EUROPEAN SOUTHERN OBSERVATORY

BULLETIN NO. 10

The Governments of Belgium, the Federal Republic of Germany, France, the Netherlands, and Sweden have signed a Convention[1]) concerning the erection of a powerful astronomical observatory on October 5, 1962.

By this Convention a European organization for astronomical research in the southern hemisphere is created. Denmark became a member of the organization on June 1, 1967. The purpose of this organization is the construction, equipment, and operation of an astronomical observatory situated in the southern hemisphere. The initial programme comprises the following subjects:

1. a 1.00 m photoelectric telescope,
2. a 1.50 m spectrographic telescope,
3. a 1.00 m Schmidt telescope,
4. a 3.60 m telescope,
5. auxiliary equipment necessary to carry out research programmes,
6. the buildings for administration, laboratories, workshops, and accommodation of personnel.

The site of the observatory is in the middle between the Pacific coast and the high chain of the Andes, 600 km north of Santiago de Chile, on La Silla, at an altitude of 2400 m.

The geographical coordinates of the main summit of La Silla are

$\lambda = +70^\circ\, 43'\, 46''\!.50$
$\varphi = -29^\circ\, 15'\, 25''\!.80.$

They were determined by the Instituto Geográfico Militar of Santiago/Chile.

1) The ESO Management will on request readily provide for copies of the Paris Convention of October 5, 1962.

Organisation Européenne pour des Recherches Astronomiques
dans l'Hémisphère Austral

EUROPEAN SOUTHERN OBSERVATORY

BULLETIN NO. 10

May 1974

Edited by European Southern Observatory, Office of the Director-General
Bergedorfer Straße 131, 2050 Hamburg 80, Federal Republic of Germany

ESO BULLETIN No. 10

CONTENTS

METEOROLOGICAL OBSERVATIONS ON LA SILLA IN 1971 AND 1972

B. E. Westerlund

Introduction

The observations concern cloudiness, wind velocity, wind direction, temperatures and humidity as in previous years. They have been obtained at point P since April 1971. P is situated almost due south of the 3.6 m telescope site; this point is being investigated as a possible future telescope site. Due to the move to point P, some instrumental difficulties and snowstorms, certain data are not quite complete. The data were compiled by H. E. Schuster for 1971 and R. Vega for 1972.

Clouds

The observations cover all nights. In Table 1 the percentages of photometric nights are given for each month. The mean values for 1966 - 1972 are likewise given. All nights having six or more hours of uninterrupted clear sky are defined as photometric nights.

Table 1: Percentage of photometric nights

Month	1971	1972	Mean of 1966 - 1972
January	61	74	76
February	89	86	83
March	87	87	81
April	73	67	66
May	51	48	46
June	40	23	40
July	45	55	44
August	48	26	48
September	47	43	49
October	58	45	53
November	57	76	66
December	71	65	81

Out of the total of 3681 hours during which observations might have been made in 1971, 2136 hours were totally clear; of the 3690 hours in 1972, 2126 hours were totally clear. These values are slightly better than those for 1969 and 1970. The number of photometric clear nights was 221 in 1971 and 212 in 1972. The mean value for the period 1966 - 1972 is 223 nights per year.

In Fig. 1 the percentage of clear nights is plotted against the month of the year for 1971, 1972 and the mean of 1966 - 1972.

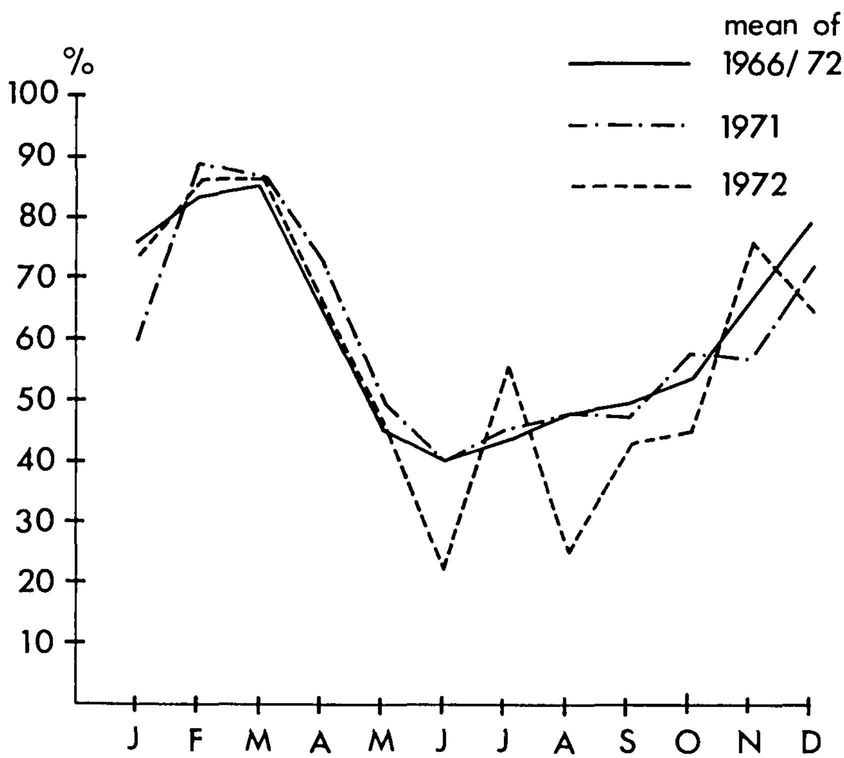

Fig 1 : Photometric nights

Maximum wind velocities during each month

In Table 2 the maximum wind velocities in m/s are given for each month. The records are mainly from the new site, P. The pattern recorded during previous years is repeated.

Table 2: Maximum wind velocity in m/s

	1971	1972
January	19*	11
February	12*	23
March	19*	10
April	16	14
May	14	14
June	18	35**
July	45**	28
August		25
September		35**
October	16	22
November	10	22
December	13	18

* Measured at point T.

** The wind meter does not read higher than 35 m/s. The value for July 1971 was obtained with a small hand anemometer.

Average wind velocities during photometric nights

Average wind velocities in m/s were read every two hours from the recordings. Tables 3 a and b give the results for 1971 and 1972, respectively. They give the number of observations with a wind velocity equal to or less than velocity v as given in the first column. The last row in the two tables gives for each month the average wind velocity, $\bar{v}$, during photometric nights. For July - September, 1971, no data are available due to the damage done to equipment and meteorological station by the severe storm in July.

Table 3 a: Frequency of average wind velocity equal to v or less during photometric nights at site T (Jan. - Feb.) and site P (from April on) in 1971

v m/s	January	February	March	April	May	June
1	12	29		10	8	2
2	16	41		27	24	6
3	25	50		35	34	8
4	32	59		46	43	12
5	38	75		54	53	14
6	41	89		65	61	16
7	49	106		78	66	24
8	52	112		97	71	37
9	59	114		108	77	48
10	62	117		115	80	56
11	63			124	83	63
12				127	89	67
13				129	95	68
14				130	96	69
15				131		71
16						
$\bar{v}$	4.9	4.2		6.2	5.1	8.5

Table 3 a continued

v m/s	July	August	September	October	November	December
1				0	0	2
2				12	9	6
3				27	17	17
4				59	44	39
5				75	55	47
6				93	68	58
7				98	74	68
8				105	76	81
9				106	77	84
10				107	85	87
11				108		87
12						88
13						
14						
15						
16						
$\bar{v}$				4.7	5.1	5.5

Table 3 b: Frequency of wind velocity equal to v or less during photometric nights at site P in 1972

v m/s	Jan.	Feb.	March	April	May	June
1	0	3	9	2	2	0
2	0	18	22	26	20	10
3	3	36	39	48	29	22
4	12	58	59	68	36	28
5	28	75	73	89	48	33
6	39	83	87	97	55	36
7	50	94	90	102	66	36
8	56	96	92	105	69	37
9	60	98	93	107	72	37
10	64		94	108	73	37
11	64			108	75	37
12	65			109	76	37
13					77	40
14						41
15						42
16						43
17						
18						
19						
20						
$\bar{v}$	6.2	4.3	4.0	4.1	4.9	5.9

Table 3 b continued

v m/s	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	4	1	10	15	7	25
2	9	3	24	34	13	51
3	14	9	36	49	30	84
4	17	12	45	59	41	104
5	25	14	51	66	55	113
6	31	15	64	68	72	114
7	40	16	65	71	81	118
8	45	16	69	73	99	118
9	55	18	71	73	110	119
10	63	19	75	78	116	
11	67	21	78	81	120	
12	70	22		83	122	
13	71			83	122	
14	72			83	122	
15	73			83	124	
16	78			84		
17	79					
18	79					
19	79					
20	80					
$\overline{v}$	8.4	5.4	4.4	4.1	6.0	2.8

Wind direction during photometric nights

Wind directions were recorded automatically at site T (Jan. - Feb. 1971) and at site P (from April 1971 on).

The records have been read every hour in 1971 and every two hours in 1972. Tables 4 a and b give for each month the number of observations with a wind direction as indicated in the first column.

The last column of Table 4 b gives the total results in percentages for 1972. They show that the prevailing winds are from N - NE during photometric nights. This is also seen in the incomplete data of Table 4 a and confirms the results from previous years.

Table 4 a: Wind directions at site T (Jan., Feb.) and site P during photometric nights in 1971

Wind Direction	J	F	M	A	M	J	J	A	S	O	N	D
S	25	40		24	35	1				29	44	12
SSW	43	73		18	37	5				12	18	15
SW	1	2		6	1	0				2	3	3
WSW	0	0		6	0	0				0	0	2
W	1	3		3	0	0				3	3	1
WNW	0	0		1	1	0				2	0	1
NW	0	0		2	9	6				8	6	5
NNW	5	12		8	8	8				27	4	10
N	22	22		85	40	39				44	18	66
NNE	30	44		48	32	36				22	12	26
NE	14	18		32	12	40				4	11	22
ENE	3	7		5	5	2				11	5	6
E	9	9		11	4	2				16	12	11
ESE	7	7		6	2	0				6	2	6
SE	6	5		6	2	1				8	5	6
SSE	5	8		3	4	0				4	27	6

Table 4 b: Wind directions at site P during photometric nights in 1972

Wind Direction	J	F	M	A	M	J	J	A	S	O	N	D	All 1972 in %
S	25	24	2	11	17	2	0	3	5	8	3	10	10.4
SSW	14	19	1	4	11	1	0	2	0	3	0	5	5.7
SW	3	5	2	4	3	1	0	4	1	3	1	5	3.0
WSW	0	2	1	0	0	0	0	1	0	1	0	4	0.9
W	3	3	1	2	1	0	0	0	2	4	2	8	2.5
WNW	0	0	1	1	1	0	0	0	0	4	4	0	1.0
NW	3	5	5	5	0	2	3	0	6	8	7	6	4.7
NNW	1	5	21	10	5	3	4	0	2	2	11	3	6.3
N	12	19	52	29	18	8	11	4	23	23	40	15	23.9
NNE	12	14	19	23	10	5	2	2	3	5	16	7	11.1
NE	11	4	8	11	3	0	18	28	17	17	39	14	16.0
ENE	7	6	4	5	3	1	0	1	2	2	5	7	4.1
E	9	5	8	4	0	1	0	0	4	2	3	11	4.4
ESE	1	2	2	3	3	0	0	1	0	0	0	4	1.5
SE	5	3	3	3	2	0	0	1	1	0	1	2	2.0
SSE	8	7	5	5	0	0	0	1	0	1	0	0	2.6

Maximum and minimum temperatures

Tables 5 a und b give for each month the maximum and minimum temperatures as measured at sites T and P (1971) and site P (1972), respectively. The temperatures were read daily, regardless of the cloudiness, from a maximum-minimum thermometer.

Table 5 a (Temperature in °C)

1971	Site T		Site P	
	Max	Min	Max	Min
January	+ 21	+ 3		
February	+ 23	+ 9		
March	+ 24	+ 4		
April	+ 21	— 2	+ 22	— 2
May	+ 22	+ 3	+ 21	+ 3
June	+ 16	— 5	+ 16	— 6
(July)	(+ 20)	(+ 3)	(+ 21)	(+ 5)
August	+ 21	— 5	+ 21	— 6
September			+ 22	— 5
October	+ 20	+ 7	+ 20	+ 6
November			+ 21	+ 7
December			+ 22	+ 8

Table 5 b (Temperature in °C)

1972	Site P	
	Max	Min
January	+ 22	+ 10
February	+ 23	+ 10
March	+ 21	+ 6
April	+ 21	+ 3
May	+ 22	— 2
June	+ 20	— 1
July	+ 19	— 9
August	+ 20	— 10
September	+ 18	— 7
October	+ 22	— 1
November	+ 20	+ 1
December	+ 23	+ 8

For July, 1971, the data are incomplete as a result of a hurricane. In Fig. 2 the maximum and minimum temperatures as measured in 1971 and 1972 are plotted together with the mean values of 1966 - 1972 against the month of the year.

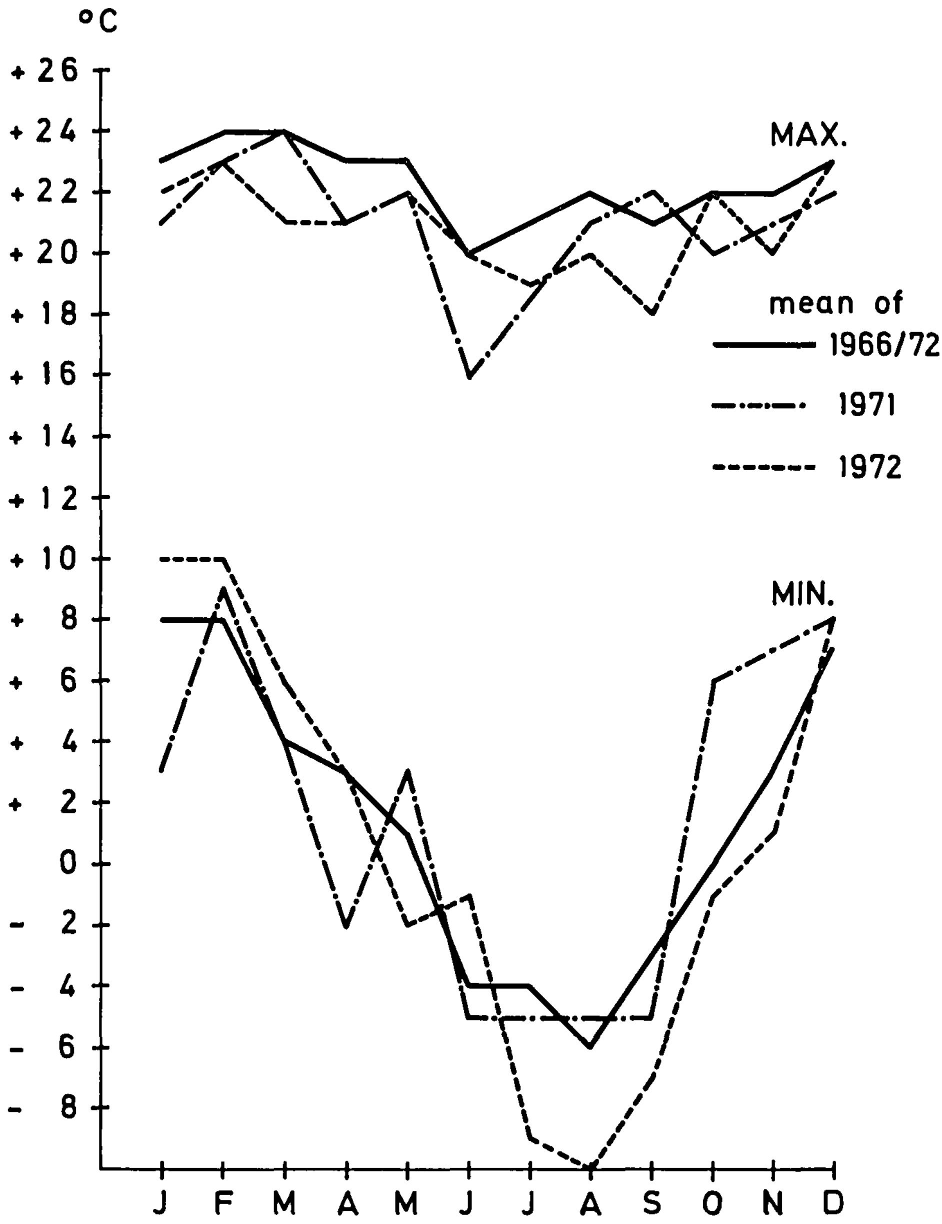

Fig. 2: Maximum and minimum temperatures on La Silla.

The differences between the maximum day temperature and the following minimum night temperature have been calculated and are given in Tables 6 a and b for all days and nights during 1971 and 1972, regardless of the cloudiness. The tables give for each month the number of days for which the temperature difference was equal to or less than the value indicated in the first column. Due to technical difficulties, the number of days shown in Tables 6 a and b is sometimes less than the actual number of days in the corresponding month.

Table 6 a: Cumulative table of differences between maximum day temperature and minimum temperature of the following night for sites S and T (Jan., Feb.) and P and T during 1971

Diff.	Jan.		Feb.		March	April		May		June	
°C	S	T	S	T	T	P	T	P	T	P	T
1	0	1	0	0	0	0	0	0	0	1	2
2	1	1	0	0	0	0	0	0	0	1	3
3	1	1	0	0	0	0	1	1	0	2	4
4	1	1	0	0	1	0	1	1	2	5	5
5	1	1	0	1	1	1	3	1	4	6	7
6	1	1	0	2	2	2	5	4	7	7	10
7	1	3	1	6	4	7	7	9	11	9	16
8	2	4	4	10	5	11	10	17	16	15	19
9	9	13	12	21	25	21	19	25	23	18	22
10	11	18	19	23	27	23	22	26	25	27	27
11	21	28	24	27	30	26	28	29	29	27	29
12	23	30	25	27	31	29	29	31	31	29	30
13	28	31	28	28		29	29			29	
14	30					29	30			30	
15	31					29					
16						30					
17											
18											
19											
20											
21											
22											
23											
24											
25											

Table 6 a continued

Diff. °C	July P	July T	Aug. P	Aug. T	Sept. P	Sept. T	Oct. P	Oct. T	Nov. P	Nov. T	Dec. P	Dec. T
1			0	0	0		0	0	0		0	
2			0	0	2		0	1	0		0	
3			0	0	2		2	2	0		0	
4			0	0	2		6	9	0		C	
5			2	4	3		15	15	7		0	
6			4	4	6		24	23	18		1	
7			8	9	9		24	27	25		4	
8			8	11	12		31	30	30		7	
9			12	16	15			30			17	
10			17	19	18			31			20	
11			19	21	19						28	
12			24	23	21						31	
13			26	26	22							
14			26	26	23							
15			26	26	24							
16			27	27	25							
17			28	29	27							
18			29		27							
19					27							
20					27							
21					27							
22					27							
23					27							
24					27							
25					28							

Table 6 b: Cumulative table of differences between maximum day temperature and minimum temperature of the following night for site P during 1972

Diff. °C	J	F	M	A	M	J	J	A	S	O	N	D
1	0	0	0	1	2	1	0	1	1	0	0	0
2	0	0	0	1	3	2	1	3	4	0	1	0
3	0	0	0	3	5	5	2	6	6	0	2	0
4	0	1	0	4	9	6	6	7	9	2	4	0
5	0	2	1	9	15	9	12	7	11	7	5	2
6	1	6	6	13	16	15	17	12	14	10	8	7
7	4	19	14	17	19	19	19	13	16	10	13	10
8	9	23	27	24	24	20	22	18	19	14	19	17
9	15	26	29	24	25	23	23	18	20	17	24	22
10	27	29	31	27	27	23	24	22	20	21	27	28
11	31			29	28	23	25	22	21	26	28	30
12				30	29	24	25	23	22	29	29	31
13					29	24	26			30	30	
14					29	25	26			31		
15					30		26					
16							26					
17							26					
18							26					
19							26					
20							27					
21							28					

Maximum temperature fluctuations during photometric nights

Tables 7 a and b give for each month, for the sites indicated in the tables, the number of photometric nights during which the maximum temperature fluctuation occurring throughout the astronomical night was equal to or less than the value indicated in the first column.

The astronomical night is defined as the interval of time during which the sun is 18° or more below the observer's horizon. As in previous years, the observations show the constancy of the temperatures during photometric nights.

Table 7 a: Cumulative table of maximum temperature fluctuations during photometric nights in 1971

△T	Jan.		Feb.		March	April		May		June	
°C	S	T	S	T	T	P	T	P	T	P	T
1	6	9	6	13	21	8	9	8	7	2	4
2	17	17	18	22	25	17	18	15	15	9	9
3	18	18	23	23	27	19	20	16	16	11	11
4			25	25		20				11	11
5										12	12
6											

△T	July		Aug.		Sept.		Oct.		Nov.		Dec.	
°C	P	T	P	T	P	T	P	T	P	T	P	T
1				1			11	11	12		5	6
2				9			18	17	17		16	16
3				10				18			18	20
4				13							20	22
5											22	
6												

Table 7 b: Cumulative table of maximum temperature fluctuations during photometric nights in 1972

△ T °C	Jan. P	Feb. P	March P	April P	May P	June P
1	9	11	11	11	4	5
2	15	17	21	16	10	6
3	20	25	26	19	11	7
4	21					
5	22					
6	23					

△ T °C	July P	Aug. P	Sept. P	Oct. P	Nov. P	Dec. P	All 1972 in %
1		4		5	5		45
2		6		9	9		76
3				11	11		95
4				12	14		98
5				12			99
6							100

Relative humidity during photometric nights

Tables 8 a and b give, for the sites indicated, for each month the percentage of hourly observations for which the relative humidity was equal to or less than the value indicated in the first column. The last column of Table 8 b gives the total results in percentage for 1972. The last row, $\overline{\text{R. H.}}$, gives for each month of the year the average relative humidity during photometric nights.

Table 8 a: Cumulative table of relative humidity in 1971

Rel. Hum. %	Jan.		Feb.		March	April		May		June	
	S	T	S	T	T	P	T	P	T	P	T
10	2	3	0	0	4	3	4	8	17	0	0
20	3	4	0	1	8	11	14	50	49	4	3
30	9	10	3	3	24	33	32	84	87	12	13
40	21	18	11	8	44	59	54	94	93	37	37
50	43	37	35	29	75	71	71	94	93	68	63
60	75	70	70	61	92	84	81	96	96	87	85
70	93	93	92	87	98	92	90	100	100	92	95
80	97	97	100	96	100	98	96			98	99
90	100	100		100		100	100			100	100
100											
$\overline{\text{R. H.}}$	56	57	59	62	46	45	49	28	26	50	52

Rel. Hum. %	July		Aug.		Sept.		Oct.		Nov.		Dec.	
	P	T	P	T	P	T	P	T	P	T	P	T
10							1	3	7		0	0
20							17	17	15		1	2
30							44	43	27		6	7
40							71	82	62		31	31
50							88	91	85		60	60
60							94	95	90		88	88
70							97	99	96		100	100
80							99	100	99			
90							100		100			
100												
$\overline{\text{R. H.}}$							38	37	44		52	52

Table 8 b: Cumulative table of relative humidity at site P in 1972

Rel. Hum. %	Jan. P	Feb. P	March P	April P	May P	June P
10	0	3	1	10	24	11
20	2	2	7	45	65	80
30	6	13	30	85	89	86
40	20	44	58	91	98	92
50	43	65	92	93	100	92
60	75	76	99	99		92
70	96	83	100	100		92
80	100	91				94
90		100				94
100						100
$\overline{\text{R. H.}}$	56	52	41	27	22	27

Rel. Hum. %	July P	Aug. P	Sept. P	Oct. P	Nov. P	Dec. P
10		0		0		
20		37		28		
30		80		47		
40		100		74		
50				87		
60				96		
70				100		
80						
90						
100						
$\overline{\text{R. H.}}$		21		37		

Prof. Dr. B. E. Westerlund
European Southern Observatory
Casilla 16317
Santiago 9, Chile

THE SOUTHERN SKY SURVEYS—A review of the ESO Sky Survey Project

Richard M. West

I. Introduction

This summary has been prepared at the request of the Director-General of ESO in order to inform in detail the ESO Council and its Committees as well as other interested parties of the purpose and scope of the ESO Sky Survey Project. The project has now been defined in almost all details, and only minor and unimportant modifications may still take place. Therefore a fairly complete picture can now be provided.

In what follows some information is given about the background of the project and the way in which it will be carried out. The various procedures are discussed, from the taking of the original plates to the publication of the resulting atlases. A technical report on the project will appear later.

The project has profited much from the experience of similar undertakings, especially the Palomar Sky Survey. For a better understanding of the planning of the project it has therefore been felt that a short historical review should also be included here.

Another important aspect is the collaboration with the Schmidt telescope project of the British Science Research Council. Consultation with the leader of that project, referred to in greater detail below, has been quite fruitful in defining the procedures chosen for the production of the atlases.

II. The background for the Southern Sky Surveys

A sky survey is a collection of astronomical photographs, covering a (large) part of the sky. Many parameters govern the properties of the sky survey: the types of the photographic plates, the filters, the telescope, the exposure time, the photographical processing, etc. ... All of these must be chosen with care to achieve in the most efficient way the aim of the survey.

Although sky surveys may serve many different purposes, these can readily be grouped into two major classes:

1. Identification of objects, and
2. Astrometrical and photometrical measurements.

The recent history of astronomy gives a very convincing proof of the value of sky surveys. It is impossible to mention all discoveries that have been made in this way, notably through the use of the **National Geographic Society-Palomar Observatory Sky Survey** (often called the "Palomar Survey"). This survey covers the entire northern sky and part of the southern down to —30°. It has had a great impact on astronomical research and still serves as the major source of identification of X-ray, ultraviolet, infrared, microwave and radio sources. There are not many fields in astronomy that have not, in one way or another, profited by it.

The Palomar Survey was carried out in the beginning of the 1950s with the famous Palomar 48″ Schmidt telescope. This type of instrument is especially suited for sky surveys because of its large field and small focal ratio, giving short exposures. The 48″ Schmidt telescope was erected next to the 200″ reflector and has since served as an ideal "support" telescope for the research done with the 200″. The Palomar Survey was, as a matter of fact, only the most important of a series of supporting programmes that were initiated with the 48″ Schmidt telescope. The specific aim of this survey was to record in two colours (blue and red) the faintest possible celestial objects, so that the interesting ones could later be studied in detail with the large telescope. The "blue" colour was defined by the transmission of the telescope optics and the limit of the 103 a-O emulsion (approx. 3500 - 4800 A) and the "red" colour was centred on Hα. Thus the Palomar Survey was an "identification" type of survey, and accordingly the plates were not astrometrically and photometrically calibrated.

The Palomar Survey was made available to the world's astronomers through the publication of the **National Geographic Society-Palomar Observatory Sky Atlas** (the "Palomar Atlas"), with financial support from the National Geographic Society on a non-profit basis. Clearly, the fragile, original glass plates were too vulnerable to be used extensively and it was decided to make copies of these valuable plates. This involved two steps, the making of intermediate on-glass positives (to avoid repeated printing from the original plate) and on-paper copies of these positives. The Palomar Atlas consists of 1,870 paper prints (935 blue and 935 red) and has so far been produced and sold in more than 200 copies. The price has increased steadily, due to inflation, and was lately (1973) about 3,000 dollars per atlas. Some on-glass negative copies were also produced and sold to institutes that needed the dimensional stability of the glass plates.

With the achievements of the Palomar Schmidt telescope in mind, it was obvious that a Schmidt telescope should be among the instruments that were included in the ESO Convention of 1962. This even more because there was still one-fourth of the sky to survey, the part south of —30° that could not be reached by the Palomar Schmidt, and the ESO Schmidt would be the first one of its size in the southern hemisphere. It was therefore, at that time, the general opinion that the ESO Schmidt would undertake a "Palomar-like" blue-red survey, as soon as it became operational.

As time went by, awaiting the completion of the ESO Schmidt telescope, it became less obvious that a straight-forward continuation of the Palomar Survey (and Atlas) should be aimed at. New methods in astronomy and improved

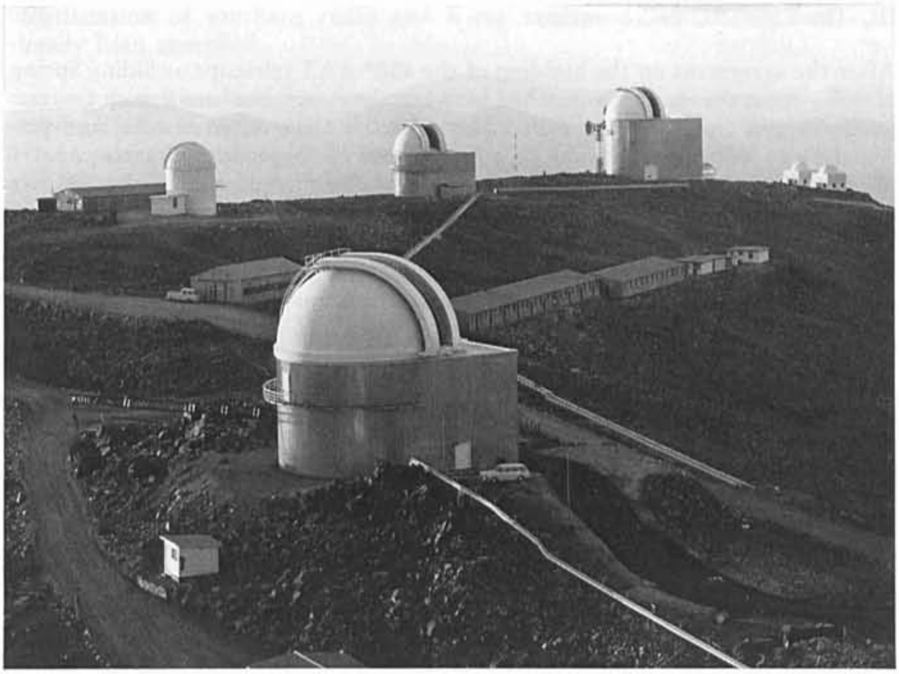

Fig. 1: General view of La Silla with the Schmidt telescope dome in the foreground.

photographic techniques appeared, the application of which would probably be of greater value for the astronomical community than continuing as before in order to preserve uniformity. Among the more decisive questions was the choice of wavebands; would not a "purer" B-waveband, closer to the standard (Johnson) B be preferable (the Palomar blue went to about λ 3,500)? Or would it not be desirable to add a pure infrared (IR) and ultraviolet (UV) waveband? Or perhaps the uvby-system or the RGU-system? It would certainly also add to the value of the survey if the plates were photometrically calibrated. Finally, it might be advisable to use transparent film instead of paper for the atlas, thereby making possible transmission measurements and promoting use of the atlas for purposes other than identification.

When the ESO-Schmidt came nearer to completion, these questions urgently called for careful analysis and subsequent decisions. Since the value of the Atlas of the Southern Sky would strongly depend on its usefulness in current astronomical research, it was obviously of great importance to review the situation in Schmidt telescope astronomy. Here ESO could best be guided by the advice of a panel of distinguished Schmidt users and it was therefore decided to hold a conference on the subject. This conference was jointly sponsored by ESO and the Science Research Council of the United Kingdom (SRC) as a first result of a collaboration that had begun in mid-1971. The events that led up to this important step are described below.

III. The ESO/SRC collaboration

After the agreement on the building of the 150″ AAT telescope at Siding Spring, N.S.W., Australia, had been reached between the Australian and British Governments in 1967, the idea arose that this telescope, like other existing and projected large telescopes, should be supported by a large Schmidt telescope. A purely British Schmidt project was initiated under the auspices of the SRC, its stated goal being the accomplishment of a Palomar-type survey of the southern sky before the 150″ was put into operation in 1974. The SRC established a project group at the Royal Observatory at Edinburgh and a "48-inch Schmidt Advisory Committee" with 6 - 8 members from major British observatories. The design of the telescope and the project progressed rapidly.

When ESO became aware of this project, contacts were taken up between the Director-General of ESO and the leader of the British project, V. C. Reddish, and subsequently between the Presidents of the Councils of ESO and SRC. A collaboration quickly emerged. The Director-General of ESO and the Director of ESO/Chile attended a meeting of the SRC 48″ Schmidt Advisory Committee in July, 1971, and close contacts were established between R. M. West, in charge of the ESO Sky Atlas Laboratory, and V. C. Reddish. It was decided to hold a jointly sponsored conference on "The role of Schmidt telescopes in Astronomy" in Hamburg, March 21 - 23, 1972. The third co-sponsor was the Hamburger Sternwarte, Bergedorf. The conference was managed by an Organizing Committee with two members from each of ESO, SRC and the Hamburg Observatory. The proceedings were published in October 1972, edited by U. Haug, now director of the Hamburger Sternwarte.

The conference was followed by a working session, attended by representatives of ESO and SRC and a number of specialists in fields related to sky surveys, among them some of the astronomers responsible for the Palomar Survey. Practically all aspects of sky surveys, from the taking of original plates to the publication of atlases, were thoroughly discussed. The experience of the conference and the working session soon after served as a most valuable basis in drawing up the lines of the ESO/SRC collaboration on the southern sky surveys. Both organizations expressed satisfaction with the arrangements that were negotiated. They were presented to the respective Councils in the course of 1973 and the signing took place in January 1974. It is anticipated that a joint ESO/SRC Atlas of the Southern Sky will appear from 1974.

Concerning the distribution of tasks, it is foreseen that the ESO Schmidt telescope will first (1973 - 1974) carry out a "quick" survey in a blue waveband very similar to the standard (Johnson) B-colour. The survey [referred to as ESO (B)] will cover 606 fields, distributed at 5° centres from —90° to —20° (to overlap the southern part of the Palomar Survey, where the plates were necessarily of lower quality). The observational part of the ESO (B) Survey, utilizing unbaked II a - O plates, will last somewhat more than one year and copies on-glass and on-film will be distributed to institutes in the ESO member states, the SRC sphere (United Kingdom, South Africa and Australia) and a few institutes in USA and Canada. The reason for this "quick" survey is the urgent need for identification of southern radio and X-ray sources, of which long lists have already been compiled.

Starting somewhat later, but for some time running simultaneously with the (B) survey, ESO will carry out a red survey [ESO (R)], utilizing the new KODAK 098-04 plates. This emulsion is similar to the 103 a-E that was used in the Palomar Survey, but is about twice as sensitive and goes a little further towards the infrared. The 098-04 plates are used unbaked.

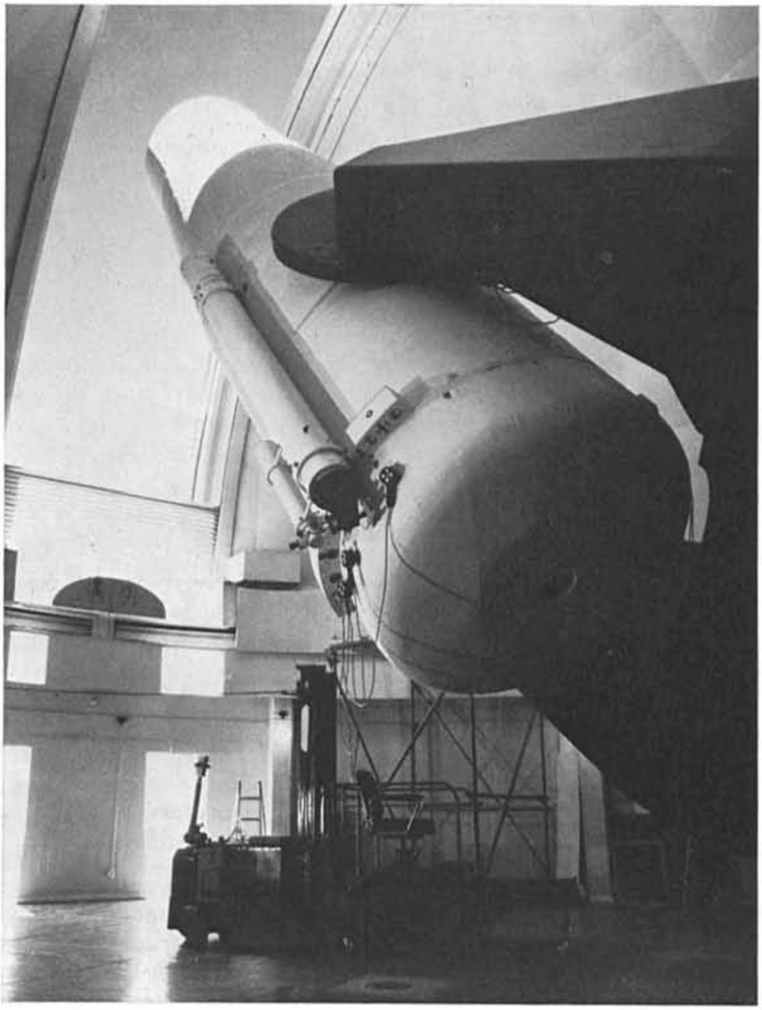

Fig. 2: The ESO 1 m Schmidt telescope on La Silla, with which the ESO surveys of the southern sky are carried out.

The SRC Schmidt telescope was commissioned from the factory in January, 1973, almost within the planned schedule and became operational at Siding Spring in September, 1973. It will soon, probably in January 1974, begin a survey on sensitized III a-J plates [the **SRC (B) Survey**]. The best method for sensitization of III a-J plates is still to be determined, but good results have been obtained at the Edinburgh Observatory with dry nitrogen flushing at room temperature during several weeks. Higher gains in sensitivity have been reported by the Hale Observatories (Miller, baking in vacuum) and Kitt Peak (Millikan and Schoening, baking in nitrogen), however so far with some loss in homogeneity over the plate surface.

The ESO (B), ESO (R) and SRC (B) surveys use the same 606 fields and guide stars. The survey plates are exposed to a calibration device, giving two images of a seven-step gray wedge. Before the plates are developed, edge markings are exposed. They serve as reference marks for astronomic work with the plates.

Two positive on-glass copies are made of all survey plates on-site, normally in Chile and Australia, respectively. From here the positive plates are sent to the ESO Sky Atlas Laboratory in Geneva. It is a central point of the ESO/SRC agreement that all reproductions, also the SRC positive plates, shall be done in this laboratory and that a joint ESO/SRC Atlas of the Southern Sky will be published on the basis of the ESO (R) and SRC (B) plates.

The entire procedure, from the taking of the original plates to the publication of the atlases, has been set up in a way that ensures maximum usefulness and highest quality of the atlases, but still without an excessive time-lag in the production. We shall now take a look at the practical details of the project with special emphasis on those that are applied for the first time to a sky survey.

IV. The ESO and SRC Schmidt telescopes

The ESO Schmidt telescope is basically an upscaled copy of the Schmidt telescope at the Hamburg Observatory. It was built by the same firm, Heidenreich & Harbeck, under the supervision of Dr. Strewinski, who also designed the Hamburg Schmidt. The optics were polished by Carl Zeiss, Oberkochen. The telescope was shipped to Chile late in 1971 and most of 1972 was spent on optical alignment and tests. Very good plates (smallest images about 20 μ on II a-O plates) have now been produced. The setting system is still liable to improvements in order to allow utilizing to best advantage the outstanding optical and climatological conditions. For the time being, this causes a certain inconvenience in the operation of the telescope but does not jeopardize the plate quality.

The SRC Schmidt telescope has been constructed at the works of Sir Howard Grubb Parsons & Co. Ltd., Newcastle, and is a somewhat modified copy of the 48″ Palomar Schmidt telescope. The mechanical and electrical parts were built in the surprisingly short time of 18 months. The telescope has two correcting plates, optimized for the blue and red wavelengths. The heavy parts were shipped to Australia in mid-1973, and the tests were carried out at Siding Spring during late 1973.

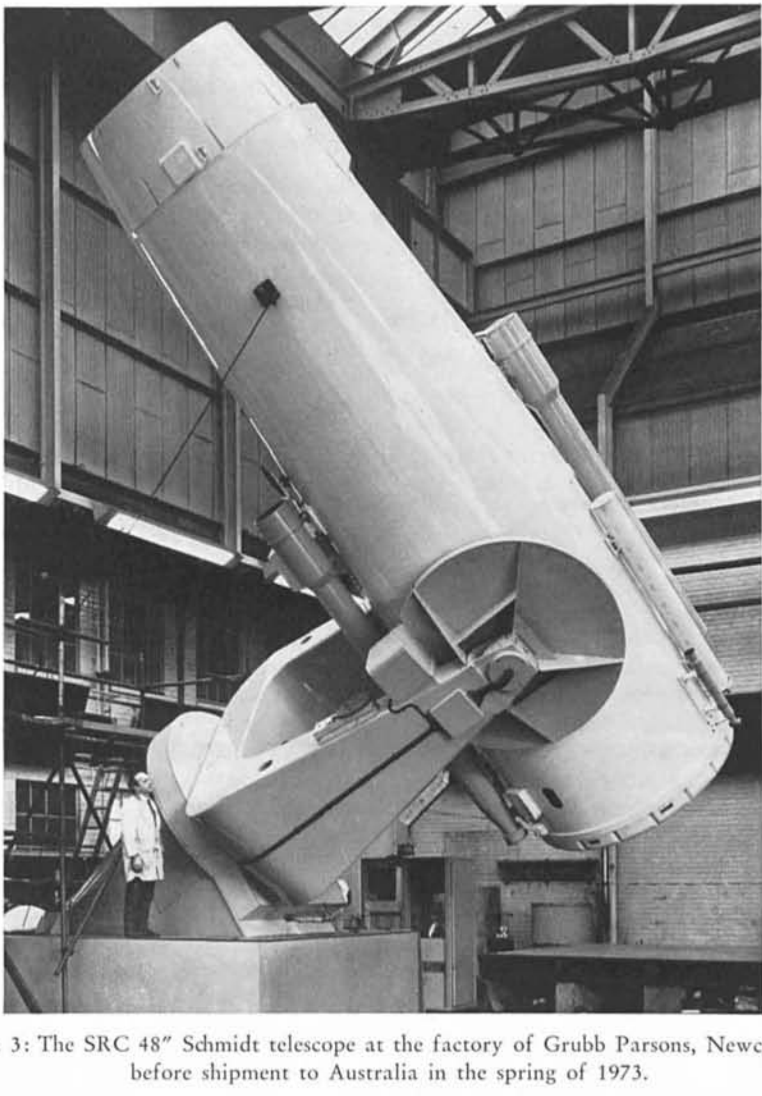

Fig. 3: The SRC 48" Schmidt telescope at the factory of Grubb Parsons, Newcastle, before shipment to Australia in the spring of 1973.

The major data of the two telescopes are collected here:

	ESO	SRC
Main telescope:		
Aperture	100 cm	122 cm
Mirror diameter	162 cm	183 cm
Focal length	306 cm	307 cm
Plate size	30 × 30 cm 16 × 16 cm	14 × 14 inch 16 × 16 cm
Prism angle	4°	—
Dispersion	450 Å/mm at Hγ	—
Guide telescopes:	2	2
Aperture	25 cm	25 cm
Focal length	305 cm	381 cm
Materials:		
Main mirror	Duran 50	CER-VIT
Corrector plate	UK 50	BK 7, UBK 7
Prism	UBK 7	
Site:	La Silla, Atacama, Chile	Siding Spring, NSW, Australia
Altitude:	2350 m	1150 m

V. The ESO Southern Sky Survey: operations on La Silla

The making of the ESO (B) atlas and the ESO/SRC joint atlas starts with the taking of plates (original negatives) in Chile and Australia. The operations are very much the same at the two observatories, and we shall here only mention those at the ESO Observatory on La Silla. The following functions, in chronological order, are performed:

1. Photometric control of plates received from KODAK
2. Ascertaining that observing conditions are good enough for the taking of survey plates
3. Cleaning of negative plate
4. Exposure at telescope; exposure of calibration marks
5. Plate data exposure

6. Edge marks' exposure
7. Processing
8. Quality control of negative plate
9. Making of positive copies
10. Quality control of positive copies
11. Storage of original plates in Santiago and transport of positive copies to ESO Sky Atlas Laboratory, Geneva.

1. Photometric control of Kodak plates

Each batch of plates is tested before being used at the telescope. The test is carried out on plates, chosen at random. It includes determination of sensitivity, relative to a standard value for the particular type of emulsion and control of homogeneity.

2. Observing conditions

No survey plate is taken when the moon is above the horizon. A two-channel photometer on the main tube measures the sky brightness of the field to be observed; no observation is made if a certain value is exceeded. The seeing is estimated visually in one of the guide telescopes; survey plates are taken only when the seeing is below 2″. There are very seldom trails of airplanes on the sky of La Silla. Bright planets are avoided.

3. Cleaning of negative plates

All negative plates are cleaned before the observations. A freon cleaning machine, similar to a prototype built at Kitt Peak, has been constructed at CERN and is placed in a clean air box (laminar air flow) in the loading room on the observing floor. This machine uses Freon TF, a highly active solvent. The freon is sprayed at a slightly downward angle under 5 atm. pressure on both sides of the vertically suspended plate; during this operation the 8 spraying nozzles move downward at a rate of approximately 8 cm/sec. Tests with the Kitt Peak machine, and now with the ESO machine have been entirely satisfactory; no speck of dust or grease is left on the plate. Freon TF has no adverse effects on the emulsion.

The washed plate is put into the plateholder while still inside the clean air box. This ensures that the plate is perfectly clean when it enters the telescope. Dust can only accumulate on the plate during the exposure, when the plateholder has been opened. This is not a serious problem since the Schmidt telescope is a closed system and the emulsion side faces downward during exposure.

4. Exposure

The plate is exposed during a predetermined period, irrespective of the sky brightness, but adjusted for the plate sensitivity. The telescope is guided throughout the exposure by centering the image of a guide star on a TV screen. An automatic guiding system has been foreseen. Two calibration marks are exposed at the opposite positions of the plate. They consist of 7 steps of increasing density (0 - 1.3) and are projected through filters. For geometric reasons this cannot be done in the telescope during the stellar exposure, but is done in the dome, just after the plateholder is removed from the telescope.

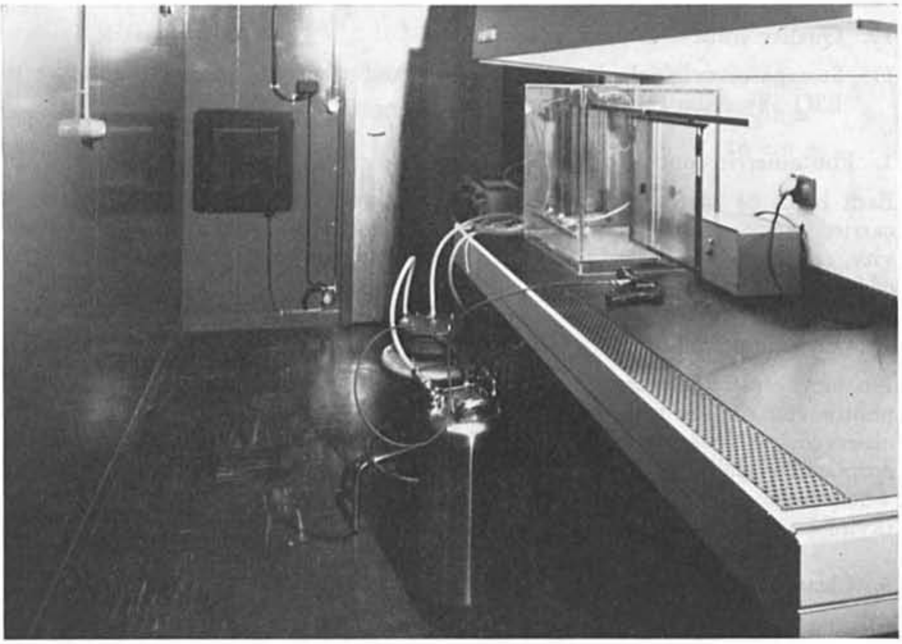

Fig. 4: The prototype of a freon cleaning machine in place inside a clean air box. ESO Sky Atlas Laboratory, Geneva.

5. Plate data

After exposure at the telescope, the plate is exposed to a data label, while still in the plateholder. The label contains the plate number, the emulsion type and the $(\alpha, \delta)_{1950.0}$ coordinates.

6. Edge marks

Before being processed the plate is taken from the plateholder and placed emulsion-down in a stainless steel mask (only touching the plate edges), through which edge marks are exposed. These markings serve as future reference for positional measurements on the plate. They have the form of 5 mm (each fifth 7 mm) long, 120 μ wide, black lines at 5 mm distance along the sides and four crosses in the middle of each plate side, 12 mm from the edge.

7. Processing

The plates are developed in a Palomar-type rocking tray. It would facilitate the development if a nitrogen bubble machine could be safely used, but this has not yet been convincingly proved. Recent experiments by the SRC group in Edinburgh show that the tray rocker method gives slightly more homogeneous results than the other, but future improvements may possibly change this situation. In any case the chosen method is the safest at the moment. After development, the plates are dipped in a stop-bath, fixed twice and rinsed in normal and demineralized water. Finally they are dipped in (filtered) Photo-Flo solution and dried horizontally in a clean air flow.

8. Quality control of negative plates

Each negative plate is now subject to a strict quality control that includes a measurement of image size and shape and localizing of plate faults, satellite tracks, etc. ... The final rules for acceptance of a plate still have to be defined in detail, but they will conform to those that were applied to the Palomar Atlas.

9. Making of positive intermediate copies

Two positive copies are normally made on La Silla of each accepted survey plate. The unexposed positive plates are washed in freon and the printing is done with a specially designed contact printer. The plates are held together by 80 % vacuum and exposed to a stabilized iodinequartz point lamp at 11 m distance.

10. Quality control of positive copies

The positive copies are subjected to a quality control that mainly ensures that no serious plate faults have been introduced.

11. Plate distribution and storage

Soon after the negative survey plate has been copied, it is stored in an air-conditioned vault at the ESO Headquarters in Santiago. One positive copy remains on La Silla and another is sent by air, in a special container, to the ESO Sky Atlas Laboratory in Geneva. All plates are placed in TYVEK envelopes, a polymer material that is very well suited to storage of photographic plates because of its softness, resistance to tear and absolute inertness to the gelantine and the chemicals in the photographic emulsion.

VI. The ESO Sky Atlas Laboratory

The idea arose in 1971 to create an ESO Laboratory in Europe for the production of the Southern Sky Atlas. After approval by the ESO Council in December, 1971, the ESO Sky Atlas Laboratory was planned during 1972 and installed in late 1972 at CERN, Geneva, next to the ESO-TP-Division. It occupies about 300 m^2 in the basement of a concrete building and has its own air conditioning system and plant for water demineralization. The laboratory is administratively associated to ESO-TP, but its budget is separate. The aim is that it will become self-supporting, through the sales of the atlases. There are presently four staff positions filled, one astronomer-in-charge (project leader), two photographers and one secretary. This staff is not expected to increase, but temporary or part-time employment of additional help may be necessary later on.

The laboratory consists of a closed, partly "clean" section (darkrooms, storage room, control room and measuring room) and a few offices.

It has been a great advantage to install the laboratory on CERN grounds; much effort and much time and money have been saved by the easy access to CERN workshops and expertise.

The work of the laboratory is naturally divided in several parts: the making of film atlases and of glass atlases, providing these atlases with additional facilities and information in order to make them more convenient for the user, and the management of the sale of the atlases. As mentioned above, two atlases are scheduled for publication, namely the ESO (B) "Quick Blue" Atlas (in 20 glass copies and 20 - 30 film copies) and the ESO / SRC two-colour Atlas of the Southern Sky.

After the installation of the laboratory, much time was devoted to the testing of various plate and film types for the positive intermediate copy and for the atlas prints. Products of Kodak, Ilford and Agfa-Gevaert were investigated with different developers in order to find a combination that preserves as many as possible of the qualities of the original astronomical plates. The graininess and the keeping qualities were particularly looked into. Thiosulfate and silver contents were compared with the specifications of ISO and ANSI for photographic materials for archival storage.

The procedures for the making of positives in Chile and Australia and of copy negatives at the ESO Sky Atlas Laboratory are governed by these experiments.

It was decided to use, for the intermediate positive plates, the **Kodak Process plates,** which are similar to the Kodak Aerial Plotting plates used for aerial photography. These plates combine a good resolution with well controllable photometric characteristics. To avoid reflexes, the plates have high-density backing.

When a positive plate arrives at the laboratory from Chile or Australia, it is first inspected for photographic quality and possible damage. In case it has to be rejected, notification is sent immediatly to the observatory.

On-glass atlases

Experiments showed that **Kodak Process plates** could equally well be used for the production of copy negatives.

The making of on-glass atlases at the ESO Sky Atlas Laboratory follows closely the procedure for making intermediate positives at the observatory. Each copy plate is washed in freon, allowed to dry and put in a special plateholder, together with the intermediate positive, while still inside the clean air box that houses the freon machine. After exposure in a 5 m contact copying machine, the glass plate is developed in a tray rocker. It is dipped in a stop-bath and fixed vertically in a special tray through which fixer is circulated by a centrifugal pump in order to obtain maximum fixing efficiency. It is thereafter placed in a second fixing bath for a short time. Well before exhaustion, the first fixing bath is discarded, the second bath takes its place and a new second bath is prepared. The silver in the fixing baths is recovered in an electrolytic silver recovery unit. Hypo-eliminator is not used, but the plates are washed well, first in normal water and later, for a short time only, in demineralized water. Finally the plates are dipped in filtered Kodak Photo-Flo solution. The plates are dried almost horizontally in a dust-free enclosure. This prolongs drying but diminishes the risk of emulsion shift.

After processing the plates are checked, put in TYVEK envelopes and stored in a vertical position until shipment to the customers.

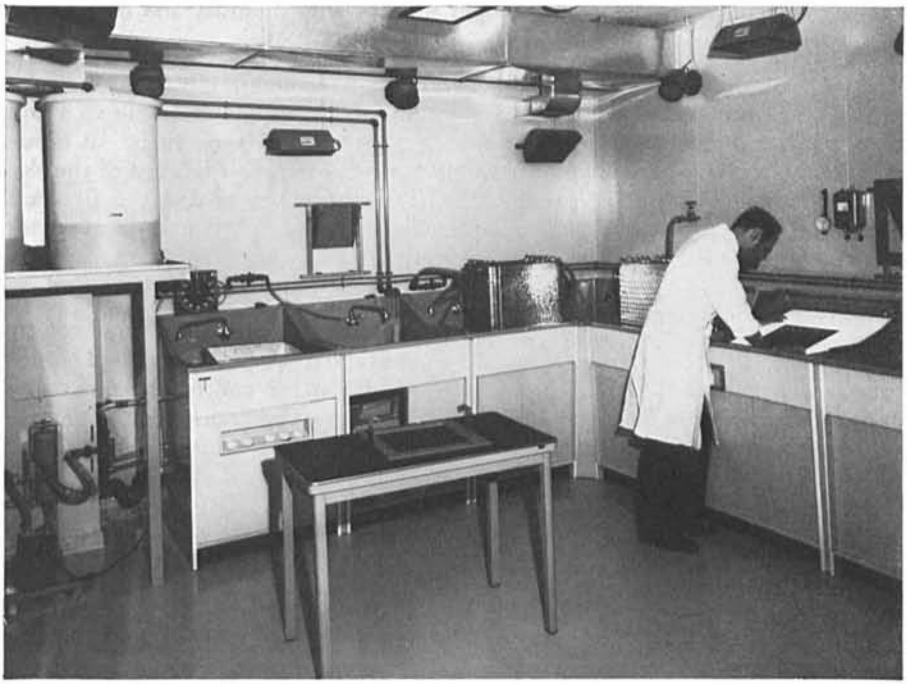

Fig. 5: The main darkrooms of the Sky Atlas Laboratory in which the glass copies of the Sky Atlases are processed.

On-film atlases

The Palomar Atlas was published on Kodak Unicontrast double-weight paper. However, with the availability of new types of films for reproduction of aerial photographs, it has become possible to publish the atlases of the southern sky on film, rather than on paper. The transparency of the film improves the contrast, ideally with a factor of two, and makes possible direct measurement in microphotometers. This is especially attractive because the atlas prints are calibrated photometrically.

It is estimated that the number of on-film atlases to be made will surpass the number of on-glass atlases with about one order of magnitude. It was therefore from the very beginning clear that a production method permitting automatic film processing must be sought. The advantages would be lower personnel cost and higher uniformity, together with much easier production control. Most automatic processors are built for graphic arts, but it was possible to find a film processor, the KODAK VERSAMAT 317, for which tests showed that the processed aerial film could be of archival quality, if only some care were exercised.

After lengthy experiments, the **KODAK 4427 Aerographic Duplicating Film** was chosen. It combines a good resolution (130 - 150 lines / mm) and fine grain with a wide range of obtainable characteristic curves, easily changeable by varying the colour of the exposing light source (lamp intensity and filters) and the development conditions.

The 4427 sheets (40 × 40 cm) are exposed in a commercial vacuum contact printer. The positive glass plate is supported in an aluminium frame to avoid cover glass and thus glass against glass with the risk of Newton rings. An interchangeable labelling device makes possible the simultaneous exposure of the sky field and the identification on the film. The positive plate and the film are cleaned with an air pistol before exposure, and the area around the contact printer is embedded in a flow of filtered air.

The processing in the VERSAMAT 317 consists of three baths, development, fixing and washing, each lasting about four minutes. The film is transported by rollers and a fast recirculation ensures an intense agitation and a very good homogeneity. The film is dried by heated air (32 ° C) at the end of the processing cycle. It is then checked and stored horizontally in sealed transparent envelopes (25 μ mylar + 50 μ polyethylene).

Quality control

The quality of the glass and film copies of the atlases is checked at various points. A test or a test film strip is processed at regular intervals (every two hours) after having been exposed to a 20-step wedge in a Joyce-Loebl 2L Sensitometer. They are then measured in a Macbeth TL-504 densitometer and corrections to the processing cycles are introduced, if necessary. The thiosulphate and silver contents are checked regularly by the methods described in ISO and ANSI Circulars. Long-term accelerated ageing tests are undertaken.

The plates and films are checked for surface damage, plate faults, etc. ... after processing and before shipment.

Publication of the atlases

The atlases are published in several instalments, like the Palomar atlas. The glass plates are distributed in TYVEK envelopes, without cover glass. The film copies are distributed in transparent envelopes that protect the relatively soft surface of the film. The film should remain in these envelopes except when being measured in a microphotometer.

Together with the atlases, additional information about the prints is given — i.e. the "story" of each plate (observing date and conditions, etc. ...). One survey plate from each field is measured at the ESO Sky Atlas Laboratory and the exact celestial positions are given for the crosses that have been marked on the original plate. By means of overlay grids it is then possible to determine the position of any object by interpolation to about 5 - 10″. This positional information will also facilitate measurement with automatic machines.

It is believed that every precaution has been taken to ensure a high astronomical value of the atlases. Many new problems have appeared during the planning

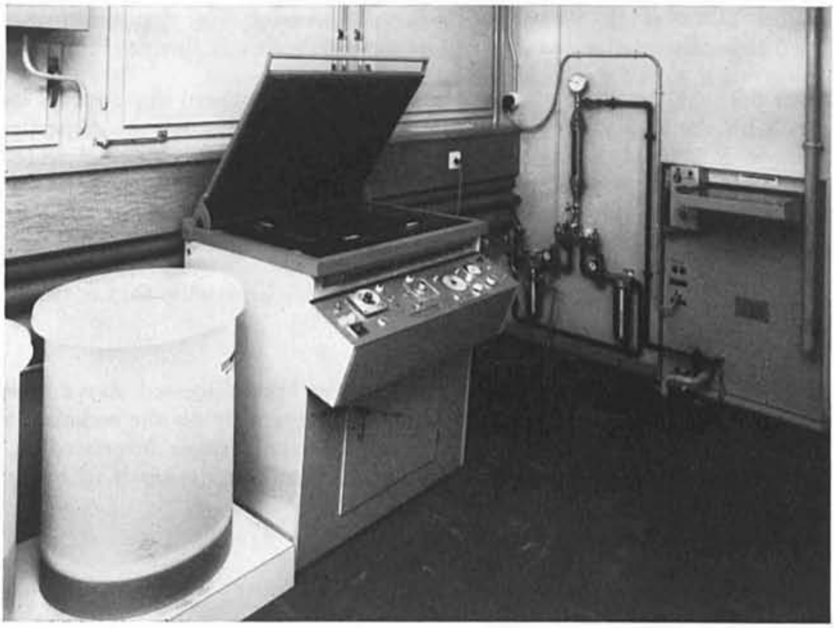

Fig. 6: The film copies of the Sky Atlases are printed on this contact copying machine and developed in a KODAK Versamat 317 Developing Machine (in background). ESO Sky Atlas Laboratory, Geneva.

of this project and a few are still to be solved definitively. The experience thus gained will be made available in publications, but all astronomers, and especially those in the ESO member states, who are interested in learning in more detail the techniques that have been applied, are, of course, very welcome to contact directly the ESO Sky Atlas Laboratory on this matter.

VII. Future surveys

On many occasions, and especially during the Schmidt conference in Hamburg, March 1972, the desirability of other sky surveys than those that are now being undertaken was mentioned. It was pointed out that much exciting and valuable research could be expected from a UV and an IR survey.

Technically speaking, an ultraviolet survey is easy to accomplish. The same plates can be used as for the blue surveys (II a-O or III a-J); only the exposure times are longer and the guiding must be very accurate. An infrared survey, however, would at present have to be carried out with for instance I-N plates that have been sensitized. Homogeneous sensitization of large I-N plates is difficult, if not almost impossible, and much effort must be put into this field before an IR survey could be started. On the other hand, with the growing interest in the infrared, Kodak has started research on infrared-sensitive emulsions (especially IV-N) and it may be hoped that more sensitive and easier handled emulsions become available. The optics of the ESO and SRC Schmidt telescopes do allow taking of UV and IR plates and it is not inconceivable that the presently planned two-colour atlas one day will be extended to three or even four colours.

The possibility of producing a spectral atlas of the southern sky appears interesting. With the available prism at the ESO Schmidt telescope the dispersion is 450 Å/mm at Hγ and the limiting magnitude is about $14^{m}5$ at 0.2 mm widening on II a-O plates. If a high-dispersion atlas (allowing MK classification) or a deep, low-dispersion atlas (e.g. for Milky Way statistics) are preferable to the intermediate dispersion, other prisms may have to be added. No similar atlas yet exists for the northern sky.

VIII. Concluding remarks

The sky survey projects of ESO (and SRC) have been discussed above in some detail. Although this summary is not complete, especially on the technical side, it is hoped that it may serve to inform provisionally those interested in the major features of the projects. A more comprehensive write-up is scheduled to accompany the atlases.

Dr. Richard M. West
European Southern Observatory
Telescope Project Division
CH-1211 Genève 23, Switzerland

ADDRESSES

ESO Directorate	131 Bergedorfer Straße, D — 2050 Hamburg 80, Fed. Rep. of Germany. Telephone: 7 21 30 01. Telex: 2 17 856. Telegrams: EURASTRO Hamburg.
ESO TP Division	(Telescope Project Division), CH — 1211 Genève 23, Switzerland. Telephone: (022) 41 98 11. Telex: 23 698. Telegrams: CERNLAB — Genève.
ESO Headquarters Chile	Alonso de Córdova 3107, Vitacura. Casilla 16 317 — Santiago 9, Chile. Telephone: 28 50 06. Telex: 3520048. Telegrams: ESOSER — Santiago de Chile.
ESO Guesthouse	Gustavo Adolfo 4634, Santiago de Chile. Telephone: 48 42 54 (near cross-roads Avenida Christóbal Colón and Amerigo Vespucio, then through Félix de Amesti).
ESO Local Office La Serena	Casilla 27 D. Balmaceda 595, La Serena, Chile. Telephone: 11 67, 11 77. Telegrams: ESOSER — La Serena.

The ESO Observatory on La Silla can best be reached by mail, telegrams etc. via Santiago Headquarters (address see above).

Printed by Lütcke & Wulff, 76 B Heidenkampsweg, 2000 Hamburg 1, Fed. Rep. of Germany