred Behr commemorated Bernhard Schmidt's achievements and showed a picture of the original Schmidt telescope, still at Hamburg Observatory. For the benefit of those readers who are not acquainted with the special properties of this type of telescope, the accompanying box describes its main optical features.

Considerable stimulus for Schmidt's work also seems to have been due to Walter Baade who was a member of the staff of Hamburg Observatory from 1920 to 1931. Schmidt died in 1935, and when in 1936 Baade was nominated for the succession of Schorr as Director, he made it a condition that the Observatory should be equipped with a Schmidt telescope of 80 cm aperture. The Hamburg authorities agreed, and notwithstanding the fact that Baade ultimately preferred to stay at Mt. Wilson Observatory with the prospect of utilizing the more powerful 120-cm Palomar Schmidt, the plans for the Hamburg Schmidt were realized [3]. It was to have a focal length of 240 cm, and a 120 cm diameter spherical primary mirror. In this realization Heckmann played a leading role.

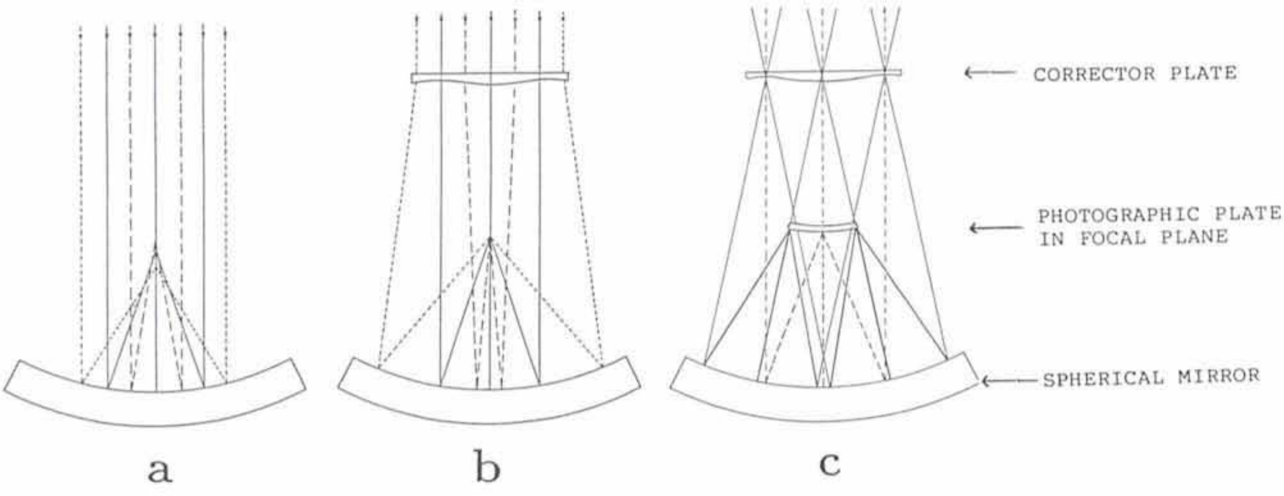
It is no surprise, then, that Heckmann felt that the acquisition of the ESO Schmidt should be very much a matter of his interest and responsibility. Along with the essentially French realization of the 1.5-m telescope, the Dutch one of the 1-m telescope (both described in article IV), and the Danish role in the development of the Telescope Project Division (described in articles VIII and IX), the Schmidt-telescope project may be considered as the early major instrumental contribution from German side.

Planning the ESO Schmidt

At the meeting which marked ESO's beginning, June 21, 1953, Baade suggested that ESO should acquire a copy of the Palomar Schmidt, and thus would be able to soon start its work. The Palomar Schmidt with its 120 cm aperture, fully operational since 1949, certainly met its designer's high expectation for wide-field photography. However, ESO astronomers wanted more: the facility to obtain objective prism spectra. In the 1950's, spectral surveys played an important role in galactic research at many European observatories and it was important to extend these to fainter stars than had been reached so far.

This point was raised for the first time by Heckmann at the July 1958 meeting of the ESO Committee, and taken up again when in November 1961 the Committee requested the recently created Instrumentation Committee to consider an alternative design. This differed from the Palomar Schmidt mainly in that the aperture would be 100 cm – 40 inch – instead of 120 cm, and the diameter of the spherical mirror 160 cm instead of 180 cm, however maintaining the focal length (305 cm) of the Palomar Schmidt and hence its plate scale (approximately 67" per mm). Reason for this modification were the reduced size, and hence the lower weight, of the objective prism and therefore a considerable reduction of the demand on the sturdiness of the telescope tube and lower costs, and an important additional consideration was the smaller chromatic variation that is left after the correcting plate's elimination of the principal part of the spherical

* Previous articles in this series appeared in the *Messenger* Nos. 54 to 62.



Schmidt telescopes allow astronomers to photograph large regions of the sky on one photographic plate and are therefore very suitable for making sky atlasses. The sketches in this box illustrate the main optical features of the Schmidt design.
A basic element is the *spherically* shaped primary mirror, contrary to the *parabolic* mirror of regular telescopes like the ESO 3.6-m telescope. Figure *a* shows how this spherical mirror would work if it would receive a beam of the star light. There would be no unique focal point: marginal light rays focus on a point closer to the mirror than rays hitting the mirror nearer to its centre. This difference is eliminated by letting the light pass through a specially figured glass plate, the corrector plate, the centre of which is placed in the centre of curvature of the primary mirror, see Figure *b*. Given the presence of this corrector plate, we may now let the telescope receive light from stars that are at large angular distance from the central axis of the system: as shown in Figure *c* these rays will be focussed in essentially the same way and at the same distance from the mirror, on a spherical surface that also has its centre of curvature at the centre of the corrector plate.
Some sensitivity of the optical system to the wavelength (colour) of the infalling beam arises from the slight refraction of the light when it passes through the corrector plate. Shape and material of the corrector plate must therefore be chosen in accordance with the wavelength region of the planned survey.
As the focal plane is curved, the photographic plates are forced to have the same curvature by placing them in specially designed plate holders, a treatment that most of the (thin) plates survive.

aberration, allowing high quality objective prism spectra over a wide range of wavelengths [4]. The Hamburg Schmidt also had been provided with an objective prism.

In October 1962 the IC, upon advice from various experts, endorsed the proposal and the EC in its meeting later that year decided accordingly. A disadvantage was the reduced size of the vignetting-free field, only $5^\circ\!.4 \times 5^\circ\!.4$, corresponding to the standard plate size of 30 × 30 cm, instead of the $6^\circ\!.5 \times 6^\circ\!.5$ of the Palomar Schmidt (due to the fact that the focal length was not reduced in the same ratio as the dimensions of correcting plate and mirror), and the consequent increase of the number of plates required for covering the sky in the survey programmes. However, this was accepted. This deviation from the specification of the Schmidt in the ESO Convention was confirmed at the first meeting of Council in February 1964.

Mechanical Engineer and Manufacturer

The Hamburg Schmidt had performed satisfactorily since its dedication in the year 1954, and so it was natural for Heckmann to propose to the IC to put the realization of the mechanical parts of the ESO Schmidt in the hands of those who had been responsible for the Hamburg telescope: the firm of Heidenreich and Harbeck (precision steel constructions) at Hamburg – henceforth denoted by H&H – in collaboration with the mechanical engineer W. Strewinski. Strewinski had been an employee of H&H, but after the completion of the Hamburg Schmidt created his own, independent, engineering bureau.

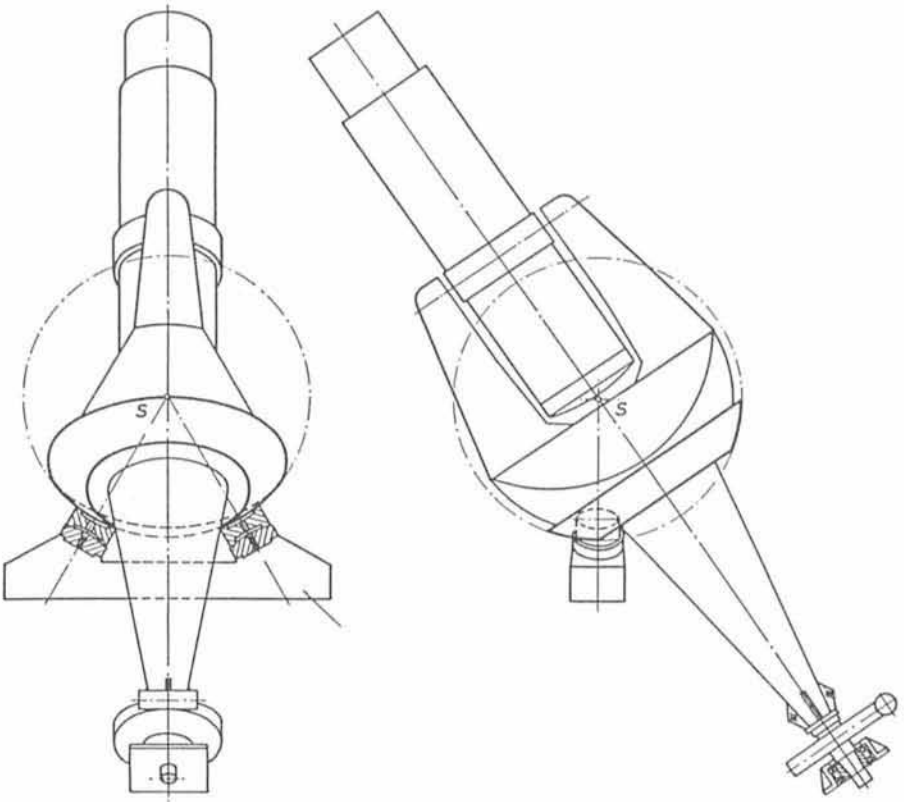
On the other hand, as described in article IV, the ESO Committee that in the early days managed the affairs, preferred the creation of an engineering group to be charged with the comprehensive task of developing all major instrumentation, including the 3.6-m and the Schmidt telescopes. A preliminary agreement for a joint venture of this nature was reached with the engineers Strewinski and Hooghoudt in November 1961 [5] and contracts were signed by them in August and September 1963, respectively [6]. To what extent these covered more than just the Schmidt telescope is not clear, but in any case the arrangement did not work out satisfactorily. In August 1963 there still was a prospect for joint effort in the design of the Schmidt [7], but in February 1964 all the ESO Directorate had at its disposal were some preliminary studies by Strewinski. Hooghoudt (whose involvement in the 1-m telescope was described in article IV) had become heavily involved in the Benelux Cross Antenna Project, a – not realized – precursor-proposal for the Westerbork Synthesis Radio Telescope.

Heckmann then decided to refrain from the joint proposition, and by the middle of 1964 proposed to IC and Council to proceed for the Schmidt exclusively with Strewinski [8]. Council agreed, although reluctantly, as it foresaw delays in view of Strewinski's simultaneous involvement in the work on the 3.6-m telescope. In June 1965, Heckmann informed Council that a draft contract with Strewinski had been drawn up. One of his first tasks was the design of the mirror cell, the mirror itself nearing completion, in 1967, at Zeiss-Oberkochen.

Some Design Features

Contrary to what has been done for the smaller ESO telescopes, no comprehensive description of the design has been published for the Schmidt. A brief description by Heckmann occurs in the report on the 1972 Conference on Schmidt telescopes [9]. Specifications also occur in R. West's article on the Sky Survey project in *ESO Bulletin* No. 10 of May 1974, and later modifications have been described by A. B. Muller, see Note [16]. Quite instructive are also the proceedings of the IC meetings over the years from 1962 on. Some of the main features of the telescope are described in the following paragraph.

As in the case of the Hamburg Schmidt, a fork mounting has been chosen, and the weights of all movable parts (tube plus polar axis) are distributed in such a way that their centre of gravity coincides with the centre of the sphere which also defines the surface of the oil pads along which the upper bearing slides during its motion when the telescope is set on, or follows, a star. As one of the advantages to this construction, it allows smooth adjustment of the polar axis. The mirror is supported in its cell in such a manner that it allows maintaining exact focussing – so essential for Schmidt photography – by means of invar rods, free of thermal expansion, which keep the plate holder at constant distance from the mirror. Stiffness of the telescope tube is achieved by a double-wall construction, and an outer layer of thermal insulation helps avoiding rapid temperature changes of the interior.



The Hamburg Schmidt Telescope: *two drawings by W. Strewinski occurring in his article quoted in the text [18] and showing design features also adopted for the ESO Schmidt.*

A Daring Design, Not Realized

In the early 1960's, as an alternative to copying the design of the Hamburg Schmidt, Strewinski suggested for further study a rather unorthodox one, referred to as the "spherical model". It went a step farther in that not only the surface of the upper bearing that is in contact with the pads of the mounting is spherically shaped, but this spherical section is extended so as to become an almost complete sphere to which the telescope tube is directly fixed.

Fork prongs and declination axis are dispensed with. The axis of the telescope tube goes through the centre of the sphere, which is also made the centre of gravity of the sphere together with the tube including its optics. There is a short polar axis with bowl-shaped upper end to which the sphere can be clamped by means of electro-magnets fixed to the bowl. For motion around the direction towards the pole, all clamps are fixed. For adjustment in declination, two of the clamps are switched off, and the third one remains clamped but it can be displaced along a slide [10]. The concept is sketched in a drawing reproduced by Ch. Fehrenbach in his recent monograph "Des hommes, des télescopes, des étoiles" [11].

As advantages of this model, Strewinski pointed out that only a short and relatively light polar axis is needed, that the spherical mounting is very rigid and quite resistive against earthquakes, and that the foundation of the mounting would be simple and cheap. Manufacturing would present no difficulties and not be expensive.

The spherical model was discussed by the IC in the meetings of March, June and September 1964. The majority of its members, although appreciative of the new concept, was hesitant about applying it in the case of the ESO Schmidt. Heckmann was in favour of pursuing the idea, and reported at the September meeting that also Bruce Rule of Palomar Observatory, after a meeting in Strewinski's office, had expressed himself positively. Yet, the idea was not followed up any further, and Strewinski agreed to follow in his design essentially that of the Hamburg Schmidt.

The Optics

Following a recommendation of the IC, the ESO Committee in its meeting of February 1963 decided to order the spherical mirror with diameter 1.62 m from Schott, Mainz, to be made of low-expansion Duran 50 glass, and from the same firm the 1-m corrector plate, to be made of ultraviolet-transparent Schott UK-50. The orders were finalized right after the ratification of the Convention. Figuring was done by Zeiss-Oberkochen, where mirror blank and corrector plate arrived by the middle of 1965 and early 1966, respectively [12]. A mishap occurred when, by unknown cause, the blank broke in the early figuring phase, but it was soon replaced so that no delay was caused. In the course of 1967 both mirror and corrector plate approached their final shape and would soon be ready for testing in the mirror cell. Unfortunately, construction of the cell and its related mechanical parts was not yet completed at that time. Provisional acceptance took place in October 1970 upon examination by Ramberg and Alfred Behr, expert in optics of Göttingen Observatory (who also made the polarimeter for the 1-m telescope). Meanwhile, also in 1967, material for the first, 4° objective prism of UBK-7 had been ordered from Schott, to be shaped by Zeiss-Oberkochen.

Mechanical Construction and First Tests

Negotiations with the firm of Heidenreich and Harbeck started in the first half of 1967 and the contract for the construction of the mechanical parts was concluded later that year. The minutes of the July 1968 Council meeting report that manufacturing had started and – optimistically! – *"A preliminary assembling – – – at the factory will be possible in October. According to the plan the definitive assembling of the telescope in its building on La Silla will start in February or March 1969."* However, it was only at the December 1968 meeting that the Directorate could report that Strewinski had finished nearly all drawings for H&H. Unfortunately, changing economic conditions in the German Federal Republic by that time caused H&H to become less interested in spending their efforts on the Schmidt and to give preference to more rewarding orders, and Council – rather superfluously . . . – urged Heckmann to put strong pressure on the firm [13].

Such, then, was the situation at the time of the dedication ceremonies on La Silla in March 1969 – a time also, however, of growing discontent among Council because of the lack of progress in the large telescope and Schmidt projects. By the end of that year, according to the Annual Report, contrary to expectations of one year earlier, the drawings of the mechanical parts were not yet completely available. Even at the end of 1970, partly due to illness of Strewinski, delivery of the telescope mounting was still retarded, and it was only in 1971 that the telescope was mounted at H&H for first tests. By the end of the year it arrived on La Silla and was assembled in "its" dome where, three years earlier, dignitaries and guests of ESO had gathered for the dedications. Final testing of the combined mechanical and optical parts could now be taken up.

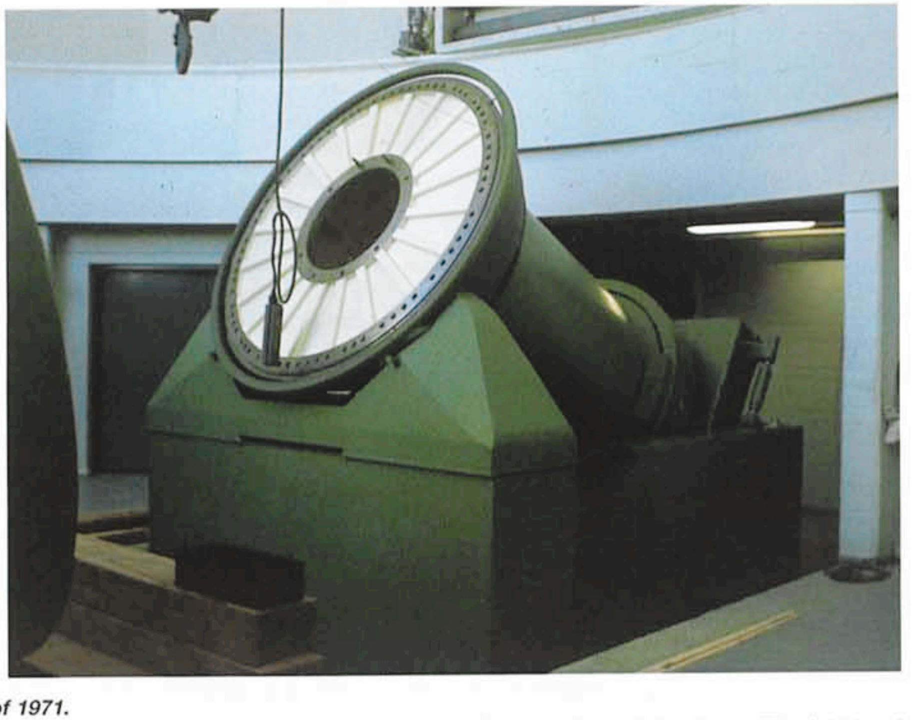
After his retirement as Director General per 1 January 1970, Heckmann acted as consultant to ESO, as agreed at the Council meeting of December 1969. This concerned first of all the commissioning of the Schmidt. He was present on La Silla for prolonged stays, usually together with Strewinski and Technical Director Ramberg. After having witnessed the first satisfactory optical performances of the telescope, he returned to Europe at the end of February 1972. He would not return to La Silla again.

Heckmann's Concern in Retrospect

With the termination of Heckmann's consultantship in 1972 and Ramberg's retirement from ESO at the end of 1971 came the conclusion of the first stage in the Schmidt's development. By that time satisfactory photographic plates could be obtained, yet many finishing touches remained to be applied before the instrument would acquire the mature status required for the highly demanding Sky Survey programmes. A new team took over in the course of 1972 of which the achievements will be sketched below. However, let me first insert a few comments on the past, troublesome period.

For Otto Heckmann, who had identified himself so strongly with the project, bringing it to satisfactory completion had been a matter of deep concern. Worry and disappointment were caused by the failure of the engineering bureau to satisfy the high expectations he had in the beginning. His strong belief in Strewinski's qualities as an engineer made Heckmann accept the burden of Strewinski's increasingly irrational and complicated reactions. This burden grew in the course of the years when, on the one hand, Strewinski, notwithstanding the broadening scope of his assignment, persisted in remaining involved in minute details of the design whereas, on the other hand, he became more and more suspicious and distrustful and lesser and lesser communicative. As far as the author is aware – and this extends into the period of my General Directorship of ESO – Strewinski has consistently refused to sign a contract for work to be undertaken, simply referring to his honesty and professional pride.

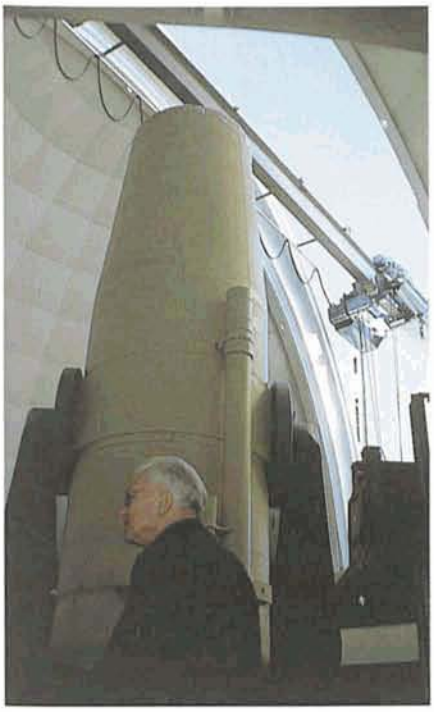
Much of this seems to be related to Strewinski's having spent years as a war prisoner in the USSR during and after World War II, where his engineering qualities and ingenuity seem to have been thoroughly exploited, even leading to continued captivity notwithstanding promises of release. He returned to Germany in 1949. Heckmann, in his book *Sterne, Kosmos, Weltmodelle,* refers at several places to their collaboration [14]. Among these references is the following, after Heckmann's mentioning



Mounting the Schmidt Telescope in the fall of 1971.

The photograph on the left shows the massive fork that would carry the telescope tube, resting on the floor of the dome. The right-hand photograph shows the polar axis already placed on its bearings. Soon after these photographs were taken, the bottom part of the fork was bolted on the flat top section of the polar axis.

Photographs by Eric Maurice in the EHPA.



December 21, 1971. *Otto Heckmann in front of the Schmidt telescope during its first test period.*
Photograph by Eric Maurice in the EHPA.

Strewinski's early work on the Hamburg Schmidt: *"Ein Jahrzehnt später stand er uns als selbständiger Ingenieur gegenüber. Leider hatten wir erst zu einem Zeitpunkt, als seine Arbeiten bereits weit fortgeschritten waren, klar erkannt, wie starr und mißtrauisch er in der Zwischenzeit geworden war. – – – Seine Unlust, sich auszusprechen oder gar zu fragen, führte leider mehrfach dazu, daß wir vor fertige Entscheidungen gestellt wurden, wo wir gerne mitbestimmt hätten. So kam es, daß später Schwierigkeiten auftauchten, weil manche Einzelheit zu geistreich, zu kompliziert gelöst worden war. – – –".*

As far as the ESO Council is concerned, the body where the ultimate responsibility rested, we have described their growing impatience in previous articles. Looking back, we may be surprised by their leniency; confidence in Heckmann's judgement prevailed.

The Schmidt Telescope in operation.
Upper right photograph: *Oscar Pizarro, who together with Guido Pizarro was responsible for carrying out most of the extensive and delicate programme of observations for the ESO Sky Surveys, guiding the telescope during an exposure.*
Lower right photograph: *placing the plateholder in the telescope.*
From undated slides in the EHPA.

Steps Toward Perfection

The first phase was followed by a lengthy period of finishing touches and improvements under the supervision of André Muller. Well qualified for the job by experience in optical instrumentation gathered early in his career, as well as by his acquaintance with La Silla, Muller embarked upon a series of technical improvements in collaboration with the staff on La Silla – particularly with Hans-Emil Schuster – and with the growing expertise of the staff of the TP Division, of which especially the important contributions of the engineer Jan van der Ven should be mentioned. In 1972 Muller stayed for several extended periods on La Silla where he collaborated in the middle of the year with Strewinski. The long series of improvements and modernizations which followed extended over many years, during the time of my Directorate and beyond. They will not, therefore, be recorded here in any detail; I shall only touch upon some main points, as a background for the account on the large observational projects summarized below, which developed parallel to this work.

Defects in the electronic control system as it had been delivered before the ESO TP Division became involved caused a major problem. Eventually, an entirely new system was installed, similar to the one developed by the TP Division for the 1-m telescope in 1974. Also, at the TP Division, entirely new mechanical drive systems in right ascension and declination were constructed.

A very important problem, encountered already in the beginning of the observational work, was that of the differential motion between the camera holding the plate holder and the field on the sky as seen by the guiding telescopes. The history of this problem goes back to the earliest work with Schmidt telescopes [15]. It became more and more pressing as the required exposure times became longer. For the ESO Schmidt, a major improvement was found by discarding altogether the use of guiding telescopes attached to the Schmidt tube, and introducing an offset guiding system that directly observes stars in the field of the Schmidt optics itself. And, when plates have to be taken with exposures of several hours, as is the case for the Sky Surveys, perfection even has to be carried so far that, by means of computer control, the variation in the relative position of the pointing of the plate centre with respect to that of the offset guider, caused by the changing differential refraction in the earth atmosphere, must be eliminated.

For a review of further improvements I refer to a contribution by Muller to the Bernhard Schmidt Centennial celebration mentioned before [16] and to a review by R. West "The ESO Sky Surveys" in IAU Colloquium No. 78 [17].

Finally, it is of interest to know that in 1958 Strewinski published a detailed description of the Hamburg Schmidt, which has much basic design in common with the ESO Schmidt. This work made him acquainted with the exactingness of astronomers: *"Die Wünsche der Astronomen bezüglich Genauigkeit und Zuverlässigkeit ihrer Instrumente sind sehr weitgehend. Es bedarf erheblicher Anstrengungen der Konstruktion und Fertigung --- um die gestellten Forderungen zu erfüllen"* [18].

Otto Heckmann (23-6-1901 – 13-5-1983), painted by the artist Herbert von Krumhaar on the occasion of his retirement from the General Directorate per December 31, 1969. After his retirement, Heckmann continued to work for ESO as a consultant with particular attention to the completion of the Schmidt telescope. This consultantship was concluded when the first operational stage of the telescope had been reached in the course of 1972. The painting was donated by friends and colleagues of Heckmann.

The Sky Atlas Laboratory

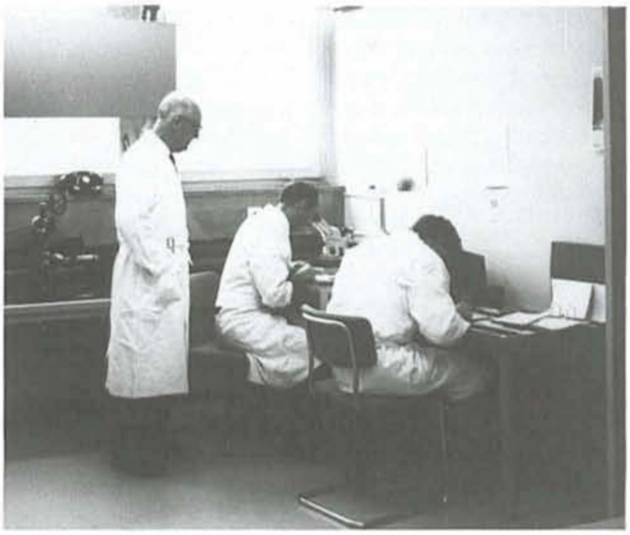
In the course of the year 1971, with completion of the Schmidt drawing nearer and the operational stage in sight, the next step to take was the creation of adequate facilities for processing the expected photographic material. The high optical performance to which the telescope was gradually brought, had to be matched by the highest possible perfection in the handling of the plates taken with the telescope. This became especially significant in connection with the planning of the sky atlas.

In the early days of the planning for ESO, the use of the Schmidt telescope for producing sky surveys did not yet figure very prominently in comparison to, for instance, objective prism spectral work. However, by the time the instrument became ready for use, observations for the Sky Atlas were seen as the most important task for the first years of operation. The Atlas produced by the Palomar Schmidt for the northern sky had proved to be of enormous importance for research in many fields, especialy for identifying candidate objects to be observed with large telescopes. Providing the southern counterpart of the Palomar Atlas became the most urgent task for the ESO Schmidt.

The extraordinary demands the photographic processing technique has to satisfy can be appreciated if one realizes that a Schmidt plate may contain some million or more stellar images, mixed with images of faint galaxies and diffuse nebulous objects, each of which may become the object of separate investigation now or in the future, and that not only all of these images should be of optimal quality, but that at the same time the plate should not contain any defect that might interfere with the research. Spurious stellar images due to inadequate processing must be avoided, and so must inhomogeneous development of the plates, scratches, etc.

The ESO Sky Atlas Laboratory on the premises of CERN.
By Council decision of December 1971 ESO established its Sky Atlas Laboratory on the premises of CERN, close to the TP Division. Before the end of 1972 it was ready to start the wholesale production of the copies of sky photographs obtained with the Schmidt telescope. The above photograph shows the laboratory's staff and visitors in March 1973. In clock-wise direction, starting from the lower left corner: Bernard Dumoulin; a visitor from TPD; Françoise Patard; another visitor from TPD; Bernard Pillet; Bill Miller from Pasadena; and Richard West. Photograph by PHOTO CERN in the EHPA.

Accordingly, two steps had to be taken: providing the dark room in the Schmidt telescope building on La Silla with up-to-date equipment for the processing of the plates and for prints to be made from them, and the creation in Europe of an ESO photographic laboratory for the wholesale reproduction of these prints without loss of quality. These were challenging tasks, for mastering the required techniques could not be learned from experience collected in any laboratory, scientific or industrial, in Europe, and contracting out to industry would have been too expensive. It was, therefore, a most fortunate circumstance that ESO could profit from the know-how gathered by American colleagues involved in the Palomar Sky Atlas project. Readiness to fully share their experience with ESO was expressed at an early stage to the author by Rudolph Minkowski who supervised at that time the Atlas Laboratory at Pasadena.



Working at the Atlas Laboratory, March 1973.
Left photograph. *B. Dumoulin inspects a 30 × 30 cm copy glass plate. The special plate frames and tanks for fixing and washing were of his design.*
Right photograph: *William ("Bill") Miller of the Palomar Atlas Laboratory (Hale Observatories), from whose experience the ESO laboratory benefitted greatly, looking over the shoulders of B. Dumoulin and R. West.*
Photographs by PHOTO CERN in the EHPA.

Consultation within ESO in the middle of 1971 led to a proposal to the Council meeting of Nov. 30–Dec. 1 for the establishment of a laboratory equipped for the production of large numbers of copies of the Schmidt plates on film or on glass. It was a major proposition, considering the space required, the personnel to be appointed, and the equipment to be purchased; on the other hand, the work to be done was a natural follow up on the completion of the telescope.

Council agreed, including the decision to establish the installation, not at the site of the administrative headquarters in Bergedorf, but on the premises of CERN, close to the TP Division which at that time had just started its work. For this project, again, strong support was received from the side of the Directorate of CERN that created space in one of its buildings adjacent to the TP Division.

As leader of the project, Richard West was appointed who since January 1970 had been an ESO employee as scientific associate to the Director General. As one of his first moves, West took up contact with the Atlas Laboratory at Pasadena and laid the foundation for close collaboration with William ("Bill") C. Miller who directed this project. Over the years, Miller's active interest and support contributed much to the work of the ESO Laboratory.

The Atlas Laboratory's first exhibition.
In November 1973 the Atlas Laboratory organized an exhibition of its work and of that of the TP Division in the entrance hall of the Main Office Building of CERN. Between the first and the second sky photographs from the left is a model of the 3.6-m telescope building, containing a model of this telescope.

The Quick Blue Survey

Well within a year after the Council decision of December 1971, the Atlas Laboratory was ready for its first tasks. A major project was soon to be undertaken: the production of the ESO-B Atlas for which the first plates were taken in April 1973. It has also been referred to as the ESO "Quick Blue Atlas", a name derived from its aim to provide the astronomical community at an early date with an overall picture of the southern sky, pending the production of the more sophisticated ESO-SRC Atlas the origin of which will be described below. The Quick Blue Atlas was distributed on a limited scale (see also below, under ESO/SRC Agreement), yet it soon played an important role in many research projects. It covered the sky between -90° and -20° declination by means of 606 fields with exposures of one hour, reaching a limiting blue magnitude of about 21.5.

Much of the successful achievement of the Atlas project (it was completed in 1978) must be attributed to the harmonious collaboration between the staff handling the Schmidt observations at La Silla including the delicate processing and making first copies, i.e. Hans-Emil Schuster and the brothers Guido and Oscar Pizarro, and the staff of the ESO Sky Atlas Laboratory.

A British Sister for the ESO Schmidt

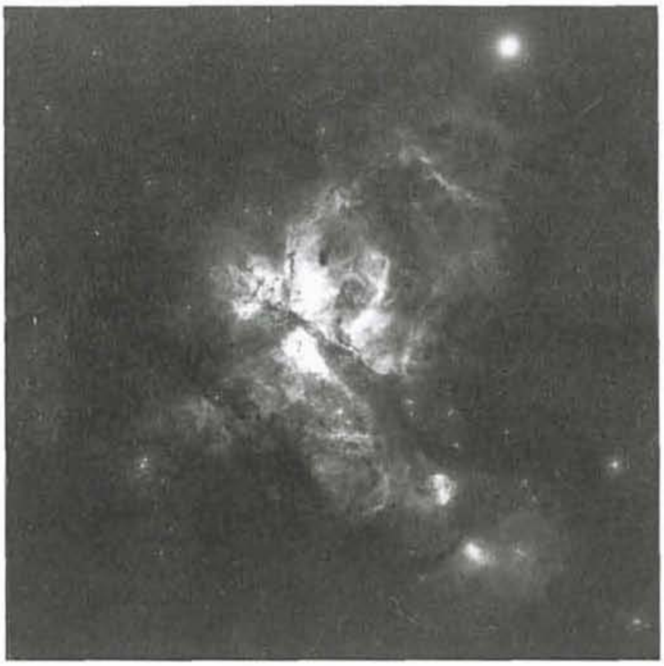
While ESO worked on the realization of its Schmidt project, a southern Schmidt also formed part of a project for two Schmidts to be acquired by Cerro Tololo and Kitt Peak Observatories around the year 1970. (In fact, as early as in 1960 a Schmidt for Tololo was under consideration [19].) Preliminary designs aimed at telescopes with an aperture of 1.3 m, a focal length of at least 4 m, and fields of $4\overset{\circ}{.}4 \times 4\overset{\circ}{.}4$. These telescopes should, moreover, be convertible to Cassegrain operation. Design considerations were presented by R. Buchroeder and B. Lynds at the 1972 Hamburg Conference referred to below, but the project did not materialize.

However, a sister for the ESO Schmidt was born elsewhere. Early 1971 the ESO Directorate learned about plans being developed for a southern Schmidt by the British Science Research Council (SRC) under the leadership of Vincent R. Reddish, Director of the Royal Observatory at Edinburgh. Based on a design closely similar to that of the Palomar Schmidt, this telescope became operational already in September 1973 – an outstanding achievement when compared to the tedious history of construction of the ESO Schmidt! A brief description of the SRC Schmidt – placed at Siding Spring Mountain in Australia where also the Anglo-Australian 3.5-m Telescope is located – was presented by Reddish at the Conference on Schmidt Telescopes in 1972 mentioned below.

Obviously, with the prospect of these two powerful Schmidts in the southern hemisphere, coordination of their programmes was in order. The ESO Directorate therefore approached Dr. Reddish and found him agreeable to joint planning, and this was soon followed by parallel consultation between the President of the ESO Council and the Chairman of the SRC. From these first steps, a very fruitful collaboration emerged.

The Hamburg Conference on Schmidt Telescopes

A first result of this collaboration was the Conference on The Role of Schmidt Telescopes in Astronomy, held at Hamburg Observatory on March 21–23, 1972. This observatory joined in the organization of the conference, and the proceedings were edited by Ulrich Haug of Hamburg Observatory [20]. The conference surveyed fields of applications of large Schmidts, and in particular served for looking ahead in connection with the extensive Sky Surveys to be carried out in the coming years. It profited much from the participation of astronomers involved in the work with the Palomar Schmidt. On the day following the conference, March 24, a session of

Two of the early photographs taken with the Schmidt telescope.
Left: *The central part of the constellation Orion including the Orion Nebula, a 20-minute exposure taken by Schuster on February 2, 1972.*
Right: *The Carina Nebula, a 45-minute exposure taken by Schuster on February 28, 1973.*

specialists discussed in detail the specifications for the surveys.

The ESO-SRC Agreement

After the Hamburg Conference, consultation between ESO and the SRC gradually shaped the final agreement [21]. A first draft was made by Reddish in April 1972, and the final text was signed in January 1974 by Reddish as Project Officer of the U.K. 48-Schmidt Telescope Unit, and the ESO Director General. From ESO side the correspondence was conducted mostly by Richard West, whose task as Head of the Sky Atlas Laboratory henceforth would also embrace this collaborative project. The agreement has been of far-reaching importance for astronomical research. We shall outline here its main features. For a more detailed account reference is made to R.M. West's article on the ESO-SRC Sky Atlas and related items in *ESO Bulletin* No. 10 of May 1974, and to accounts in the ESO Annual Reports.

The agreement consisted of four parts. The first one defined a general framework for collaboration *"– – – considering that ESO and SRC have previously expressed their interest to cooperate in carrying out southern sky surveys and publishing the results, – – –"*. The second part was an arrangement *"governing the production, publication and sale of a two-color atlas of the southern sky"*, to be printed on film. The third part concerned arrangements *"governing the production and distribution of initial [glass] copies of the ESO (R) and the SRC (IIIaJ) surveys"*. The fourth part dealt with *"the production and distribution of initial copies of the ESO "B" Survey"*.

In this fourth part, principal item was the number of copies of the Quick Blue Survey to be distributed by ESO among ESO countries and a few US observatories and by SRC among observatories in the UK (and the price to be paid for the latter by SRC). 20 glass copies and 20 film copies were to be made, of which SRC acquired 6 on glass and 14 on film. Taking the plates for the Quick Blue Survey had started in April 1973. By the end of 1973, 40 acceptable plates (out of 80 taken) were available. We note that the earliest plate used for this survey carries the number 299 [22]; plates taken previously served many other purposes.

The second part specified the most substantial component of the collaboration: the joint production of the two-colour Atlas for which the SRC Schmidt would provide the ESO Sky Atlas Laboratory with the "blue" plates on IIIaJ emulsion, and the ESO Schmidt the "red" plates on 094-04 emulsion. Other items of this agreement included market exploration, selling prices, the number of copies to be made, etc., and the fact that the Sky Atlas Laboratory would handle the production, distribution and sale on a non-profit basis. The Atlas referred to here, containing 606 fields between declinations -20° and -90°, was made on film.

The third part specified the production of a small number of copies of the Atlas on glass: 6 for SRC and 4 for ESO.

The ESO-Uppsala Faint Galaxies Survey

As a last item in this early history of the Schmidt telescope, I shall briefly dwell on the birth of the ESO-Uppsala faint galaxies project. When early 1973 the first Schmidt plates of atlas quality became available, astronomers' thoughts naturally went to the many research projects for which they might be used. As mentioned before, a most important field of application would be the study of extragalactic stellar systems. Was there a task for the ESO Directorate beyond just providing the astronomical community with the Atlas?

A comparison may be drawn with an earlier situation in astronomy when, in the beginning of this century, wholesale spectral classification by means of objective prism plates became possible. Harvard Observatory then initiated the systematic cataloguing of the spectral types of all bright stars, resulting in Annie Cannon's monumental Henry Draper Catalogue. With its more than 200000 stars it has been a basic reference in stellar research since then. Now, with extragalactic research being opened up in the southern sky, shouldn't it be a task for ESO to promote the provision of the community with a basic catalogue of galaxies, down to a well-defined observational limit and specifying main characteristics such as Hubble type and apparent magnitude? Many considerations pointed to answering "yes", including the important side effect of ensuring uniformity in the identification numbers to be used in the future.

Since the task would be far beyond what might be done by the ESO staff itself, collaboration with an astronomical institute, preferably in one of the ESO countries, would be the solution and this led the ESO Directorate to approach in the spring of 1973 the Director of Uppsala Observatory, Eric Holmberg. Uppsala Observatory was one of the few in the ESO countries with an established tradition in extragalactic work, including work of statistical nature. A major project published in 1973 was P. Nilson's Uppsala General Catalogue of Galaxies, containing data for nearly 13,000 galaxies north of declination $-2°30'$ and based on the Palomar Sky Survey [23]. In reply to a formal letter of May 16, 1973 of the ESO Director General, Holmberg expressed his interest in the proposition and sketched first outlines for the collaboration in a letter of May 27. Further correspondence and meetings between ESO and Uppsala staff led to a formal agreement between the two institutes of February 8, 1974 [24].

In the course of the negotiations, for ESO the Head of the Sky Atlas Laboratory, Richard West, became more and more involved, and soon took this project, too, under his wings. The agreement specified, among other items, that the Uppsala search was to be made by an astronomer at Uppsala Observatory on copies of the original plates of the Quick Blue Survey especially made for this purpose; an Annex, apart from giving technical details, stated that besides galaxies satisfying certain observational criteria, also a selection of stellar clusters and planetary nebulae were to be included. The criteria to be adopted for the selection of the galaxies were the same as those used by Nilson so that homogeneous coverage of the northern and southern parts of the sky would be assured.

In a letter of February 20, 1974 to the Director General of ESO, Holmberg wrote that, since November 1973, the work had been going full force by Andris Lauberts, and a first batch of 20 plates were under survey. A comprehensive description of the project was published in 1974 by Holmberg, Lauberts, Schuster and West [25].

Acknowledgement

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References and Notes

Abbreviations used;

EC = ESO Committee, the committee that preceded the ESO Council.

EHA = ESO Historical Archives. See the description in the *Messenger* No. 54 of December 1988.

FHA = Files belonging to the Office of the Head of Administration of ESO.

EHPA = ESO Historical Photographs Archive.

Heckmann Sterne = O. Heckmann, *Sterne, Kosmos, Weltmodelle,* Verlag Piper and Co., München – Zürich, 1976.

[1] I am indebted to Prof. U. Haug of Hamburg Observatory for providing me with the references [2] and [3] below.

[2] Abhandlungen Hamburger Sternwarte Band X, Heft 2, p. 50, 1979.

[3] See O. Heckmann, in *Nature,* Vol. 76, p. 805, 1955 and in *Mitteilungen Astron. Gesellschaft* 1955, p. 57, 1956.

[4] See Fehrenbach's report in the minutes of the 9th meeting of the Instr. Comm., Oct. 18, 1963, p. 10 in FHA. Reference is also made to the minutes of the EC of Nov. 1961, Oct. 1962, in FHA, and to the ESO Annual Rep. 1964.

[5] Minutes of the 6th meeting of the Instr. Comm., p. 3, in FHA.

[6] Minutes Instr. Comm. June 25, 1964, p. 7, in FHA.

[7] Minutes of the 13th meeting of the Instr. Comm., p. 4; Minutes 2nd Cou Meeting, May 1964, both in FHA.

[8] See also, in EHA-I.A.2.10, relevant correspondence between Oort and Heckmann in June and July 1964 and March 1965.

[9] Proceedings of the Conference on "The Role of Schmidt Telescopes in Astronomy", Ed. U. Haug, published jointly by ESO, SRC and Hamburg Observatory, 1972, p. 137–139.

[10] A more extensive description is in the minutes of the Instr. Comm. of March 1964, in FHA.

[11] Editions du Centre National de Recherche Scientifique, Paris 1990, p. 404.

[12] See ESO Annual Reports 1964–1966 and minutes Cou Meetings 1965 and 1966, in FHA.

[13] FHA-Cou minutes Dec. 1968, p. 4.

[14] Heckmann Sterne, p. 216 and 321–322.

[15] In a letter of January 10, 1990, Prof. U. Haug of Hamburg Observatory points out to me, that in the case of the Hamburg Schmidt, whereas Strewinski was responsible for the mechanical design of the mounting, the combination optics-telescope tube was primarily handled by Zeiss-Jena, including a solution for the alignment telescope-tube/guiding-telescopes.

[16] Ref. [2], p. 79.

[17] *"Astronomy With Schmidt Telescopes",* Ed. M. Capaccioli, Reidel, 1983, p. 13.

[18] *Mitteilungen Ver. Drehbank-Fabriken* No. 15, March 1958, p. 1, in EHA-III.

[19] According to a letter by D. Shane to J. H. Oort of August 22, 1960; in EHA-I.A.1.13.

[20] See note [9].

[21] Documentation pertaining to the development of the ESO-SRC collaboration is contained in FHA-2.8.3, "Cooperation with SRC", including copies of correspondence between West, Blaauw and Reddish and the legal advisors of ESO and SRC from April 20, 1972 and draft texts for the Agreement from November 1972 till the final version of January 1974.

[22] See, for instance, the internal Memo ref. SK/74/186/RW/FP of October 10, 1974 from West to various ESO Officers: "List of plates which have been distributed" in EHA-III.

[23] *Uppsala Astron. Obs. Ann.,* Vol. 6, 1973.

[24] I am much indebted to Prof. E. Holmberg and Dr. A. Lauberts for providing me with copies of the early correspondence in the files of Uppsala Observatory: letters of May 27 and Sept. 26, 1973. The ESO FHA-2.8.6. contain, for the period reported here, copies of correspondence and drafts as well as the final contract, beginning Sept. 26, 1973. See also the ESO Annual Reports.

[25] E.B. Holmberg, A. Lauberts, H.-E. Schuster and R.M. West, The ESO/Uppsala Survey of the ESO (B) Atlas of the Southern Sky. I., in *Astron. Astrophys. Suppl* **18,** p. 463–489, 1974.

Open Clusters Under the Microscope

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Stellar Evolution Models

Our use of, and faith in, stellar evolution models underlie much of contemporary astrophysics. Stellar evolution theory has provided a framework within which, in broad terms, we can fit the apparently bewildering variety of single and double stars into a logical order described by a physical theory.

Stellar evolution models are used to calculate the ages of observed stars and their lifetimes in various evolutionary phases. They also describe the transformation of lighter to heavier chemical