OBJECTIVE PRISM SURVEYS

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ABSTRACT

A survey of surveys made with objective prisms since the Hamburg Schmidt Conference in 1972 is presented. Ten outstanding achievements attained by these techniques are listed. Detailed accounts of particular surveys both general and specific follow. A table listing fundamental classical studies is given plus a list of the location and properties of the largest Schmidt-type cameras.

INTRODUCTION

The first coma free telescope was built by B. Schmidt in Hamburg in 1930. Thirteen years later the Morgan-Keenan-Kellman Atlas was published and opened up the HR diagram for large scale spectral classification. Today we consider the objective prism surveys, made for the most part with Schmidt-type telescopes in the years since 1972, when, under the gracious auspices of SRC, ESO and the Hamburger Sternwarte, we last met to talk together about the role of Schmidt telescopes in astronomy.

We should recall, as we attempt here to survey the objective prism surveys, just what kind of surveys have been carried out in this decade; next we can look at the reasons why these surveys were undertaken; finally, we can reflect on how such surveys have affected our science. Some surveys, begun in this period, turned out to be irrelevant or of secondary importance or could be done better by using other techniques (especially from the exciting new developments in multicolor photometry). Objective prism research in the past ten years has become more "problem oriented" than it was previously. Nonetheless, many, and these very important, surveys have been undertaken with objective prisms which continue to excite and illuminate our research efforts.

Some of the earlier papers which review progress and problems in objective prism survey work are listed in Table 1; I also commend to

M. Capaccioli (ed.), Astronomy with Schmidt-Type Telescopes, 37–52.

your attention the Symposia and Colloquia sponsored by the IAU et al. for example at Saltsjobaden (1964), Cordova (1971), Lausanne-Geneva (1975), Washington (1977), Vatican City (1978) and most recently in Toronto (1983). Also deserving of our attention are the Reports of IAU Commissions 45 and 28 at the General Assemblies: XV in 1973 at Sydney and in Poland, XVI in 1976 at Grenoble; XVII at Montreal in 1979 and XVIII at Patras in 1982.

Table 1.

Some Fundamental References for Objective Prism Work

Pickering, E. C., 1891, Harvard Annals, 26, vii.
Introduction to the Draper Catalogue

Lindblad, B. and Stenquist, E., 1934 Stockholm Ann. Bd. 11, No. 12.
On the Spectrophotometric Criteria of Stellar Luminosity

Ohman, Y., 1934, Astrophys. J., 80, 171.
Spectrographic Studies in the Red

Morgan, W. W., 1951, Pub. Obs. Univ. Michigan 10, 33.
Application of the Principle of Natural Groups to the Classification of Stellar Spectra

Keenan, P. C., 1954, Astrophys. J., 120, 484.
Classification of S Type Stars

Nassau, J. J., 1958, Stellar Populations, Ric. Astron. Spec. Vaticana 5, 171 and 183.
M Type Stars and Red Variables; Carbon and S Type Stars

Bidelman, W. P., 1966, Vistas in Astronomy, 8, 53 (Ed. A. Beer).
Accurate Spectral Classification by Objective Prism Techniques

Stephenson, C. B., 1966, Vistas in Astronomy, 7, 59 (Ed. A. Beer).
Astrophysical Investigations Utilizing Objective Prisms

Blanco, V. M., 1965, Galactic Structure, (Ed. A. Blaauw and M. Schmidt) in Stars and Stellar Systems (Gen. Ed. G. P. Kuiper and B. Middlehurst) Ch. 12, pp. 241-266
Distribution and Motions of Late Type Giants

McCuskey, S., 1965, Ibid., Ch. 1, pp. 1-26.
Distribution of the Common Stars in the Galactic Plane

Today we look at a mixed situation when we consider the Schmidt cameras in regular use for objective prism studies. Some Schmidt-type cameras have become inactive; some have been moved or are being moved to better sites. In the past decade we have all come to appreciate the importance of excellent seeing as a condition for superior quality research with objective prisms. Today we ask ourselves with more concern: "What will be the role for objective prism survey work in the final years of this century?"

The answer to this question comes rather immediately from a source heretofore little studied with objective prism techniques. I refer to the realm of the external galaxies as explored with objective prisms (mostly very small angled ones) attached to Schmidt-type telescopes. This story has been told and the steps of its early progress outlined by Malcolm Smith (1979) at the Secchi Conference. Since T. D. Kinman (1984) will be presenting his Invited Paper on Emission Line Galaxies, I shall not speak further of objective prism surveys of galaxies.

Ten Outstanding Achievements in Objective Prism Studies

I consider now some of the outstanding achievements and features of work attained through the objective prism surveys in the decade since the Hamburg Conference (Haug, 1972).

First. I begin by mentioning an object discovered on objective prism plates, listed as an object showing Hα in emission with suspected emission also at He I 6678Å. SS 433 indeed has peculiar emission features and its true nature still fascinates and eludes us. The complexities surrounding SS 433, listed in the emission star survey of Sanduleak and Stephenson (1977) as a 13.5 mag object, have stimulated much follow-up research and been the occasion for many new publications and conferences. We rejoice that many of the first successful observations of SS 433 and its fast shifting systems of spectral lines were made here at Asiago by Ciatti and Mammano (1981) and their colleagues. Sanduleak and Stephenson (1981) point out that neither the original nor follow-up plates would indicate that SS 433 was very peculiar. This fact may also serve as an encouragement for continuing the patient searches for emission objects. They are indeed a "mixed bag" of celestial objects but can, as we are seeing here, lead through subsequent research to new and most valuable results.

Second. The successful application of small angle prism methods to fainter (and so often to more distant) objects in Schmidt survey work. Besides the above mentioned research leading to the discovery of QSO and other emission line galaxies we note the successful application of small prism techniques to the study of stars of late type in nearby galaxies by Blanco and McCarthy (1975) and by Sanduleak and Philip (1977) and by our late colleague Bappu and Parthasarathy (1977). The first two mentioned studies were carried out with the thin prism at CTIO attached to the Curtis Schmidt. The Indian experiments were devoted to ultralow dispersion of stars and galaxies.

Third. The completion of the Michigan survey of spectral types in the southern sky and the publication of Volumes 1, 2 and 3 of the Catalogue (Houk and Cowley 1975; Houk 1978, 1982). This work is sponsored by the National Science Foundation.

Fourth. The introduction and successful adaptation of objective prism and gratings to Schmidt cameras of the largest size. We recall the interesting comments made at Hamburg by R. Minkowski (1972) on the reasons why no prism was made for the 1.2m Palomar Schmidt. Subsequently, paced by the successful introduction of the 1° prism objective combination for the 1.3m Tautenburg Schmidt, prisms of 0°.8 and 0°.2 have been installed and now combined on the 1.2m UK Schmidt while prisms of 2° and 4° have been attached to the Tokyo Observatory 1.05m Schmidt at Kiso, Japan. The success of these large diameter objective prisms have led to plans for installing prisms at the Palomar 1.2m Schmidt.

Fifth. The exploration of new regions of the spectrum for survey work with objective prisms has been the result of the new fine-grain emulsions developed by Eastman Kodak and of the new techniques introduced for hypersensitizing plates and finally, of the extended possibilities for making much longer exposures now available with new autoguiding techniques; to this should be added new methods for minimizing field rotation effects such as done with the UK Schmidt. A most useful aid in optimizing objective prism work was alluded to above: the successful transport of Schmidt cameras to regions where excellent seeing is normal.

Sixth. The establishment of new rapport among objective prism spectroscopists, slit spectroscopists (especially those with Reticon, Vidicon or CCD receivers at hand) and photometrists.

Seventh. The extension and improvement of objective prism techniques through the introduction of the combination grating-prism (the so-called 'grism') or other combination dispersion techniques (McCarthy and Blanco 1978).

Eighth. The successful application of objective prisms for use in determinations of radial velocities. Here the pioneering work of C. Fehrenbach (1978, 1983) with the GPO and the PPO has been crowned with success in both hemispheres and applied successfully to the discernment of members from nonmembers of our own nearby galaxies.

Ninth. The availability of very large interference and other specialized filters which make possible surveys for extremely faint objects. Examples: (a) searches for Planetary Nebulae with a 50Å bandpass filter centered at [O III] 5007Å and Hα; (b) investigations of SNRs with plates centered at Hα and again at SII 6317-30, and (c) discovery of low metallicity halo objects with filters limiting the observed spectrum to the H and K lines plus Hα (work of Preston and Schectman at CTIO).

Tenth. The progress of plans for Schmidt spectral surveys in space, especially with Space Telescope.

A word of caution may be inserted here immediately after our description of the outstanding achievements and improvements in objective prism spectroscopy in recent years. Many of the new observational techniques require very long exposures. These in turn lead to noticeable field rotation and flexure effects as the telescope tracks through large hour angles. It is therefore important not to overlook the fact that some of the best present day Schmidt telescopes were simply never designed for extremely long exposures.

Now we consider concrete instances of objective prism surveys. We shall be speaking here of prisms of all sizes: from the smallest apex prisms used chiefly for extragalactic objects [but also for special objects (PN, S and C stars) in our own galaxy] to the largest (10°, 12° and 15°) angled prisms, which serve to spread out the continuum in the spectrum and to enhance the contrast with emission features such as Hα. We shall first consider the largest (in area) prisms attached to the largest Schmidt telescopes, then we shall discuss in turn the kinds of objects detected in objective prism surveys.

The Largest Schmidt Cameras and Their Prisms

What is a large Schmidt telescope? Many definitions might be offered. I suggest this definition here: a large Schmidt is one whose correcting plate has a diameter of 1 meter or greater. Thus the

Table 2.

The Largest Schmidt Telescopes and Their Prisms

Tautenberg Schmidt			East Germany
134/200/400 cm	Prism:	1°	2500 Å/mm at Hγ

By combining corrector and dispersor light losses in the 132 cm prismatic correcting plate are minimized and the weight is low. (Beck 1972)

United Kingdom Schmidt			Siding Springs, Australia
120/180/cm	Prisms:	2°.2	830 Å/mm at Hγ
		0°.8	2440 Å/mm at Hγ
Palomar Schmidt			Palomar Mountain, California
122/183/307 cm	Prism:	in planning stages	
Tokyo Observatory Schmidt			Kiso, Japan
105/150/330 cm	Prism:	4°	170 Å/mm at Hγ
		2°	800 Å/mm at Hγ
ESO Schmidt			La Silla, Chile
100/162/305 cm	Prism:	4°	450 Å/mm at Hγ
Kristaberg Schmidt of Uppsala Obs.			Kristaberg, Sweden
100/135/300 cm	Prism:	7°	273 Å/mm at Hγ
			See Uppsala Ann. Vol. 5, No. 5

Hamburg Schmidt at Calar Alto would not be included since its corrector is 80 cm; similarly the Abastumani 70 cm meniscus telescope will not appear on this list, we note that both of these telescopes are larger than the many intermediate size Schmidts such as the Curtis, the Burrell, the Vatican, the Tonantzintla, the French-Liege, the Armagh-Dunsink-Harvard and the Torun Schmidts. In Table 2 we have listed the Largest Schmidt Telescopes along with the aperture in cm of the corrector plate, the spherical mirror and finally the focal distance; we also give the reciprocal dispersion at Hγ for the prisms used with the camera. It is worthwhile noting that none of the largest Schmidts has as yet completed a full sky objective prism survey. The reasons for this are that only recently has it become possible to construct and to mount such large pieces of glass and also that major efforts with large Schmidts have until now been concentrated and devoted to sky surveys in the direct mode.

OBJECTIVE PRISM SURVEYS

General Classification Surveys

General classification projects with objective prisms are usually carried out on blue sensitive plates and cover the range from 3800 to 4800Å at dispersions near 150 Å/mm to 250 Å/mm at Hγ. Such surveys aim at the classification of all spectral types to a convenient limiting magnitude.

If the spotlight for the most exciting breakthroughs in objective prism work in this decade has centered on surveys of QSOs, emission line galaxies and on the 'thus far unique' object SS 433, the focus on the most thorough and extensive survey employing objective prism techniques must surely rest on Dr. Nancy Houk of Michigan. At Toronto she discussed the latest features of her current work and reviewed the present status and future prospects for this reclassification of the stars of the Henry Draper Catalogue in the MK system (Houk 1983). This work has begun with the 4° and 6° combined Michigan prisms on the Curtis Schmidt in Chile; it continues now with the new 10° prism attached to the Burrell Schmidt in Arizona. Three volumes of this work begun at Dec = -89° and reaching presently to Dec = -26° have now been published (Houk and Cowley 1975; Houk 1978, 1982). A generous overlap in declination zones is planned which will allow an intercomparison of the two telescopes, two different prism arrangements, and two different sites. The observational work for this project in regions north of Dec = -30° has been started at Kitt Peak under the direction of the Case astronomers. Bidelman will speak to us here of this work. This biggest objective prism survey is acknowledged and encouraged by us all. A feature of it has been the successful transfer of the two dimensional MK system of classification to this very large scale program of objective prism work. That this transfer could be made so serenely and successfully on plates covering the whole sky is a tribute to Houk and Cowley and to their predecessors Cannon, Maury and Mayall and of course, to Keenan, Morgan and Nassau, and in a most special way to S.

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McCuskey (1965) who pioneered the first application of MK classification to objective prism projects for his monumental LF papers. We have with each new volume of the Michigan Catalogue thousands of new secondary and very localized standards for classification, all accomplished in a most uniform manner by most accomplished classifiers. It seems remarkable (yet most logical) that both the original HD work at Harvard and now the new MK classification at Michigan- Case have been made from objective prism plates.

A second general (i.e., covering all spectral types) project of classification is that due to the excellent work of our colleagues in the Soviet Union under the leadership of Professor E. Kharadze and Dr. R. Bartaya (1976, 1977, 1979, 1983). Their work is recognized and used more extensively each year. Since 1956 the 70 cm meniscus telescope at Abastumani with its objective prisms of 2°, 4° and 8° (yielding corresponding reciprocal dispersions of 1200, 660 and 160Å/mm at Hγ) has been used to survey more than 100,000 stellar spectra in two dimensions. These stars are located in the Kapteyn Selected Areas and were observed through the 8° prism. This survey is complete for Areas 2 to 43; classifications have been made for stars to a limiting mag of m = 12. For Selected Areas 44 to 115 observational material has been obtained and the classification is in progress. We shall be speaking about other valued contributions from our Soviet colleagues when discussing specific surveys later on.

Another large scale general survey in progress is the study of stars at Intermediate Latitudes made by J. Stock and co-workers (1979, 1980) in Venezuela. This work includes besides spectral classification also the radial velocity measures plus the determination of positions and magnitudes for 10,000 stars in a region which extends from R:A: 11^h 47^m to 15^h 43^m and Dec -30° to -35°. We note once again that this large general survey is concerned with stars in the once very neglected Southern Hemisphere.

Other general classification surveys are less extensive but merit consideration here. Fehrenbach and Burnage (1981) give spectral types together with radial velocities, accurate positions and approximate magnitudes for 713 stars in four fields. Similarly, Amieux and Burnage (1981) present a catalogue for 169 stars for a field in NGC 3114. J. Drilling and A. Landolt (1979) have made MK classifications from low dispersion objective prism spectra for 608 of the 624 secondary UBV faint standards of Landolt. J. C. Doyle and C. J. Butler (1978) report on their classification of spectra taken with the ADH and its objective prisms. P. A. Krug, D. C. Morton and K. P. Tritton (1980) have made observations for the faint standards which are to be used with the objective prism plates taken with the UK Schmidt. E. Recillas Cruz (1982) has searched the deep spectral plates of the UK Schmidt for faint blue spectra of early type stars which may belong to the Magellanic Stream. Johannsen (1981) has classified 800 stars with the ADH.

Worthy of note, it seems to me, is the fact that certain of the large national plate archives containing low dispersion spectral data, especially those concerned with data acquisition from space, have recently become available to members of the astronomical community; perhaps more heed might be paid, especially when telescope time is very scarce and travel expenses are mounting, to this 'second hand' source material which may have for us, as for Ruth in the Old Testament, many golden items for our gleaning.

Specific Classification Surveys

Specific classification surveys limit themselves to a special group of objects. Such surveys usually employ preferentially lower dispersions; occasionally, however, the highest available dispersion is used along with strong filtering to cut down unwanted background radiation; this limits the range of the spectrum covered. So many conferences and publications have been dedicated to each of the main classes of objects detected in such specific objective prism surveys (QSOs, PN, OB and C Stars, etc.) that adequate coverage of these surveys here is not feasible. We shall cite with examples some of the more common types of objects surveyed with objective prisms.

Surveys of Emission Objects. The outstanding emission feature observed in stars, nebulae and galaxies is of course Hα. One of the features noted in the past decade since the Hamburg meeting has been the improvement of plate sensitivity in the red region as evidenced in the development of the III a F emulsion. Another significant advance has been the introduction of successful techniques for increasing the sensitization of red and near infrared sensitive plates. Such improvements in the photographic process and in the filtering mentioned above have helped to limit sky background contamination and to exclude night sky emission.

The objects detected in surveys for Hα are a "most unnatural" group. They encompass many 'natural' groups. Certain of these true natural groups can be individualized only when more observations besides those which display the Hα feature have been carried out; such further observations will most commonly involve slit spectroscopy at higher dispersion and resolution, multicolor photometry, or both. The objects which display Hα prominently in emission include besides the Be stars, PN, H II objects, Wolf Rayet Stars, Novae, Of stars, Ke, Me, Ce and Se stars. Thus in searches for objects with Hα in emission we will harvest many species of stellar (and nonstellar) objects. The harvest yields quite an array of different members of very different 'natural' groups which must be 'separated out' like fish after a big catch in a large net.

Several of the earlier published lists of early type stars showing Hα in emission were collated by Bertiau and McCarthy (1969); a much more extensive list was published by Wackerling (1970), which included the important southern Be stars from Henize's survey (1967). The listing by Bidelman (1954) of the emission stars of late type remains today a fundamental source of information. Perek and Kohoutek (1967) have provided us with the General Catalogue of Planetary Nebulae; this has been supplemented by a listing of PN observed in the red spectral region by MacConnell (1982). The excellent Be Star Bulletins originated by Mme. Herman continue to contribute much to our picture of these early type emission stars so important for spiral arm tracing.

The important work of the Case-Hamburg Survey of High Luminosity Stars is extended now through the researches of many of the original observers and their students. From Case we note the studies of emission objects by Sanduleak and Stephenson (1977) which has given us SS 433 and its other not yet so famous companions. Other Hα emission stars have been published by Sanduleak and Bidelman (1980), by Stephenson (1979, 1981) by Bidelman (1981) and by Pesch (1984) who will be telling us here of some of the the faint emission stars observed at 1500 Å/mm at Hγ and at 18th mag. In his high-latitude red-region objective-prism survey, Stephenson (1983) has identified many emission line objects. This project is now two-thirds complete with 1000 of 1300 fields already photographed; it covers the sky north of Dec = -25° and covers galactic latitudes beyond b = -10°. He uses a dispersion of 1000 Å/mm at Hγ and reports some 200 new Hα emission objects, noting that a few but by no means the majority are dMe stars. Among the interesting objects found, Stephenson mentions a faint C star with bright Hα. We may expect more surprises when higher dispersion spectra can be secured for these objects. Indeed studies of emission objects seem alive and well at Warner and Swasey Observatory. From Merida in Venezuela, Mac Connell (1981) reports the discovery of some 900 new Hα stars found on red-visual plates taken with the Curtis Schmidt. From Hamburg we will be hearing next from Kohoutek (1984) what the Hamburg Schmidt is doing with emission objects at its new site in Calar Alto, Spain. From Ohio State, another of the original Case-Hamburg researchers, A. Slettebak, reports continued work on emission objects.

Extensive work in surveying galactic fields for Hα emission objects continues with the Tonantzintla Schmidt under G. Haro and his coworkers (1982).

New combined efforts at objective prism survey work by the astronomers of Indonesia (Hidyat 1983) and Japan (Maehara 1983), constitute a most welcome manifestation of international cooperation in research. Samples of the first fruits of this collaboration are the researches of K. K. Hamajima et al. (1982) and by Maehara (1982). Both the Kiso Schmidt of Tokyo Observatory and the Bima Sakti Schmidt at the Bosscha Observatory in Java are used. The combined surveys have concentrated on regions of dark nebulosity and special attention is given to emission stars in the vicinity of Bok globules and to the discrimination of associated T Tau stars as distinct from the more distant Be stars, or from Mira variables or other Hα objects. These results are studied along with star counts, infrared studies, and surface photometry with narrow filters in order to trace the processes of stellar formation. Surveys have been completed for areas in Ara, Crux, and Monoceros and in the direction of the galactic center.

From Sweden, Welin's (1979) contributions to Hα emission studies are very important. At Castel Gandolfo, G. Coyne (1978, 1983) and his coworkers Cardon, DeGraeve, Lee, Mac Connell, and Wisniewski have published five lists with a sixth list now in press, in addition to this there is, also in press, a revised final listing prepared by Coyne and Mac Connell. There are no further plans to continue the search for Hα emission objects from Castel Gandolfo because of the deterioration of observing conditions there (bright lights from the Roman campagna).

Martinez, Muzzio and Waldhausen (1980) have listed approximate spectral types for 139 Hα emission objects in the Coalsack using the Curtis Schmidt at CTIO with a dispersion of 1350 Å/mm at Hγ. M. Kun (1982) has studied 110 Hα emission objects discovered in dark clouds along the galactic plane. Ogura (1983) has detected 140 new emission line stars in associations in Monoceros.

Each of us has enjoyed rediscovering the beauty of the emission features in Campbell's Hydrogen Envelope Star: HD 184738 (BWo + P) or made observations with objective prisms at the highest available dispersion of galactic Novae and appreciate their fascination. W. Seitter in her Atlases of Novae has given a splendid demonstration of the spectral features which are observable at objective prism dispersions especially when short exposures on unfiltered infrared IN plates reveal the full display of features from 9000 to 3500Å. However, there does not seem to be any formal survey work in progress directed at detecting Novae or peculiar emission objects. Like many other objects, they will be detected in Hα emission surveys and can then be subjected to more detailed exploration.

Surveys of Carbon Stars. Carbon stars have come into their own and are receiving much attention since we met at Hamburg in 1972. Among the pioneering giants here we note Secchi, C. D. Shane, Sanford, Merrill, Morgan, Keenan, Nassau and Blanco and others. One of these, Y. Fujita (1980) of Japan has presented his philosophy of spectral classification when he discussed the problems associated with Carbon Stars.

Fuenmayor (1981) in Venezuela surveyed regions near the galactic center and towards the galactic anticenter and confirms Blanco's (1965) observation concerning the concentration of C stars towards the anticenter and the absence of C stars in the direction fo the galactic center. Mac Connell (1978, 1981, 1982) has reported 34, 10 and 46 new C stars in surveys he has made along the Milky Way plane. Nandy, Smeriglio and Buonanno (1978) present the results of their C star surveys and Smeriglio and Nandy (1981) announce the discovery of new C stars in Cepheus. Kurtanidze et al. (1979, 1980) has found 39 new Carbon stars in a survey with the Abastumani meniscus telescope and he and West (1980) have found 10 new C stars. Alksnis et al. (1979)

reports the discovery of new Carbon stars on plates taken with the Latvian Schmidt and is studying the relation of observed IR colors with the C stars discovered. I. Platais (1979) also reports finding new C stars in several fields of the sky. Most of these observations were made along the galactic plane. Stephenson (1983) on the other hand has been looking at the distribution of R and N stars at higher latitudes and reports finding 100 new C stars. These 'out of the plane' Carbon stars should prove interesting for further photometric, kinematic and evolutionary studies.

Maehara (1983) at Tokyo has used red plates exposed through a GG 455 filter and the 4° prism on the Kiso Schmidt to survey 180 square degrees in Cassiopeia. He confirms 73 of the C stars already discovered by Stephenson and finds four new C stars and notes that for all C stars observed there is a scarcity of types earlier than C_4 on the Keenan- Morgan classification scheme. Similar studies at strategic points along the galactic plane and away from it might pay significant dividends for evolutionary studies.

Surveys of Other Late Type Stars. The classic Case researchers on objective prism spectra of M and S type stars in the near infrared are summarized by Nassau (1956, 1958). In the past decade, few new extensive surveys have been carried out to find galactic M stars. We mention here two unpublished studies of M stars in the direction of the galactic center. Blanco, Blanco and McCarthy (1978) report the discovery of 300 late M stars in the region of 0.12 square degrees in Baade's 'Clean' Window near NGC 6522, they also report one suspected C star. Recently these same investigators aided by DeGraeve and Meier have counted in an area of 0.12 square degrees some 750 late M stars plus a possible C and an S star; this latter investigation was carried out closer to the galactic center in Sgr I, another of the windows reported by Baade; we note that these surveys were not accomplished with Schmidt cameras but with a grism attached at the converging beam of the prime focus of the CTIO 4m telescope.

I believe that this 'drop off' in Schmidt M star surveys is due to the fact that there are so many other challenges in observational studies of evolution that the 'sheer plod' of M and S star surveys may have discouraged some possible investigators. It is as though we were all waiting for the day (which indeed may now be dawning) when automatic data processing and plate reduction techniques can accomplish classification tasks more efficiently than ever we could with low power microscopes used to examine very crowded fields with overlapping spectral images. Another factor, without doubt, has been the scarcity of giant M stars near the sun. This makes it difficult to determine the absolute luminosities of M giants. The grism technique used in the galactic center and in the Magellanic Clouds have given us for the first time the opportunity to obtain reliable luminosity measures.

Russian colleagues have been active in observing red stars and have used the Abastumani 70 cm meniscus camera to survey M and C

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stars in the northern part of the galaxy in a band 10° wide along the galactic plane. They have noted a tendency for a lesser concentration of high luminosity M stars towards the galactic plane than had been previously thought or expected (Kharadze 1983).

This work at Bosscha Observatory cited above includes the discovery of 2000 late type M giants and 59 supergiants in a region of 200 square degrees towards the galactic center and extending from 1 = 330° to 0° to 30° along the plane. One aspect of this study may be that we will have available for further study several new windows of transparency similar to those disclosed years ago by Baade. The Javanese and Japanese astronomers are examining their M star surveys in the light of observations of associated IR enhancement; such research may permit a close and more accurate glimpse of the regions near the galactic nucleus, and may complement the finds of the wonderful new IRAS satellite.

Mac Connell (1982) reports finding 328 M and MS stars on his Curtis Schmidt plates. Smiriglio and Nandy (1981) have been surveying a region in Cepheus for M stars brighter than m_i = 13.

Stephenson's above mentioned (1983) survey has yielded 100 new stars of type S. These plates also serve to identify late M stars which, as Stephenson notes, are, most usually, well known variable stars which often lack spectral types.

Pesch and Sanduleak (1978) have published a catalogue of probable dwarfs of type M3 or later. Alcaino and Pik Sin The (1982) report on M stars in the South Galactic Pole and Stephenson notes the presence of some 400 to 450 M dwarfs in his survey at high latitudes. We note that the unfinished portion of this survey will include the north galactic pole. The estimates and hypotheses about the numbers and densities of M dwarfs is a fascinating old 'ghost' which keeps 'rumbling' in the M star closet. New and shining nails for closing this case, in addition to those reported in 1976 by Faber and by King, were brought forth at the 1983 IAU Colloquium at Middletown, where the luminosity function was discussed. However, we all remember that it is difficult to bury 'ghosts'.

H. Bond (1980) by means of an objective prism survey has been searching for extremely metal-deficient stars, mostly of late type; this work has opened up the fascinating topic: 'Where have all the Population III Stars gone?' Such studies are of importance as we seek stars of very advanced age.

At Ohio State, McNeil and Schiller report surveys with the Curtis Schmidt of late type stars in the region of the South Galactic Pole. They use a dispersion of 580 Å/mm at Hγ. McNeil (1981) found 2200 G, K and M stars in his survey which reached to 13.5 mag in an area of 81 square degrees. Schiller (1981) has surveyed a much larger area and finds 183 M giants to a limiting magnitude of 14.5 m_{pg}.

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Surveys of Early Type Stars. The major work in discovering the intrinsically brighter OB stars is now completed through the successful Case-Hamburg studies. New searches and surveys extend to fainter limiting magnitudes in our own galaxy and to the intrinsically brighter OB stars in members of the local group. Sanduleak and Philip (1979) have observed many candidate OB stars in the Magellanic Clouds. Some of the greatest excitement in the OB star domain today concerns the IUE spectra but these are not a matter for our discussion here.

Orsatti and Muzzio (1980) and Forti and Orsatti (1981) have been searching for faint OB stars in the southern Milky Way and report the discovery of more than 200 OB stars on thin prism plates taken at CTIO.

At the Abastumani Observatory the 2° prism attached to the 70 cm meniscus telescope is used to search for O and B stars.

L. Erculiani Abati and H. Lorenz (1984) will be describing here some of the spectral studies they have been making at Asiago using the objective prism plates from the 1.2m UK Schmidt and the 1.3m Tautenberg Schmidt (plus our 'host' Schmidt here in Asiago). They will report first spectra on blue objects detected in the Asiago field, where UVX objects have been noted.

From Case-Western Reserve, Pesch (1984) will be reporting here on initial results of the low dispersion (1500 Å/mm at Hγ) survey which can detect O and B stars to the 18th mag. This work is being done with the Burrell Schmidt in Arizona.

This survey of surveys with objective prisms must necessarily leave largely untouched the grand domain of specific studies of A-F-G-K stars. Many of the brighter stars of these types will, of course, be classified in the Michigan Catalogues; many have already been classified in the LF spectral surveys by McCuskey (1965) with the Case Schmidt in Cleveland; Kharadze and Bartaya and their colleagues will be giving us accurate types for fainter stars than the surveys with the Curtis and Burrell Schmidts record. As mentioned above, with the coming of automatic classification processes, both new and old objective prism plates (if they have some calibration keys available) can be surveyed and studied. Space density analyses according to spectral types may be made according to the methods of Schalen and the other methods of star counting cited by Bok. Such observations and analyses will prove most important for large scale evolutionary studies of sprial arm and interarm regions. In addition, we will be able to follow so much better than has been hitherto possible the changes in spectral type of so many variable stars found on Schmidt plates. This, in the words of W. W. Morgan, represents one of the last unexplored areas for spectral studies.

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DISCUSSION

P.S. BUNCLARK: Will the large amount of plate material used in the manual searches you have mentioned be readily available for use with the automated scanning facilities?

M. McCARTHY: The answer to your question depends on observatory policy and this differs markedly from one Institute to another. In national centers where space observations are deposited, these data (after a determined examination time assigned to the project scientists who actually directed and made the observations) do become available for open study by qualified persons. We know that traditionally photographic observational material obtained by individual guest astronomers remains the property of the host observatory - is used as long as required by the guest observers then should be returned to the institutes archives.

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