

Final Program with Abstracts

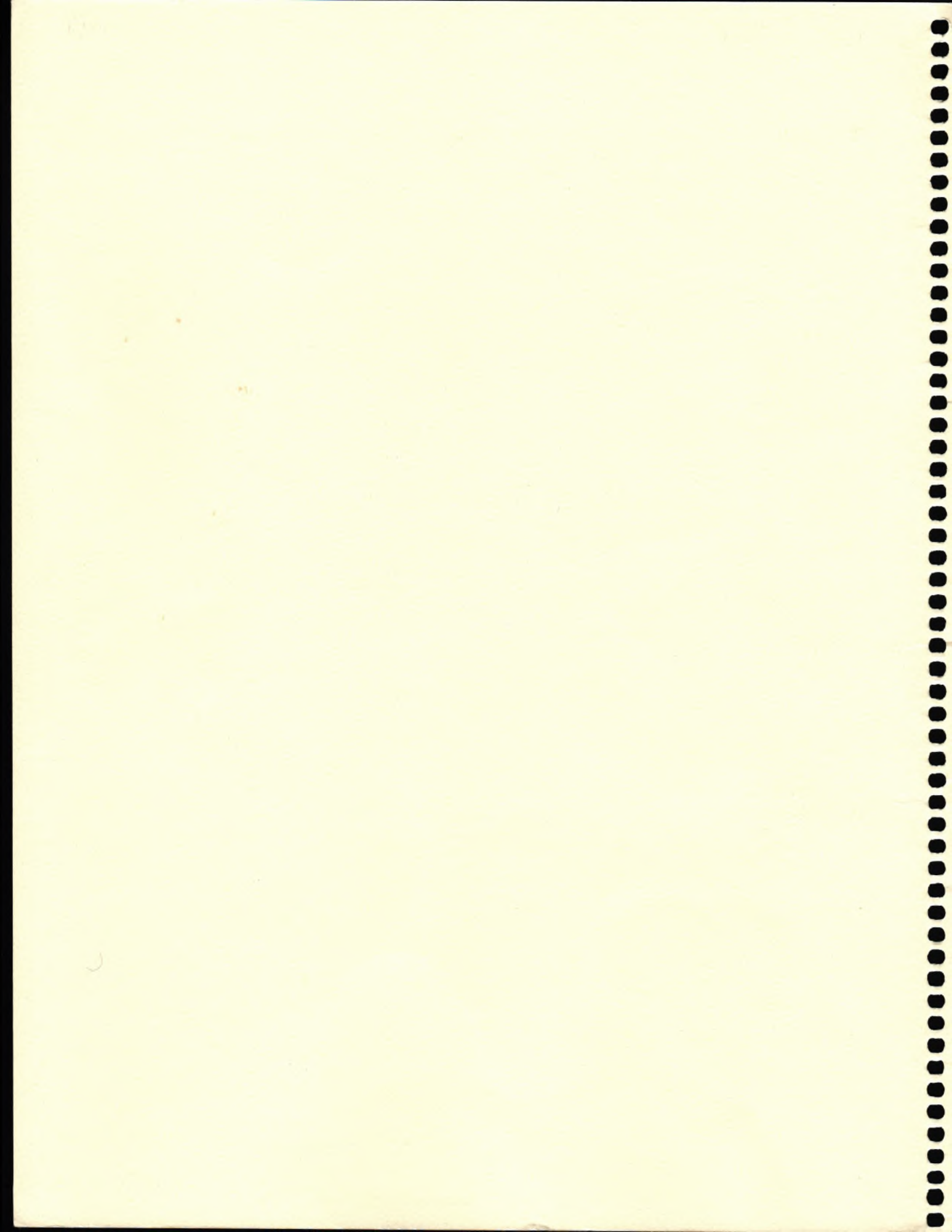


**The 100th Annual Meeting
of the Astronomical Society of the Pacific**

—○—
**The 1988 General Assembly
of the Royal Astronomical Society of Canada**

—○—
**The 1988 Summer Meeting
of the Western Amateur Astronomers**

—○—
June 28 to July 3, 1988
University of Victoria
Victoria, British Columbia, Canada



The Organizing Committee gratefully acknowledges the financial support of the following:

The Natural Sciences and Engineering Research Council of Canada

Bureau of International Relations, The National Research Council of Canada

Canadian Institute of Theoretical Astrophysics

Province of British Columbia

The Lieutenant Governor, Province of British Columbia

University of Victoria

This Meeting is co-hosted by the following:

Dominion Astrophysical Observatory, The National Research Council of Canada

Department of Physics and Astronomy, University of Victoria

Victoria Centre, Royal Astronomical Society of Canada

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Chris Pritchett, University of Victoria
James E. Hesser, Dominion Astrophysical Observatory

Local Organizing Committee:

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Co-chair: Jack Newton, Royal Astronomical Society of Canada
Jeremy Tatum, University of Victoria
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This Meeting is Sponsored By:

Astronomical Society of the Pacific
390 Ashton Avenue, San Francisco, California, 94112, U.S.A.

Royal Astronomical Society of Canada
136 Dupont Street, Toronto, Ontario, M5R 1V2, Canada

The Western Amateur Astronomers
c/o Margaret Matlack, Secretary, 13617 E. Bailey Avenue, Whittier, California, 90601, U.S.A.

EXHIBITS

MacLaurin Building

We invite you to visit the exhibits of astronomical books, equipment and software in the exhibit halls (where the coffee and poster papers are also located). Many of the items on exhibit will be given away during the door prize drawing at the Awards Banquet.

This meeting and many other educational activities of the Astronomical Society of the Pacific are made possible in part by generous donations from the following companies and organizations.

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TUESDAY JUNE 28

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

7:15 am Breakfast, Commons Building

8:30 am Registration, Conference Services Office

12:00 Lunch, Commons Building

5:00 pm Dinner, Commons Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

7:15 am Breakfast, Commons Building

8:30 am Registration, Conference Services Office

12:00 Lunch, Commons Building

5:00 pm Dinner, Commons Building

EXHIBITS AND SPECIAL EVENTS

7:15 am Breakfast, Commons Building
 Note: Participants of the two tours are asked to pick up a bag lunch at breakfast

8:30 am ASP Board Meeting, Elliott 038

8:30 am Exhibits, MacLaurin Building

12:00 Lunch, Commons Building

12:00 Butchart Gardens Tour,
 Bus departs from Lot #5.

DAO/IOS Tour,
 Bus departs from Lot #5

4:00 pm Exhibits Close

4:30 pm Lieutenant Governor's Reception,
 Bus departs from Lot #5

5:00 pm. Dinner, Commons Building

8:00 pm Opening Reception,
 Commons Building

WEDNESDAY JUNE 29

EXTRAGALACTIC DISTANCE SCALE RASC/ASP/WAA JOINT MEETING EXHIBITS AND SPECIAL EVENTS SYMPOSIUM

Recital Hall, MacLaurin Building David Lam Auditorium, MacLaurin Building

7:15 am Breakfast, Commons Building 7:15 am Breakfast, Commons Building

8:00 am. Registration, MacLaurin Lobby 8:00 am Registration, MacLaurin Lobby 8:00 am Exhibits, MacLaurin Building

8:30 am Opening Remarks

8:45 am Paper Sessions:

G. de Vaucouleurs,
The Extragalactic Distance
Scale—from 1918 to 1978

Local Group Galaxies

9:15 am M. W. Feast,
The Magellanic Clouds and the
Extragalactic Distance Scale

10:00 am Coffee and Posters

10:30 am W. Freedman,
Cepheid Distances to Nearby
Galaxies

11:00 am C. J. Pritchett,
RR Lyrae Stars in Nearby Galaxies

11:30 am G.H. Jacoby,
Planetary Nebulae as Distance
Indicators

12:00 am Lunch, Commons Building 12:00 Lunch, Commons Building

1:30 pm WAA Board Meeting
Elliott 162

WEDNESDAY JUNE 29

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

1:45 pm H. Ford,
Novae as Distance Indicators

2:15 pm J. R. Mould,
Review of the Local Group Distance
Scale

Calibration of Standard Candles

3:00 pm A. R. Walker,
Calibration of the Cepheid Period-
Luminosity Relation

3:30 pm Coffee and Posters

4:00 pm J. Cohen,
Nova Expansion Parallaxes

4:30 pm B. Tully
Effect of the Local Velocity Anomaly
on the Hubble Constant

5:00 pm Dinner, Commons Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

2:30 pm Opening Remarks

2:45 pm Invited Paper:

A.G. Fraknoi,
Telescopes versus Horoscopes: A
Skeptic's Guide to Answering
Questions About Astrology

3:30 pm Coffee and Posters

4:00 pm Contributed Paper:

S. Dodson,
Filming Astronomers in Action:
Canada's Stargazers, from Louisbourg
to Supernova (film presentation)

5:00 pm Dinner, Commons Building

EXHIBITS AND SPECIAL EVENTS

4:30 pm No-Host Bar, MacLaurin Lobby

5:00 pm Exhibits and Registration Close
Dinner, Commons Building

9:30 pm DAO Observatory Tour & Star Party
Bus leaves from Lot #5

THURSDAY JUNE 30

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

- 7:15 am Breakfast, Commons Building
- 8:00 am Registration, MacLaurin Building
- 8:30 am Paper Sessions

Calibration of Standard Candles

D. A. Vandenberg,
Constraints on the Hubble Constant
from Globular Clusters

9:00 am J. J. Melnick,
Giant HII Regions as Distance
Indicators

9:30 am R. M. Humphreys,
The Brightest Stars in Galaxies

10:00 am Coffee and Posters
Group Photograph

10:30 am D. Branch,
Supernovae as Distance Indicators

11:00 am D.G. Monet,
Astrometry and the Distance Scale

The Virgo Cluster

11:30 am W.E. Harris
Globular Cluster Systems as Distance
Indicators

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

7:15 am Breakfast, Commons Building

8:00 am Registration, MacLaurin Building

8:45 am Invited Paper:

F. Drake,
The Search for Extraterrestrial
Intelligence

10:00 am Coffee and Posters
Group Photograph

10:30 am Invited Paper:

M. Schmidt,
Quasars: A 25th Anniversary Report

11:30 am Contributed Papers:

R.D. Lewis,
Light Pollution - What Can We Do?

EXHIBITS AND SPECIAL EVENTS

7:15 am Breakfast, Commons Building

8:00 am Exhibits, MacLaurin Building

8:30 am RASC National Council Meeting,
Elliott 162

10:00 am Coffee and Posters
Group Photograph

THURSDAY JUNE 30

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM	RASC/ASP/WAA JOINT MEETING	EXHIBITS AND SPECIAL EVENTS
Recital Hall, MacLaurin Building	David Lam Auditorium, MacLaurin Building	
11:40 am	C.F. Brown, Photometry for the Beginner	
11:50 am	A. Ling, De-fuzzing the Fuzzy Deep Sky Objects	
12:00	Lunch, Commons Building	12:00 Lunch, Commons Building
1:45 pm	TRUMPLER LECTURE J. Bechtold, High Resolution Spectroscopy of Quasar Absorption Lines	
1:55 pm	R. Attwood, The March 18 Total Solar Eclipse	
2:05 pm	I. Halliday A Study of 44 Meteorite-Dropping Fireballs in Western Canada	
2:15 pm	HISTORY OF ASTRONOMY A. H. Batten, Glimpses of the First 70 Years of the Dominion Astrophysical Observatory (session to be held in the David Lam Auditorium, MacLaurin Building)	
2:15 pm	HISTORY OF ASTRONOMY A. H. Batten, Glimpses of the First 70 Years of the Dominion Astrophysical Observatory (session to be held in the David Lam Auditorium, MacLaurin Building)	
3:15 pm	Coffee and Posters	3:15 pm Coffee and Posters

THURSDAY JUNE 30

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

3:45 pm D.E. Osterbrock,
Lick Observatory: The First Century
(David Lam Auditorium)

4:45 pm ASP Business Meeting,
Recital Hall

5:00 pm Dinner, Commons Building

7:30 pm 1988 HELEN SAWYER HOGG
LECTURE:

H. Reeves,
The Early Moments of the Universe
(University Centre Auditorium)

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

3:45 pm D.E. Osterbrock,
Lick Observatory: The First Century

5:00 pm Dinner, Commons Building

7:30 pm 1988 HELEN SAWYER HOGG
LECTURE:

H. Reeves,
The Early Moments of the Universe
(University Centre Auditorium)

EXHIBITS AND SPECIAL EVENTS

5:00 pm Dinner, Commons Building

7:30 pm 1988 Helen Sawyer Hogg Lecture,
H. Reeves,
The Early Moments of the Universe
(University Centre Auditorium)

9:00 pm Murphy Slide Show and
Reception,
MacLaurin Lobby

FRIDAY JULY 1

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

- 7:15 am Breakfast, Commons Building
 8:00 am Registration opens, MacLaurin Lobby

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

- 7:15 am Breakfast, Commons Building
 8:00 am Registration, MacLaurin Lobby

EXHIBITS AND SPECIAL EVENTS

- 7:15 am Breakfast, Commons Building
 8:00 am Exhibits, MacLaurin Building

9:00 am Paper Sessions:

The Virgo Cluster

S. van den Bergh,
 Novae, Supernovae and the Distance
 Scale

9:30 am J.P. Huchra,
 Infall into the Virgo Cluster

9:20 am J.H. Wujek
 An Amateur Astronomer's Look at the
 V.L.A. (Very Large Array)

9:50 am D. Pyper,
 Time Sharing On An Automatic
 Telescope

10:00 am Coffee and Posters

10:30 am G.A. Tammann,
 The Distance of the Virgo Cluster- a
 Review

10:00 am Coffee and Posters

10:30 am Contributed History Papers:

T.A. Hockey
 Planetary Photospheres: The Story of
 a "Misdiscovery"

10:00 am Coffee and Posters

FRIDAY JULY 1

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

EXHIBITS AND SPECIAL EVENTS

10:45 am W.J. S. Unruh,
Through The Looking Glass

11:00 am G. Reaves,
To Determine The Moon's Libration
from a Photograph or Drawing

11:15 am J. S. Tenn,
William H. Wright: The Man Who
Declined the Bruce Medal

11:30 am F.K. Edmondson,
Contributions of the Ford Foundation
to Astronomy in the Southern
Hemisphere

12:00 Lunch, Commons Building

12:00 Lunch, Commons Building

12:00 Lunch, Commons Building

1:30 pm Invited Lecture:

D. Levy,
Some Thoughts About Searching For
Comets

Deviations from a Smooth Hubble Flow

2:00 pm D. Lynden-Bell,
Large-scale Motions of, and the Best
Distances to, Galaxies

2:20 pm Contributed Papers:

T.J. Hewitt,
The Mars Hoax: Can We Turn the
Tide of Planetary Pseudoscience in
1988?

FRIDAY JULY 1

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

2:30 pm S.G Djorgovski,
The Universality of Distance Scale
Indicator Relations: What Do They
Say About Galaxy Formation (and
Vice Versa)?

3:00 pm Coffee and Posters

3:30 pm J. E. Gunn,
Review of the Theory and
Observations of Deviations from a
Smooth Hubble Flow

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

2:30 pm R.S. Iyengar,
A Quantative Analysis of the Energy
Processes in Auroral Turbulence

2:40 pm L. Doyle,
Photometric Constraints on the Age
of Saturn's Rings

2:50 pm F. Pinto,
Globular Clusters: A Laboratory in
Space and Time

3:00 pm Coffee and Posters

3:30 pm Invited Paper:
W.J. Kaufmann,
From the Moon's Creation to the
Structure of Quasars: Supercomputing
in Astronomy

EXHIBITS AND SPECIAL EVENTS

5:00 pm Exhibits Close

6:00 pm No-Host Bar Reception
Dining Room, Commons Building

7:00 pm Awards Banquet and Giant Prize
Draw,
Dining Room, Commons Building

SATURDAY JULY 2

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

EXHIBITS AND SPECIAL EVENTS

7:15 am Breakfast, Commons Building

7:15 am Breakfast, Commons Building

8:00 am Registration, MacLaurin Building

8:30 am Invited Paper:

8:30 am Exhibits, MacLaurin Building

S. Edberg,
Research Opportunities for Amateur
Astronomers
(1988 G. Bruce Blair Award Lecture)

9:10 am Contributed Papers:

F. J. Howell,
Observing the Moons of Mars with a
Small Telescope

9:20 am R. L. Bishop,
Black Holes or Crescent Moons?

9:30 am J. H. Lutz,
CCD Images of Southern Hemisphere
Planetary Nebulae with Binary Nuclei

9:40 am H. Roser
Optical Synchrotron Radiation from
Radio Hotspots

9:50 am J.M. Nemec
Period-Luminosity Relationship for
Anomalous Cepheids

10:00 am Coffee and Posters

10:00 am Coffee and Posters

SATURDAY JULY 2

EXTRAGALACTIC DISTANCE SCALE SYMPOSIUM

Recital Hall, MacLaurin Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

EXHIBITS AND SPECIAL EVENTS

10:20 am Invited Paper:

J.E. Gunn,
Large-Scale Structure of the Universe

11:20 am

W. Morley
Astronomy Education In Lunenburg
County Schools and Throughout the
Rest of Nova Scotia

11:30 am

L. Kellerman,
How Teachers Perceive the Teaching
of Astronomy and Space Science in
the 7th and 8th Grades: Results of a
Study Taken in March, 1988

11:40 am

D. W. Hladiuk,
Public Education Programs in
Astronomy

11:50 am

Lunch, Commons Building

11:50 am Lunch, Commons Building

1:00 pm

Invited Lecture:

J. Kormendy,
Central Monsters in Galaxies
(1988 Muhlmann Prize Lecture)

2:00 pm

RASC Annual Meeting,
David Lam Auditorium, MacLaurin
Building
(RASC National Council Meeting to
immediately follow)

2:00 pm

RASC Annual Meeting,
David Lam Auditorium, MacLaurin
Building
(followed by National Council
Meeting)

SATURDAY JULY 2

**EXTRAGALACTIC DISTANCE SCALE
SYMPOSIUM**

Recital Hall, MacLaurin Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

EXHIBITS AND SPECIAL EVENTS

3:00 pm Coffee and Posters

4:00 pm Exhibits Close

5:00 pm Sooke Barbecue
Bus leaves from Lot #5

SUNDAY JULY 3

**EXTRAGALACTIC DISTANCE SCALE
SYMPOSIUM**

Recital Hall, MacLaurin Building

RASC/ASP/WAA JOINT MEETING

David Lam Auditorium, MacLaurin Building

EXHIBITS AND SPECIAL EVENTS

- 7:15 am Breakfast, Commons Building
NOTE: participants taking Gulf
Island Tour should pick up bag lunch
at breakfast
- 8:30 am Gulf Island Tour
Bus leaves from Lot#5
- 12:00 Lunch, Commons Building
- 12:30 pm Butchart Gardens Tour
Bus leaves from Lot #5

PROGRAM ABSTRACTS RECEIVED BY 25 MAY, 1988

Listed alphabetically by author in sections:

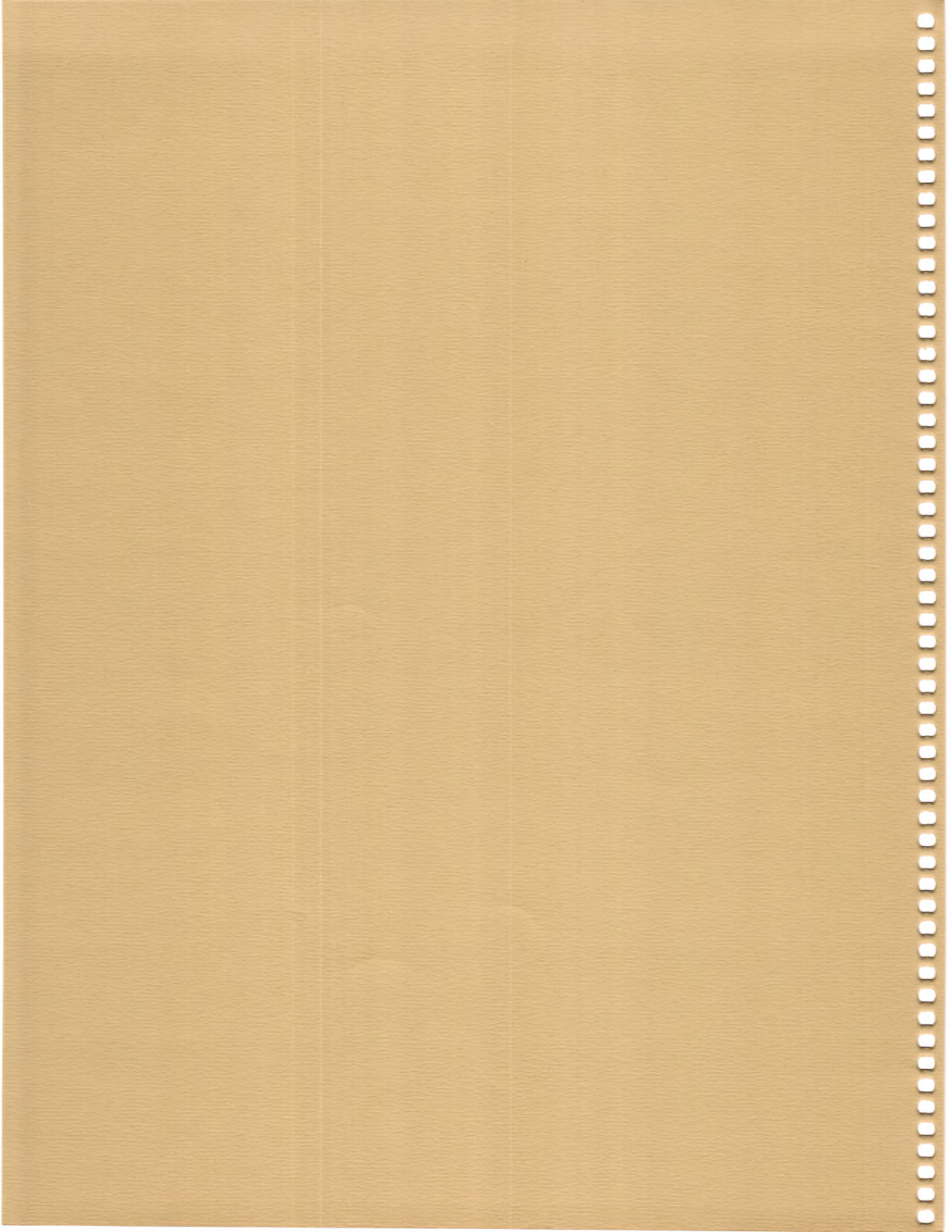
Section 1 Extragalactic Distance Scale Symposium

Section 2 RASC/ASP/WAA Joint Meeting

Section 3 History Papers

Section 4 Poster Sessions

Section 1
Extragalactic Distance Scale Symposium



HIGH RESOLUTION SPECTROSCOPY OF QUASAR ABSORPTION LINES

Jill Bechtold (MWLCO)

High resolution spectroscopy of quasar absorption lines can reveal unique information about the physical conditions, kinematics, and large-scale spatial distribution of the absorbing clouds. A study of metal-line absorption systems in quasar spectra with $z(\text{abs}) \ll z(\text{em})$ was carried out with the echelle spectrograph at the Multiple Mirror Telescope. A comparison was made between these systems, which almost certainly originate in the halos of intervening galaxies at $z \approx 2$, and the gaseous halo of the Milky Way, also studied in absorption. More recent results, obtained with the echelle spectrograph at the Du Pont Telescope at Las Campanas, will also be discussed.

SUPERNOVAE AS DISTANCE INDICATORS.

D. Branch (U. of Oklahoma)

Three ways to use supernovae to estimate the value of the Hubble constant will be discussed: (1) Type I supernovae as standard candles; (2) the Baade (expansion parallax) method for Type II; and (3) the nickel radioactivity method for Type I. Type I supernovae as standard candles must be used with caution (if at all) in view of the distinction between Type Ia (the classical kind) and Type Ib (a less luminous subtype), and recent demonstrations that even the members of Type Ia are not all alike. The results of an application of the Baade method to SN 1987A, which provides the first opportunity to check the method on a supernova of known distance, will be presented. If the standard model of a completely disrupting carbon-oxygen white dwarf is correct for at least some Type Ia supernovae, the nickel radioactivity method provides a rigorous lower limit to the Hubble constant of about 40 km/sec/Mpc, and an upper limit of about 70 km/sec/Mpc.

NOVA EXPANSION PARALLAXES

J. COHEN

G. de Vaucouleurs

THE EXTRAGALACTIC DISTANCE SCALE - FROM 1918 to 1978

The main reasons for the successive revisions of the scale will be analysed.

THE UNIVERSALITY OF DISTANCE INDICATOR RELATIONS: WHAT DO THEY SAY ABOUT GALAXY FORMATION (AND VICE VERSA)?

S. G. Djorgovski (Caltech)

The two most successful distance indicator relations, Tully-Fisher for spirals, and $R - \sigma - \mu$ for ellipticals and bulges, are based on essentially the same physics, viz., that galaxies are bound by the Newtonian gravity, and that their dynamical structures are similar. The latter condition is highly nontrivial: it connects the kinematical and density structures, and the effective M/L ratios in such a way that they can be expressed as simple power laws of variables from the distance indicator relations. The smallness and the size of the scatter in these relations contains important constraints on the processes of galaxy formation. Conversely, the generic expectation from our present understanding of galaxy formation and evolution is that some of the relevant variables (e.g., the degree of dissipation, the structure of the halos, the M/L ratios) may depend on the large-scale environment. Any *systematic* variations of the dynamical structures and/or the M/L ratios within a given Hubble type from cluster to cluster would masquerade as peculiar velocities, and the variation at the level of $\sim 5\% - 10\%$ can explain all the large peculiar motions claimed in the literature. This is difficult to check, but some attempts can be made. Until the universality of the distance indicators is demonstrated at such fine level, it may be premature to interpret the data in terms of large streaming or infall motions.

THE MAGELLANIC CLOUDS AND THE EXTRAGALACTIC DISTANCE SCALE

M.W. Feast (SAAO)

The relevance of the Magellanic Clouds to the general problem of the extragalactic distance scale will be examined with special reference to Cepheid, RR Lyrae and Mira variables. The significance for the distance scale problem of SN 1987A in the LMC will be briefly discussed.

NOVAE AS DISTANCE INDICATORS

H. Ford (Univ. of Michigan) and R. Ciardullo (KPNO)

We discuss possible problems associated with distances derived from calibrations of novae in the galaxy and in M31. The absolute magnitudes of galactic novae may suffer from insidious systematic errors which arise when distances are derived from expansion parallaxes. Possible sources of errors in distances based on M31 novae are: i) extinction from dust in the bulge, ii), differences in populations between the bulges of spirals and the halos of ellipticals, and iii) selection for anomalously bright novae in distant galaxies.

Although a nova's light curve may be the best indicator of its distance, at distances as great as Virgo the logistical problems of making the requisite number of high quality observations are formidable. Consequently, we explore other methods of using novae to measure distances. In particular, the time-averaged luminosity function (NLF) which is created by an ensemble of novae observed at random phases may be a useful tool for obtaining distances. We discuss and illustrate the method by presenting a broadband (B) NLF derived from published data and an $H\alpha$ NLF derived from recently obtained light curves.

CEPHEID DISTANCES TO NEARBY GALAXIES

W. L. Freedman (MWLCO)

A long-term program to measure cepheid distances to nearby galaxies has been undertaken using CCD detectors. Data have been obtained at B, V, R, and I wavelengths enabling direct estimates of the total (internal and foreground) reddening to be made. The availability of CCD detectors has allowed an increase in the accuracy with which photometry can be obtained in the crowded extragalactic fields in which the cepheids are located. Point-spread-function photometry using DAOPHOT has been obtained for data acquired at the CFHT, Palomar 5m, and KPNO and CTIO 4m's. Galaxies in the program include the Local Group Galaxies IC 1613, NGC 6822, WLM, M33, and M31, as well as the more distant galaxies sextans A and B, NGC 2403, and M81.

REVIEW OF THE THEORY AND OBSERVATIONS OF DEVIATIONS FROM A SMOOTH HUBBLE FLOW

James E. Gunn (Princeton Univ.)

The deviations from a smooth Hubble flow are caused, in most models, by gravitational accelerations arising from deviations from a smooth density field. In some models the peculiar motions arise from energetic events at relatively early epochs. The physics of these two situations is reviewed, along with the constraints the observed deviations place on the models. It would appear at present that none of the fashionable models work very well if the observations are taken at simplest face value, but it is not clear that the correct comparisons have been made with theory.

GLOBULAR CLUSTER SYSTEMS AS DISTANCE INDICATORS

W.E.Harris (McMaster University)

The familiar globular clusters found in the Local Group galaxies have a distribution in number versus magnitude that is roughly gaussian, with a well defined peak frequency ('turnover') at $M_B = -7.0$, $M_V = -7.6$. Coupled with deep CCD photometry of the globular cluster populations around more distant galaxies, this luminosity function shape and turnover magnitude is now developing into an effective distance indicator. Since this technique is especially useful for large elliptical galaxies, in which globular clusters are found in the largest numbers, it is complementary to all the Population I-based techniques for later-type galaxies.

A major step forward in the cluster LF technique has now been achieved with deep photometry of the clusters around the giant ellipticals in the Virgo System. New CCD data for 4 galaxies, obtained at the CFHT and reaching $B(\text{lim}) \gtrsim 26$, will be presented: these new observations reach clearly past the 'turnover' magnitude, and demonstrate that the cluster LF has a consistent shape and zero point to within ± 0.2 mag from one galaxy to another. The resulting distance modulus to Virgo, derived in a single step from the Milky Way, now favors a 'low' value of H_0 near 60 km/s/Mpc. With the Virgo data as secondary calibrators and with limiting ground based photometry, globular cluster systems could be employed as standard candles in giant E galaxies out to $d \sim 50$ Mpc.

INFALL INTO THE VIRGO CLUSTER

J. P. Huchra (CfA)

The history of the study of our motion with respect to the Local Supercluster is reviewed from the original suggestions of de Vaucouleurs and Peebles through today. Direct measurements of the infall pattern using velocity independent galaxy distances suggest an infall component at the Local Group of ~ 250 km/s. This is consistent with the velocity expected if the average mass-to-light ratio of galaxies is similar to that dynamically measured in binaries, groups and clusters, a value that gives an Ω of only 0.15. The infall pattern is also consistent with galaxy density maps produced by IRAS surveys, although it may be only marginally consistent with the "Great Attractor." On smaller scales, there is strong evidence that most of the spiral galaxies near the cluster core are still falling in — that the spiral galaxies in the core of the cluster do not form a dynamically relaxed system. Using the best distance estimates to the Virgo cluster, the local value of the Hubble constant is $\sim 80 \pm 20$ km/s.

THE BRIGHTEST STARS IN GALAXIES

R.M. HUMPHREYS (U. MINN. AND LANDESSTERNWARTE HEIDELBERG)

THE LUMINOSITY CALIBRATION OF THE BRIGHTEST STARS IN LOCAL GROUP GALAXIES AND OTHER NEARBY SPIRALS IS REVIEWED. THE LUMINOSITIES OF THE BRIGHTEST EARTH-TYPE SUPERGIANTS HAVE A WELL-KNOWN DEPENDENCE ON THE LUMINOSITY OF THE GALAXY. IN ADDITION, MANY OF THE BRIGHTEST BLUE "STARS" ARE ACTUALLY COMPACT HII REGIONS, CLUSTERS, AND COMPOSITE IMAGES. THIS IS A SERIOUS PROBLEM IN INCREASINGLY DISTANT GALAXIES. THEREFORE, THEY ARE NOT RECOMMENDED AS DISTANCE INDICATORS. THE BRIGHTEST RED STARS, THE M SUPERGIANTS, HAVE AN UPPER BOUND TO THEIR BOLOMETRIC LUMINOSITIES DUE TO A LIMIT TO THE STABILITY OF THE MOST MASSIVE EVOLVED STARS. THIS TRANSLATES INTO $M_V \approx -8$ MAG OVER SEVERAL MAGNITUDES OF GALACTIC LUMINOSITY, MAKING THE RED SUPERGIANTS POTENTIALLY POWERFUL DISTANCE INDICATORS.

PLANETARY NEBULAE AS DISTANCE INDICATORS

G. H. Jacoby (NOAO-KPNO), H. C. Ford (U. of Michigan), and R. Ciardullo (NOAO-KPNO)

The [O III] $\lambda 5007$ fluxes of the brightest planetary nebulae (PN) in the Local Group galaxies are constant to within 20%, suggesting that an upper limit exists for PN luminosities. While this limit may be valuable as a standard candle, we show that the luminosity function for PN is universal and has a sharp bright-end cutoff near $M_V = -4.5$ which provides an even better estimator of distance. The cutoff is a direct result of the small range in masses ($0.61 \pm 0.02 M_\odot$) of PN central stars combined with the extremely rapid evolutionary timescales for the more massive stars.

Using the technique of maximum likelihood, the luminosity functions for PN in M81 (Sb), NGC 5128 (E0p), the NGC 3379 group, including NGC 3368 (Sab), NGC 3384 (SB0), and NGC 3377 (E6), are used to derive distances to these and various other galaxies as distant as Virgo. Distances to galaxies in a single group (NGC 3379) having an assortment of Hubble types, and different fields within a single galaxy (NGC 5128) agree to better than 5%, consistent with the formal errors derived using Kolmogorov-Smirnov statistical tests. We propose that PN are excellent distance indicators for galaxies of all Hubble types. Additional advantages include observations are required at only one epoch, they can be observed to distances beyond 15 Mpc with currently available ground based telescopes, and the analysis is straightforward in uncrowded fields as a result of continuum suppression by narrow band filters.

D. LYNDEN-BELL

LARGE-SCALE MOTIONS OF, AND THE BEST DISTANCES
TO, GALAXIES

GIANT HII REGIONS AS DISTANCE INDICATORS

JORGE MELNICK (EUROPEAN SOUTHERN OBSERVATORY)

AN HISTORICAL OVERVIEW OF THE SUBJECT IS PRESENTED WITH EMPHASIS ON METHODS BASED ON EMPIRICAL CORRELATIONS BETWEEN INTRINSIC HII REGION PARAMETERS AND BETWEEN THOSE PARAMETERS AND THE LUMINOSITIES OF THE PARENT GALAXIES.

IT IS SHOWN THAT THE CORRELATIONS BETWEEN THE VELOCITY DISPERSION OF THE NEBULAR GAS AND THE LUMINOSITY OF EITHER THE GIANT HII REGIONS OR THE PARENT GALAXIES HAVE SMALL ENOUGH SCATTERS TO BE USEFUL AS DISTANCE INDICATORS.

THE RESULTS FOR GIANT HII REGIONS ARE APPLIED TO HII GALAXIES - GAS RICH DWARF GALAXIES WITH ONE OR MORE DOMINANT GIANT HII REGION COMPONENTS - TO DERIVE THE VALUE OF HUBBLE'S CONSTANT OUT TO DISTANCES WHERE THE EFFECT OF THE LARGE-SCALE STREAMING MOTIONS ON THE LOCAL UNIVERSE CAN BE NEGLECTED.

THE EFFECT OF MALMQUIST BIAS AND OTHER SYSTEMATIC BIASES ON THE FINAL VALUE OF $H_0 \approx 89 \pm 10 \text{ km s}^{-1} \text{ Mpc}^{-1}$ FOR HUBBLE'S CONSTANT ARE DESCRIBED IN DETAIL.

ASTROMETRY AND THE DISTANCE SCALE

David G. Monet (US Naval Observatory Flagstaff Station)

Two groups (Gatewood *et al.* 1988 and Monet *et al.* 1988) have demonstrated astrometric accuracies of one milliarcsecond or better, and modern photographic programs (e.g. Dahn *et al.* 1988) are not far behind. Because of the proliferation of charge coupled devices (CCDs), this realm of astrometric accuracy is no longer limited to astrometrists. Unfortunately, problems such as limiting magnitude, field of view, dynamic range, and lack of suitable reference objects preclude doing many astrophysically interesting astrometric programs. This paper will review the limitations of advanced astrometric techniques in the context of using astrometry to improve our knowledge of the distance scale. Other astrometric problems, such as the difficulty of measuring optical and radio objects in the same coordinate system, will also be discussed.

REVIEW OF THE LOCAL GROUP DISTANCE SCALE

J.R. MOULD (CALTECH)

THE DISTANCE SCALE IN THE LOCAL GROUP HAS SPECIAL SIGNIFICANCE, BECAUSE THESE GALAXIES CAN PROVIDE CONSISTENCY CHECKS ON DIFFERENT DISTANCE INDICATORS AND CALIBRATION FOR THOSE INDICATORS THAT CANNOT BE CALIBRATED ADEQUATELY WITHIN THE MILKY WAY.

DISTANCES TO THE MAGELLANIC CLOUDS, OTHER DWARF IRREGULARS, DWARF ELLIPTICALS, AND THE TWO OTHER MAJOR SPIRALS IN THE LOCAL GROUP ARE REVIEWED WITH EMPHASIS ON VARIABLE STAR PERIOD-LUMINOSITY RELATIONS AND MAIN SEQUENCE FITTING IN STAR CLUSTERS.

IN GALAXIES WHICH HAVE HAD DIFFERENT CHEMICAL ENRICHMENT HISTORIES, AN ASTROPHYSICAL EXTRAGALACTIC DISTANCE SCALE CANNOT BE A PURELY EMPIRICAL CONSTRUCTION. THE THEORY OF STELLAR STRUCTURE MUST BE CALLED ON TO PROVIDE CORRECTIONS TO DISTANCE INDICATORS IN SITUATIONS WHERE THE CHEMICAL COMPOSITION IS KNOWN. WHERE THE CHEMICAL COMPOSITION IS POORLY KNOWN, THEORY CAN PLACE LIMITS ON THE UNCERTAINTIES IN DISTANCES OBTAINED WITH THESE INDICATORS.

RR LYRAE STARS IN NEARBY GALAXIES

C.J. Pritchett (U. Victoria)

RR Lyrae stars are well-calibrated distance indicators that can, with modern instrumentation on ground-based telescopes, be observed out to distances of order 1 Mpc. RR Lyrae stars have been observed in a number of Local Group galaxies (including the Magellanic Clouds, M31, and NGC 147), and play an important role as primary distance indicators. Recently candidate RR Lyrae stars have been observed in M33; the mean magnitudes of these variables should help to pin down the distance to this galaxy with greater certainty than has previously been possible. The Hubble Space Telescope offers opportunities both to improve the calibration of $M_v(RR)$, and to extend observations of RR Lyrae stars to galaxies beyond the Local Group.

THE EARLY MOMENTS OF THE UNIVERSE

Hubert Reeves

The exploration of the very ancient parts of the universe is a joint venture of astronomy and high energy physics. Both the telescope and the particle accelerator are being used to reach backwards in time and to reconstitute the sequence of events which were of major importance in shaping up our world. The main results acknowledging both the successes and the difficulties of the cosmological theories of today will be presented.

THE DISTANCE OF THE VIRGO CLUSTER - A REVIEW

G.A. Tammann, Astronomisches Institut der Universität Basel; ESO, Garching

Recent distance determinations of the Virgo cluster yield converging results: from globular clusters (van den Bergh et al. 1985, Cohen 1988) $(m-M) = 31.50 \pm 0.30$, from novae (Pritchett and van den Bergh 1986) 31.57 ± 0.43 , from supernovae (Tammann 1987) 31.94 ± 0.44 , and from the D_n/σ relation (Dressler 1987) 31.64 ± 0.20 . Previous discrepancies of the blue and/or infrared Tully-Fisher relation are due to selection effects; a nearly complete sample of 81 inclined spirals (Sab - Sm) is free of such selection ambiguities and requires 31.60 ± 0.15 (Kraan-Korteweg et al. 1988). The formal mean of 31.62 ± 0.11 ($r = 21$ Mpc) is quite insensitive to the particular choice of the local calibrators. - Relative distance indicators beyond Virgo have consistently led adherents of the long and short distance scales - independent of the true cluster recession velocity and our Virgocentric infall velocity - to the conclusion that H_0 (global) $\times r(\text{Virgo}) \approx 1200 \pm 150 \text{ km s}^{-1}$ and hence H_0 (global) ≈ 57 from all available evidence.

EFFECT OF THE LOCAL VELOCITY ANOMALY ON H_0

R.B. Tully (U. Hawaii)

The luminosity-line width relation has been reformulated using CCD photometric data in B, R, and I passbands. At the near infrared bands, the dispersion in a sample drawn from the Ursa Major Cluster is only 0.25 mag. The relationship is shallower than previously suspected in the infrared: $L \propto W^{3.2}$. Distances of 15.5 and 15.6 Mpc are determined for the Ursa Major and Virgo clusters. The clusters provide a calibration of the L-W relation that can be used to estimate the distances of field galaxies free of Malmquist bias. When galaxies with distances are grouped by cloud membership, systems within the local Coma-Sculptor Cloud and the companion Leo Spur are found to have low velocities for their distance: the 'local velocity anomaly'. This anomaly could be caused by $10^{14} M_\odot$ associated with the local clouds, whence $M/L \sim 300 M_\odot/L_\odot$ on a scale of 10 Mpc. When this anomaly is accounted for, the Hubble Constant is found to be in the range 85-95 km/s/Mpc.

CONSTRAINTS ON H_0 FROM GLOBULAR CLUSTERS

Don A. Vandenberg (U. of Victoria)

On the basis of canonical stellar evolutionary calculations, globular cluster ages are derived from a variety of methods - including the main-sequence fitting technique, the calibration of the magnitude difference between the horizontal branch and the turnoff, and the intercomparison of predicted and observed luminosity functions. Depending on how the helium abundance and $[O/Fe]$ vary with $[Fe/H]$ in the cluster stars, current models suggest that either the globulars have very similar ages, in the vicinity of 13-14 Gyr, or the metal-poor systems are as much as 3-4 Gyr older than the metal-rich clusters for an age of ~ 18 Gyr. In the former instance (assuming that the clusters formed at a redshift $z \sim 5$), H_0 is constrained to the range $45 \lesssim H_0 \lesssim 65$ km/sec/Mpc if the standard Big-Bang cosmological theory ($\Lambda = 0$) is correct and $1 \gtrsim \Omega_0 \gtrsim 0$, respectively. On the other hand, if the oldest globular cluster has an age close to 18 Gyr, then H_0 must be smaller than 50 km/sec/Mpc, independent of the value of Ω_0 .

NOVAE, SUPERNOVAE AND THE DISTANCE SCALE.

S. van den Bergh (Dom. Astrophys. Obs.)

Novae are brighter than Cepheids. Furthermore they occur in photometrically smooth regions such as elliptical galaxies and the nuclear bulges of spirals (in which dust absorption is negligible) and they appear to obey a maximum magnitude versus rate of decline (MMRD) relation with a relatively small dispersion. These properties make novae powerful tools for the calibration of the extra-galactic distance scale. The suitability of supernovae as standard candles for measuring even greater distances will also be discussed.

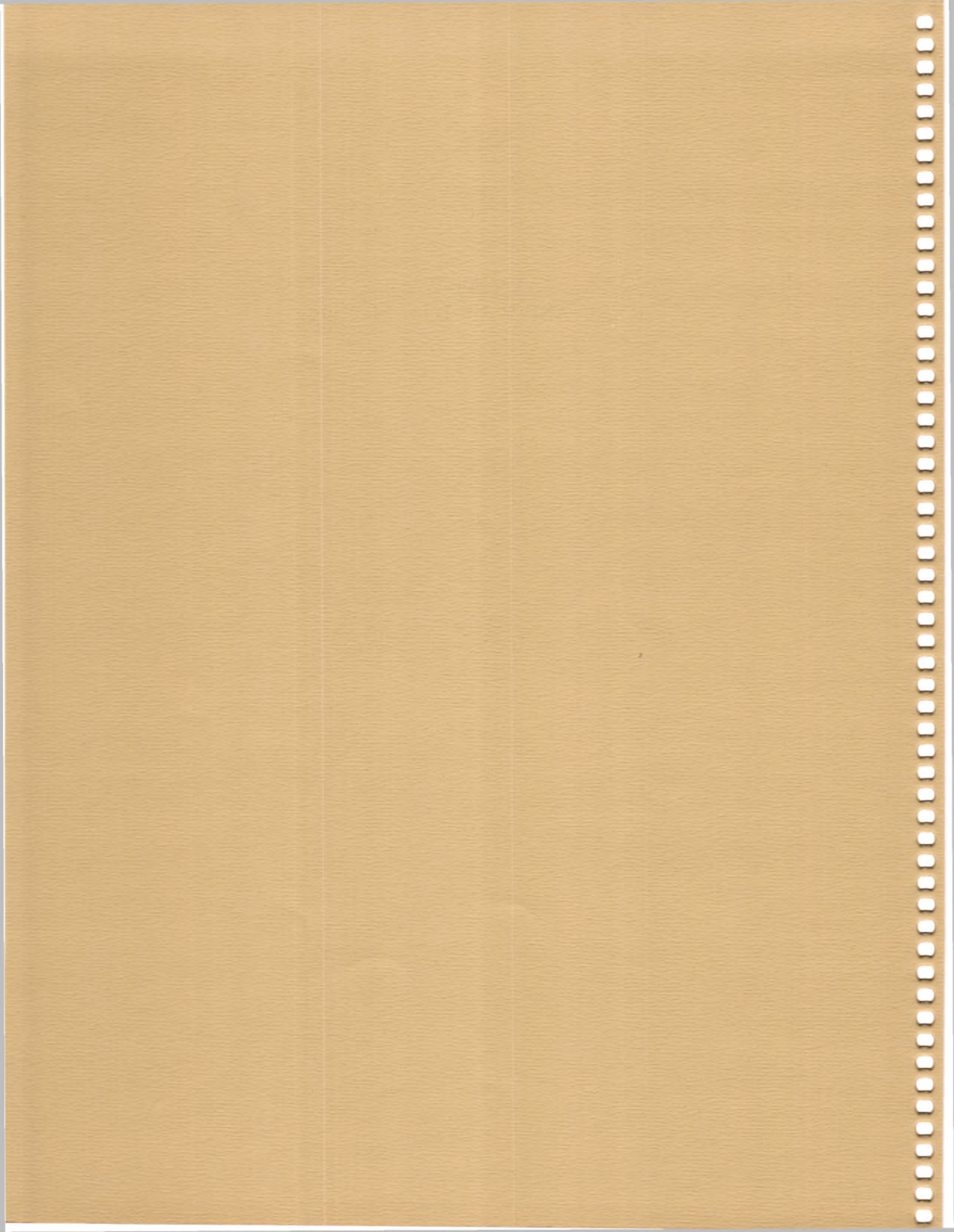
CALIBRATION OF THE CEPHEID PERIOD-LUMINOSITY RELATION

ALISTAIR R. WALKER (CTIO - NOAO)

For seventy-five years the absolute calibration of the Cepheid Period-Luminosity relation has been of vital importance, since Cepheids are the primary distance indicator for nearby galaxies, whose distances are in turn crucially important for fixing the distance scale out to cosmologically interesting distances.

The PL relation, with slope fixed from Cepheids in the Magellanic Clouds and zeropoint primarily from Cepheids in galactic clusters, now appears to be able to predict the absolute magnitudes of Cepheids with an error of only $\pm 0.10 - 0.15$ mag. A sizeable part of this error is due to the uncertainty in the distance to the Pleiades.

Section 2
RASC/ASP/WAA Joint Meeting



CHASING ECLIPSES: WEATHER PROSPECTS FOR 1990, 1991 AND BEYOND.

Jay Anderson (ASP)

Eight more total solar eclipses will occur before the end of the century. Using recently published data collected from satellite imagery over the past decade, it is possible to construct coarse resolution maps of the monthly climatological cloud cover for the areas along the eclipse track. Cloud cover statistics for the 1990 eclipse over Finland and Russia, and for the 1991 eclipse over Hawaii, Central America and South America are presented in more detail. Strategies are suggested to maximize the probability of viewing these events.

THE MARCH 18 TOTAL SOLAR ECLIPSE

RANDY ATTWOOD, TORONTO CENTRE, R.A.S.C.

LAST MARCH, 23 MEMBERS OF THE TORONTO CENTRE TRAVELLED TO THE PHILIPPINES TO VIEW A TOTAL SOLAR ECLIPSE.

THIS PAPER WILL REVIEW THE PREPARATIONS, EVENTS AND RESULTS FROM THIS SUCCESSFUL EXPEDITION TO OBSERVE ONE OF ASTRONOMY'S RAREST AND MOST BEAUTIFUL EVENTS.

BLACK HOLES OR CRESCENT MOONS?

Roy L. Bishop (Acadia U.)

The astronomy that appears in popular literature tends to dwell on the exotic, the far away, and the long ago. Through many years of dealing with the public and of teaching introductory physics and astronomy, I have come to realize that most people have little appreciation of the astronomy that they can observe, such as the geometry associated with lunar phases and our Moon's orbital motion. Topics of this sort are important in their own right, and an understanding of them is a prerequisite to an appreciation of the more exotic. Examples of conceptual difficulties will be presented, and a plea made for a greater awareness of our corner of the universe.

PHOTOMETRY FOR THE BEGINNER

C.F. BROWN, WINNIPEG CENTRE, R.A.S.C.

UNTIL RECENTLY, THE COLLECTION AND REDUCTION OF PHOTOMETRIC DATA WAS SO TIME-CONSUMING AND SENSITIVE TO ERROR THAT ONLY PROFESSIONALS AND THE MOST DEDICATED AMATEURS ATTEMPTED IT. TODAY, COMMERCIALY PRODUCED ELECTRONIC PHOTOMETERS LINK DIRECTLY TO PERSONAL COMPUTERS TO MAKE SHORT WORK OF THE TEDIOUS PARTS OF PHOTOMETRY AND OPEN UP A WORLD OF DISCOVERY AND SCIENTIFIC CONTRIBUTION TO THE AMATEUR.

THIS TALK FOCUSES ON THE VALUE OF PHOTOMETRY TO THE AMATEUR AND THE HARDWARE, SOFTWARE AND SUPPORT AVAILABLE. IT WILL ALSO PRESENT DATA COLLECTED BY AMATEURS FROM THE RS CYN VARIABLE STAR SIGMA GEMINORUM AND COMPARE IT TO THE TEN-YEAR STUDY BY FRIED ET AL.

FILMING ASTRONOMERS IN ACTION: CANADA'S STARGAZERS - FROM LOUISBOURG TO SUPERNOVA

S. Dodson and D. Lickley (Science North)

Having obtained a Canada studies grant to produce a series of general-interest motion pictures on the history of science in Canada, Science North film-maker David Lickley travelled across Canada from Louisbourg to Victoria, and to Chile to meet Canadian astronomers in action and create a living history of Astronomy as a human activity. The resulting film weaves together archival footage, historic re-enactments, a modern day night of observing at Las Campanas, and the Supernova discovery by Ian Shelton, to present a rich and colourful portrait of Canadian astronomy.

Using slides, Steve Dodson goes behind the scenes to give a glimpse of the earthly odyssey of the film-makers as they travelled to key sites in Canada's astronomical past and present.

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The movie is 27 minutes long and will convey to audiences everywhere a sense of why astronomers travel to remote sites and mountain tops to observe and study the universe.

Photometric Constraints On the Age of Saturn's Rings

L.R. Doyle (S.E.T.I./Ames), L. Dones (NAS-NRC/Ames), and J.N. Cuzzi (N.A.S.A./Ames)

Voyager imaging data of the outer B ring of Saturn, taken at different phase angles, have been analyzed using radiative transfer models, including both the solar and the Saturnshine components of the reflected light. We have determined, among other parameters of interest, that the spherical albedo of the primarily macroscopic particles in the outer B ring is $0.53 \pm .03$. Both the extremely backscattering phase function and near infrared spectra indicate that there is a significant regolith on these large particles themselves, with the spectra indicating an effective regolithic particle radius of about $20\mu m$. Modeling this regolith as a multiple scattering "atmosphere" of individual grains with varying fraction of non-icy material, we find that an albedo of 0.53 indicates $\leq 10\%$ dark meteoritic material in the rings, a result consistent with other estimates of the ice purity from longer wavelength (i.e. microwave) observations of ring particle albedo. The flux and composition of meteoritic debris at Saturn are somewhat uncertain, but may be estimated. If the meteoritic flux at Saturn is comparable to that at Earth and constant in time, and even if, as calculations indicate, only 10% of the dark meteoritic material impacting onto the rings survives, the outer B ring of Saturn should nevertheless have darkened to its present albedo in about 2×10^8 years. This result joins prior independent dynamical constraints in indicating that the rings may possibly be younger than the age of the solar system.

THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE

F. DRAKE

RESEARCH OPPORTUNITIES FOR AMATEUR ASTRONOMERS

S. EDBERG

TELESCOPES VERSUS HOROSCOPES: A SKEPTIC'S GUIDE TO ANSWERING QUESTIONS ABOUT ASTROLOGY

A.G. Fraknoi (Astronomical Society of the Pacific)

Recent revelations about Nancy Reagan's interest in astrology have focused on renewed public interest in this ancient superstition. Whether they like it or not, astronomers (and amateur astronomers) are frequently asked about astrology. This talk will provide ammunition you can use to respond to astrological claims and to encourage a skeptical view of the influence of celestial objects on terrestrial events. Topics covered will include: some embarrassing questions about astrology, a comparison of the influences on a new born baby, a review of statistical tests of astrology, and a suggestion for a new discipline of "jet-ology," in which the positions of all the jumbo jets at the moment of a child's birth influence its personality and future.

LARGE SCALE STRUCTURE OF THE UNIVERSE

J.E. GUNN

A STUDY OF 44 METEORITE-DROPPING FIREBALLS IN WESTERN CANADA

Ian Halliday, Alan T. Blackwell and Arthur A. Griffin (H.I.A., N.R.C., Ottawa)

The Canadian meteorite camera network was in operation in western Canada from 1971 to 1985. Although only the Innisfree meteorite was recovered, it can be stated with confidence that many other events are associated with typical meteorite falls. We discuss 28 fireballs for which the main surviving fragment is expected to be at least 0.5 kg and an additional 16 events larger than 0.1 kg chosen for their accessible locations. Details on all 44 events are available. Searches and educational campaigns among local residents would be an attractive project for RASC Centres or other astronomical groups in the area. The data on these 44 fireballs are used to construct a picture of a typical meteorite fall, one that differs in certain respects for traditional beliefs.

THE MARS HOAX: CAN WE TURN THE TIDE OF PLANETARY PSEUDOSCIENCE IN 1988?

T.J. HEWITT (LHS)

TEACHING THE PUBLIC ABOUT MARS DURING THE 1988 OPPOSITION WILL BE DIFFICULT. IN CLASSROOMS AND IN PUBLIC OBSERVING PROGRAMS, WE WILL BE SUBJECTED TO A BARRAGE OF QUESTIONS ABOUT ONE SINGLE PSEUDOSCIENCE TOPIC, THE SO-CALLED "FACE" ON MARS, AN ERODED MESA IN THE ACIDALIA PLANITIA REGION. THIS HOAX IS BEING PROMOTED ACTIVELY BY A SMALL GROUP OF WRITERS AND PUBLISHERS VIA A MEDIA BLITZ WORLDWIDE. THE CLAIMS MADE BY THESE PROMOTERS APPEAL TO THE INCOHERENT BELIEF SYSTEMS OF "NEW AGE" TABLOID DEVOTEES, AND TO THE VAST MASS MARKET FIRST FULLY EXPLOITED BY THE "ANCIENT ASTRONAUTS" BOOKS OF THE 1970'S.

IN THIS PRESENTATION, WE WILL REVIEW THE HISTORY OF THE "FACE ON MARS" HOAX, DISCUSS THE SPECIFIC AND GENERAL FALLACIES CURRENTLY BEING PROMOTED, AND SUGGEST STRATEGIES FOR COUNTERING SUCH ASTROFANTASY. WE WILL IDENTIFY SOME COMMON ELEMENTS FOUND IN PLANETARY PSEUDOSCIENCE SCENARIOS OF THE PAST AND PRESENT.

PUBLIC EDUCATION PROGRAMS IN ASTRONOMY

D. W. Hladiuk (R.A.S.C., Calgary Centre)

The Royal Astronomical Society of Canada, Calgary Centre has implemented several public education programs in an attempt to promote better public awareness in astronomy. These programs are relatively basic and can be used by Centres of all sizes. The author believes that these programs not only help to provide a strong base for Centre growth (in terms of membership), but also provides sources for additional funding. This paper will summarize the various programs that are now operated by members of the Calgary Centre.

OBSERVING THE MOONS OF MARS WITH A SMALL TELESCOPE

F. John Howell

In 1971 I found it was not very difficult to observe Phobos from Calgary, Alberta. By using an occulting bar (1 m.m. or so in width) across the eyepiece my 250 m.m. reflector showed an 11th magnitude object. In about 10 minutes, motion was apparent. It was Phobos. It moves from one side of its orbit to the far side of Mars in about 3 hours 50 minutes so an observer with two hours of clear skies should be able to observe it.

With Mars and Phobos the target of the Russian spacecraft investigation in 1989, the public can be shown Phobos and Deimos at star parties hosted by amateur astronomers.

I will report the observations made by a group of Canadians from April until the conference.

A QUANTITATIVE ANALYSIS OF THE ENERGY TRANSFER PROCESSES IN AURORAL TURBULENCE

R.S. IYENGAR (MOUNT ALLISON UNIVERSITY, SACKVILLE, NEW BRUNSWICK)

A QUANTITATIVE ANALYSIS OF THE ENERGY TRANSFER THROUGH THE EDDY HIERARCHY IS PRESENTED WITH RELATED DYNAMICAL PARAMETERS IN AURORAL TURBULENCE. ENERGY TRANSFER RATE PER UNIT VOLUME AT THE LARGE SCALE END FOR THE 100 KM HEIGHT REGION AS WELL AS 110-120 KM RATE AT THE LARGE SCALE END OF THE HIGHER LEVEL (110-120 KM) AND RELATED RESULTS OBTAINED WILL BE DISCUSSED.

FROM THE MOON'S CREATION TO THE STRUCTURE OF QUASARS: SUPERCOMPUTING IN ASTRONOMY

William J. Kaufmann (NCSA, U. of Illinois & San Diego State U.)

The advent of high-speed computers has given astronomers a new way of doing science. With supercomputers, astronomers can solve the nonlinear partial differential equations that describe exotic phenomena. The resulting simulations reveal the details of processes that cannot be observed directly, such as the Moon's creation or instabilities in supersonic jets emanating from quasars. The lecture begins with a brief history of supercomputing and includes a description of how one actually uses a supercomputer. Several examples of supercomputer simulations are presented, including a collision between two neutron stars, the formation of accretion disks around black holes, and the behavior of cosmic strings.

HOW TEACHERS PERCEIVE THE TEACHING OF ASTRONOMY AND SPACE SCIENCE
IN THE 7TH AND 8TH GRADES: RESULTS OF A STUDY TAKEN IN MARCH,
1988

L. KELLERMAN (ASU)

THE AUTHOR CONDUCTED A SURVEY OF TEACHERS IN ARIZONA. THE SURVEY ASKED TEACHERS TO RATE VARIOUS STATEMENTS DEALING WITH THE INSTRUCTION OF ASTRONOMY AND SPACE SCIENCE IN THEIR CLASSROOMS. THE TEACHERS WERE TO RATE STATEMENTS FROM STRONGLY AGREE TO STRONGLY DISAGREE IN A 5-POINT SYSTEM.

THE RESULTS INDICATE THAT TEACHERS "KNOW" ASTRONOMY, BUT ARE NOT SURE THEY ARE GETTING THE INFORMATION TO THE STUDENTS. THE TEACHERS UTILIZE PERIODICALS AND AUDIO-VISUAL MATERIALS, BUT THE COMMUNITY DOES NOT PROVIDE MATERIALS SUFFICIENT TO HELP THEM IN THEIR INSTRUCTION.

THE SURVEY RESULTS INDICATE THAT TEACHERS MAY BE READY FOR HELP IN TEACHING ASTRONOMY AND SPACE SCIENCE; ONE WAY TO AID THEM WOULD BE TO CHANGE THE WAY THAT THE SUBJECTS ARE BEING PRESENTED IN TEXTBOOKS. ANOTHER WAY WOULD BE TO PROVIDE A CURRICULUM GUIDE/RESOURCE GUIDE.

CENTRAL MONSTERS IN GALAXIES

JOHN KORMENDY

Some Thoughts About Searching for Comets

David Levy

This paper considers the art, history, philosophy, literature, emotions, science, sport and feelings of hunting for comets, from the very first recorded comet hunter, Charles Messier, to the present. I will emphasize that a serious comet hunter needs to do only three things to ensure a continuing supply of comets. First, keep the lens cover off your telescope, for a telescope in a closet will not find comets. Second, the searcher must know what a comet looks like, (and after seeing 85 of them, I'm beginning to get the hang of it!). Finally, the observer needs to know what a comet does not look like, and to be familiar with the thousands of objects that masquerade as comets.

LIGHT POLLUTION - WHAT CAN WE DO?

R.D. Lewis (RASC, Calgary Centre)

Amateur as well as professional astronomers are all too painfully aware of some of the affects of light pollution and the difficulty of convincing civic leaders that there is an alternative to the recent trend to use high pressure sodium (HPS) lighting. Educating the public at large regarding the cost advantages of low pressure sodium (LPS) lighting plus other energy saving measures should be one of the prime directives of amateur astronomers across the country. This paper will address methods which can be used by any amateur group to increase public awareness of this serious problem.

DE-FUZZING THE FUZZY DEEP-SKY OBJECTS.

A. Ling (R.A.S.C. Edmonton Centre)

A simple change in the attitude of observers rather than the purchase of a larger instrument will enable them to see more detail in deep-sky objects. "The optics aren't great, but galaxies are fuzzy anyway." This paper will highlight a few observing techniques and simple instrument modifications which will allow the observer to clearly focus their mind and telescope. Spiral arms, dust lanes, and H II regions are within reach of all amateurs!

CCD IMAGES OF SOUTHERN HEMISPHERE PLANETARY NEBULAE WITH BINARY NUCLEI

J. H. Lutz and N. J. Lame (Wash. State U.)

CCD images are presented for nine southern hemisphere planetary nebulae that are known to have binary central stars either by photometric variations or by the presence of a star that is too cool to account for the ionization of the nebular shell. The objects included in our survey are NGC 3132, A 14, A 41, H 3-75, He 2-58, K 1-2, ScWe 2, and Sh 2-71. The observations were obtained with a TI chip and H-alpha, [O III] and [N II] narrow band filters on the 0.9 m. telescope at CTIO. The planetary nebulae with binary central stars do not appear to have morphologies that are any different from planetary nebulae in general. Either binarity may not have a major role in shaping the nebular shells or there may be many planetary nebulae whose central stars are not recognized as binaries due to the difficulties of observations.

STRUCTURE IN A SLOWLY INFLATING UNIVERSE WITH A DISCONTINUOUS COSMOLOGICAL CONSTANT.

(POSTER PAPER)

C. V. Manning

Two main problems besiege modern cosmology, the observations of structures approaching $0.1c$ ($12\text{Mpc}/\Lambda h^2_{100}$ is expected), and the smallness of the cosmological constant, Λ . These problems are addressed by a new interpretation of allowing non-conservation of particles and photons, with $\Lambda=3H^2$. Here, a new principle disallows positive energy forms which are not localised, including the positive vacuum energy resulting from the standard interpretation. To get this energy into the Universe, a continuous field of probability of point-like "creation events" is substituted. Quasi-infinite energy density allows particle nucleations and a field of spatial distortion about the event, giving the quasi-continuous Hubble flow in a de Sitter type Universe.

Generic predictions are growing filamentary structures with no upper bound, streaming motions of up to $0.3Hr$ within extended structures, and stable voids which become thinly populated as they age (as Bootes). Accretion studies show purely baryonic matter is inconsistent with the flat rotation curves of galaxies, but is consistent if 95% of matter is dissipationless. This theory compares quite favorably with Big Bang alternatives in the analysis of QSO absorption systems, and explains the otherwise perplexing absence of voids in the data at large z .

ASTRONOMY EDUCATION IN LUNENBURG COUNTY SCHOOLS AND THROUGHOUT THE REST OF NOVA SCOTIA

W. Morley RASC, Halifax Centre

The status of astronomy in Nova Scotia will be discussed emphasizing schools of Lunenburg County.

Included in this is, as follows:

1. Evolvement of astronomy at the high school level - another avenue of science.
2. Outline of the high school course.
3. what is happening in the elementary and junior high schools.
4. Difficulties and frustrations.
5. The future of astronomy in high schools.

PERIOD-LUMINOSITY RELATIONSHIP FOR ANOMALOUS CEPHEIDS

James M. Nemec (Univ. of British Columbia), Amelia Wehlau (Univ. of Western Ontario) and Claudia Mendes de Oliveira (Univ. of British Columbia)

Anom. Ceph. are short period ($0.4 < P < 1.6$) Cepheid variables found in all the nearby dwarf galaxies (Baade and Swope 1961, A.J. 66, 300; Swope 1968, A.J. 73, S204; Zinn and Searle 1976, Ap.J. 209, 734). One is also known in the Galactic globular cluster NGC 5466 (Zinn and King 1982, Ap.J. 262, 700), and several are known in the Small Magellanic Cloud. During the course of an investigation of the entire system of ~ 90 variable stars in the Ursa Minor (UMi) dwarf galaxy (Nemec, Wehlau and Oliveira 1988, in press) a total of seven anom. Ceph. were identified in UMi. Combining this new information on the periods and absolute B magnitudes of the variables, with that of all the other known anom. Ceph., we show that all known anom. Ceph. can be classified as either fundamental or first-overtone radial pulsators, and that each type obeys a well defined period-luminosity relation. Knowing the pulsation mode, and the mean effective temperature and surface gravity of an individual star, permits accurate mass estimates to be made. The mean and maximum mass of the Draco anom. Ceph. are shown to be $1.38 M_{\odot}$ and $1.77 M_{\odot}$, respectively. The origin and evolution of anom. Cepheids is discussed.

ASTROPHOTOGRAPHY

Jack B. Newton

Amateur astrophotography is most often developed over long periods of time. First attempts are usually made with a simple camera and tripod arrangement and evolve into the use of larger, more sophisticated equipment. My paper, embellished with over 100 of my colour slides, illustrates this gradual transition, a process culminating with the construction of a 50cm f/5 telescope specially designed for astrophotography. Included is the development of a "user friendly" cold camera for deep sky objects, gas hypering techniques and discussion of the advantages of a computer-assisted telescope.

GLOBULAR CLUSTERS: A LABORATORY IN SPACE AND TIME

F. PINTO (B.Y.U.)

WHETHER WE THROW A GLANCE AT A PICTURE OF A GLOBULAR CLUSTER, OR ENJOY THE OPPORTUNITY OF OBSERVING ONE OF THEM WITH A GREAT TELESCOPE, OR WATCH THE COMPUTER-GENERATED SOLUTION OF THEIR DYNAMICAL EVOLUTION, WE CANNOT HELP BUT FEEL THE BREATHTAKING FASCINATION OF THESE NATURE WONDERS AT WORK. THE ROLE PLAYED BY THE STUDY OF THESE SYSTEMS IN OUR UNDERSTANDING THE STRUCTURE AND EVOLUTION OF THE UNIVERSE HAS BEEN EVER-INCREASING SINCE THE TIME OF HARLOW SHAPLEY. FRONTIER RESEARCH PRESENTLY UNDERWAY INCLUDES THE STUDY OF THE DYNAMICAL EVOLUTION OF GLOBULAR CLUSTERS, ONE AMONG THE MOST DEMANDING MATHEMATICAL PROBLEMS IN ASTROPHYSICS, EVEN IF APPROACHED BY MEANS OF SUPERCOMPUTERS. EXTREMELY RICH IN STIMULATING ANSWERS IS THE STUDY OF GLOBULAR CLUSTER FORMATION. EVERY STEP TOWARD THE SOLUTION OF THIS STAR AND GAS DYNAMICAL PROBLEM THROWS NEW LIGHT NOT ONLY ON THIS PROCESS BY ITSELF, BUT ALSO ON A NUMBER OF RELATED COSMOLOGICAL ISSUES, SUCH AS THE DETAILS OF GALAXY FORMATION. IN THIS PRESENTATION, SOME RECENT RESEARCH ON THE SUBJECT WILL BE DISCUSSED AT AN INFORMATIVE LEVEL; A "GALLERY OF SLIDES REPRESENTING OBJECTS OBSERVED IN THE MILKY WAY, IN THE LARGE MAGELLANIC CLOUD, AND IN OTHER EXTERNAL GALAXIES WILL BE SHOWN, ALONG WITH COMPUTER-GENERATED IMAGES OF CLUSTERS IN EVOLUTION.

TIME SHARING ON AN AUTOMATIC TELESCOPE

Diane M. Pyper (U. Nevada, Las Vegas), R. J. Dukes (Coll. of Charleston), and R. M. Genet and D. S. Hayes (Fairborn Obs.)

The Automatic Photoelectric Telescope Consortium is a group of seven observers from four schools (Coll. of Charleston, The Citadel, UNLV and Villanova) who will be using four different observing techniques to do photometry on a 0.75 programmable fully-automatic telescope (APT). We must optimize our telescope time allocation procedure, as the old practice of block scheduling telescope time is too inefficient to be acceptable in our case. We therefore are devising a system of priorities that 1) permits long sequences of observations to be made on a single object, 2) flags time intervals when important events will occur, 3) carries out "classical" differential photometry, and 4) observes standards for extinction and transformation calculations. We will also implement all-sky photometry for the first time using an APT, so we must schedule a number of nights that are dedicated to this purpose. The algorithms must also ensure that each observer gets his/her fair share of the total usable observing time. Our system is now under development and is being tested on one of the existing APT's operated by the APT Service on Mt. Hopkins in Arizona.

OPTICAL SYNCHROTRON RADIATION FROM RADIO HOTSPOTS

H.-J. Röser, K. Meisenheimer and P. R. Hiltner (MPI für Astronomie, Heidelberg)

We report on extending the spectra of radio hotspots in classical radio double sources to the optical. In the light of hotspots being a prominent seam between a jet and the intergalactic medium, this could help clarify the still largely unknown processes of energy transport and redistribution going on there.

We are performing a search for optical counterparts of radio hotspots in strong double sources (so far centered primarily on the 3CR-sample). Direct imaging and imaging polarimetry with a Savart plate or a Wollaston prism in front of a CCD gives the position of the counterpart and can discriminate against unrelated nonsynchrotron sources by measuring the degree and angle of polarization.

Up to now we have 6 successful identifications among the about 50 sources we looked at. This is indicative of the range in which cutoff frequencies are lying.

QUASARS: A 25TH ANNIVERSARY REPORT

M. SCHMIDT

NO "MISSING MASS" AND A CLOSED UNIVERSE

POSTER PAPER

D.C. Wilson (PtPd)

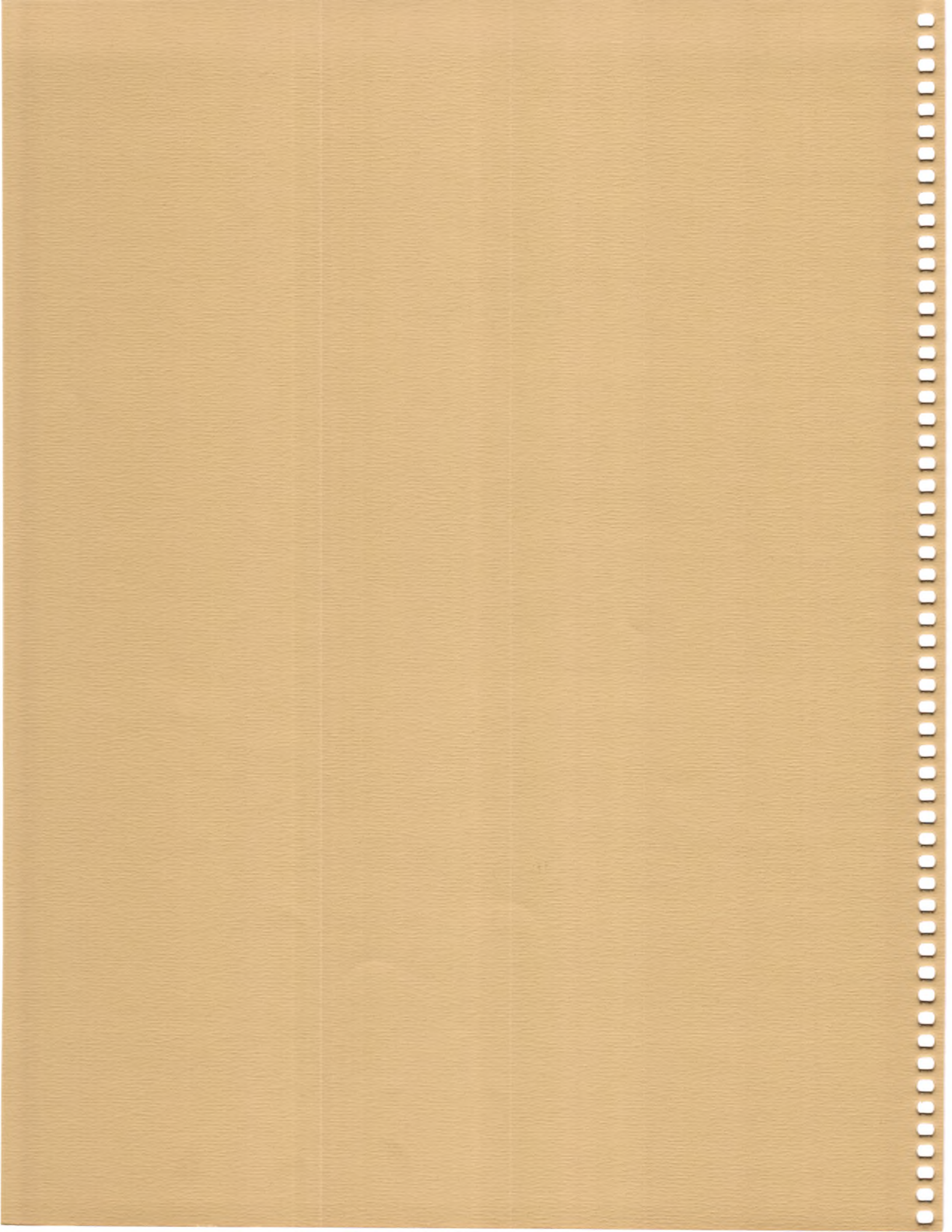
The observed Hubble constant is a composite of a Thermodynamic Redshift fraction and the traditional cosmic expansion fraction which is so small it is difficult to determine if the universe is expanding or contracting. This concept, presented with a diverse base of verifying data, demonstrates a unique compatibility with the observable universe thereby resolving a series of problems: missing mass, missing helium, extreme cosmic flatness, and evolutionary time constraints. The Thermodynamic Redshift is the transfer of energy from the photon to its surrounding field as a single gravitational dipole wave burst within the "near zone" causing a constant redshift equivalence of 74.69 ± 0.06 (km/sec)Mpc. The derived limits for the cosmic expansion are ± 5.83 (km/sec)/Mpc for a predicted overall Hubble constant of between 68.9 and 80.5 (km/sec)/Mpc. Other values derived from the concept are an universe age of 108 billion years or greater and a radius of 36,300 Mpc or greater.

An Amateur Astronomer's Look at the V.L.A. (Very Large Array)

Joseph H. Wujek
Apple Computer Inc.

Wujek spent 4 weeks in the fall of 1987 as Guest Engineer at the Very Large Array at the National Radio Astronomy Observatory on the Plains of San Agustin, New Mexico. The VLA is the world's most sensitive radio telescope and is used annually by over 500 visiting scientists. This discussion centers on the facilities and human side of the VLA. Views of the VLA dishes and facilities and one of the VLBA (Very Long Baseline Array) antennae under construction are included. Some fundamental concepts of radio astronomy will be explained and several images of radio-sources in both the radio and optical spectrum will be shown.

Section 3
History Papers



GLIMPSES OF THE FIRST 70 YEARS OF THE DOMINION ASTROPHYSICAL OBSERVATORY

A. BATTEN

CONTRIBUTIONS OF THE FORD FOUNDATION TO ASTRONOMY IN THE SOUTHERN HEMISPHERE.

F.K. Edmondson (Indiana U.)

"Who have made the most important contributions to Astronomy?" Harlow Shapley answered this in the 1930s by naming Andrew Carnegie and John D. Rockefeller. The Carnegie Institution of Washington had built and supported the operation of the Mount Wilson Observatory, and the Rockefeller Foundation had funded the construction of the 200-inch Palomar telescope. The name of Henry Ford should be added to this list because the Ford Foundation provided funds in the 1960s for four important astronomical projects in the southern hemisphere:

- 1) The European Southern Observatory (ESO). \$1,000,000 in 1959 (paid in 1964).
- 2) The Yale-Columbia astrograph in Argentina. \$750,000 in 1960.
- 3) CSIRO for the Australian Solar Radio Telescope (Radioheliograph). \$550,000 in 1962, plus a supplement of \$80,000 in 1966, for a total of \$630,000.
- 4) AURA for half the cost of the Cerro Tololo 150-inch telescope. \$5,000,000 in 1967.

The \$1,000,000 grant to ESO will be discussed in detail, and the others will be summarized briefly.

PLANETARY PHOTOSPHERES: THE STORY OF A "MISDISCOVERY"

T. A. Hockey (College of Wooster)

The history of astronomy often seems to have been a continuous sequence of improvements in our knowledge of the Universe. In reality, it more resembles a tree with many branches, only one of which has led to our present interpretation of any given phenomenon.

I will present an anecdotal account of one such forgotten "dead end" branch to be found in the history of solar system astronomy. After more than two centuries of observations of planetary disks, in 1822 completely new "features" associated with the major planets were seen: "photosphären"--luminous spheres situated well beyond the measured radii of these bodies. I will also discuss the simple and elegant observational experiment that provided proof of the illusory nature of this discovery.

LICK OBSERVATORY: THE FIRST CENTURY

D. E. Osterbrock (Lick Observatory)

The world's first permanent mountain top observatory and America's first big-science research center, Lick Observatory exemplifies astronomy's development in the past century. Founded by a bequest from James Lick to build a telescope "superior to and more powerful than any telescope yet made," from its dedication in 1888 until today it has been one of the most important astronomical research centers on the globe. In this paper Lick Observatory's history is told in terms of the lives, careers, accomplishments and discoveries of its designers, builders, astronomers and astrophysicists.

TO DETERMINE THE MOON'S LIBRATION FROM A PHOTOGRAPH OR DRAWING

Gibson Reaves (U. of Southern California)

On a photograph or drawing of the moon, the distance of a given feature from the apparent center of the lunar disk is a function of the moon's libration in longitude and latitude. This function is the basis of a new and simple graphical method to determine rough values for these librations.

For an example of this method, consider the drawing on page 8 of Galileo's Sidereus Nuncius (1610). Measurements of the positions of several features on this drawing by Righini (1975) are used to determine the libration in longitude and latitude, -5° and -1° , respectively, to an accuracy of about a degree. These values are then compared with those corresponding to Righini's (1975) and Whitaker's (1978) dates for this drawing.

WILLIAM H. WRIGHT: THE MAN WHO DECLINED THE BRUCE MEDAL

Joseph S. Tenn (Sonoma State U.)

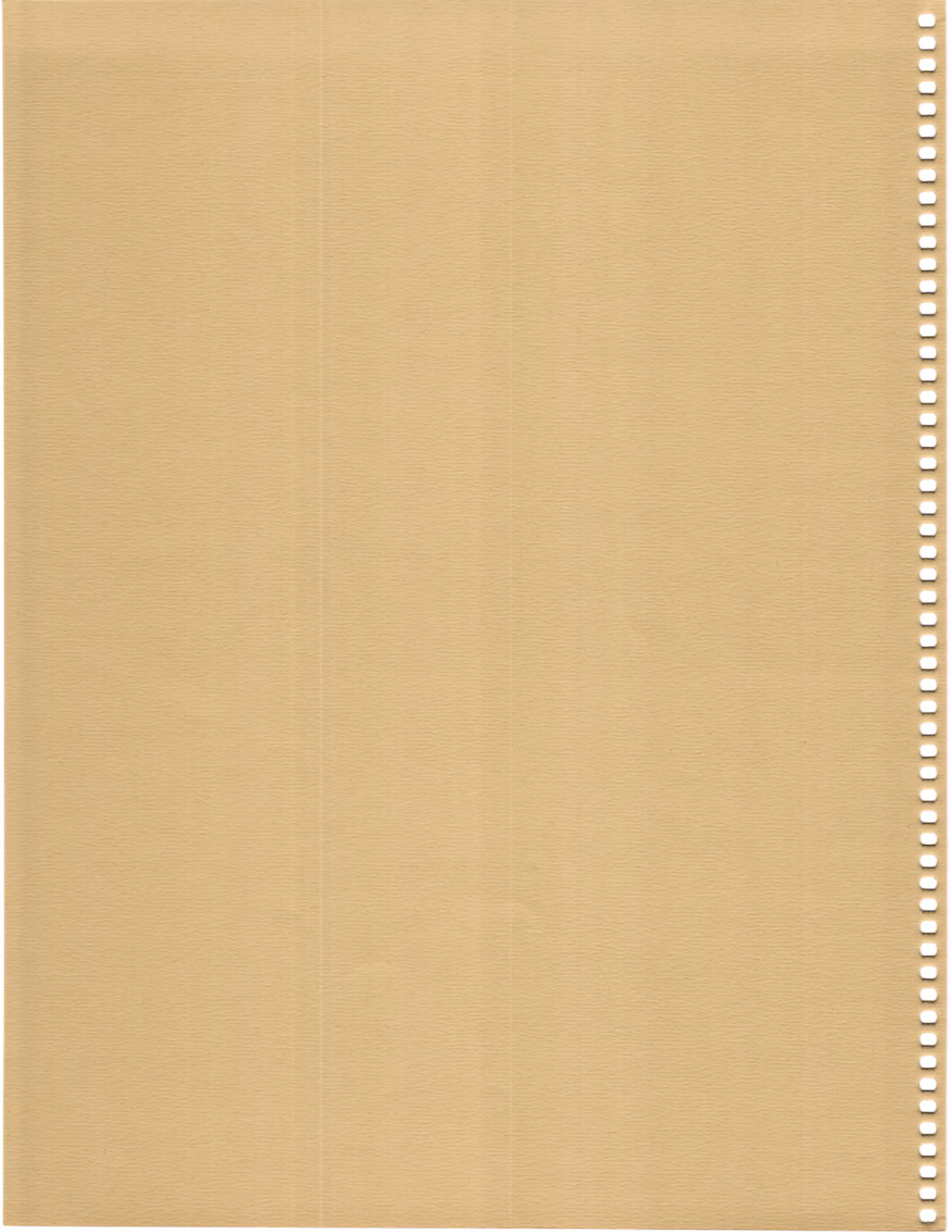
Lick Observatory's fifth director (1935-42) is less well-known than those who came before him—Holden, Keeler, Campbell, and Aitken—or more recently—Shane, Whitford, Osterbrock, and Kraft. Only his immediate successor, Moore, is more obscure. His career at Lick extended from 1897 to 1944. It included establishing the Lick southern observatory in Chile despite numerous problems (including bandits). At Mt. Hamilton he measured stellar radial velocities and made spectroscopic studies of novae and planetary nebulae. He designed and built instruments which allowed him to extend his studies into the ultraviolet and infrared regions of the spectrum, and he made pioneering infrared photographs of the planets. He assembled images of Mars and Jupiter into motion pictures which were widely admired. As observatory director he obtained the funding and oversaw the design and construction of the Carnegie astrograph to make possible the Lick proper motion survey. Although he gratefully accepted the Janssen Medal of the French Academy, the Gold Medal of the Royal Astronomical Society, and the Henry Draper Medal of the National Academy of Sciences, Wright declined the Catherine Wolfe Bruce Gold Medal of the A.S.P. in 1944.

THROUGH THE LOOKING GLASS

W.J. Shiloh Unruh (Mount Hamilton)

The history is given of the French firm of Charles Feil, which produced the optical glass used for so many of the telescope lenses made by Alvan Clark & Sons in the last century, including the Lick 36 inch refractor. Feil was the last descendant of the Guinands, the famous French family which dominated production of the world's finest optical glass for over a century.

Section 4
Poster Sessions



SURFACE PHOTOMETRY OF NGC 3379 WITH A TEKTRONIX 2048 X 2048 CCD CAMERA -- COMPARISON WITH THE LUMINOSITY PROFILE OF DE VAUCOULEURS AND CAPACCIOLI.

H.D. Ables, H.C. Harris, and D.G. Monet (U.S. Naval Obs.)

The development of large-format CCDs offers a new opportunity to study the luminosity distributions in galaxies. In this paper we present the first astronomical photometry with a Tektronix 2048 x 2048 CCD. The U.S. Naval Observatory large format CCD camera with an engineering setup grade front illuminated Tektronix 2048 x 2048 CCD was used on the 40-inch Ritchey-Chretien telescope at the Flagstaff Station to measure the luminosity profile in NGC 3379. We compare the result with the E-W luminosity profile published by de Vaucouleurs and Capaccioli, and we describe some of the features of the CCD.

A COMMON EXPLANATION OF THE HUBBLE RED-SHIFT AND "MISSING MASS" PROBLEM

T.B. Andrews, Brooklyn, N.Y.

Since a physical explanation for the Hubble red-shift, other than the current doppler shift and expanding universe concept, has not been possible with current physical concepts, a revolutionary approach to basic physics is proposed. From the hypothesis that the physical universe is a pure wave system, it is shown that the elementary particles are the constructive interference peaks of the wave system modes. The peaks are then stable entities because the concentration of energy at the peaks results in a minimum frequency system.

As an application of this theory, it is shown that a reciprocal gravitational potential exists between different parts of the universe which is proportional to the distance. This is proposed as the cause of both the Hubble red-shift and the missing mass problem. It is calculated that the additional potential exceeds the normal gravitational potential due to mass at approximately 35K light years from the center of the galaxy. The extra force derived from this potential is responsible for the anomalous high orbital velocities of stars within galaxies.

THE USE OF GIANT EXTRAGALACTIC HII REGIONS AS DISTANCE INDICATOR

R. Arsenault (ESO), J. Boulesteix (Obs. de Marseille), Y. Georgelin (Obs. de Marseille), and J.-R. Roy (U. Laval)

The well known linear diameter vs velocity width relation in Giant Extragalactic HII Regions seems to hold only for the 3 largest HII regions in galaxies. A sample of 141 HII regions in the spiral galaxy NGC 4321 (M100) does not show any trend between linear diameter and velocity width, nor between $H\alpha$ luminosity and velocity width. This raises questions about the true nature of this distance indicator and in particular about the zero-point of the diameter vs velocity width relation in HII Galaxies.

SOLAR INERTIAL MOTION AND SOLAR ACTIVITY.

Jane B. Blizard (Front Range Community College)

The barycenter of the solar system follows a regular path in orbiting the galactic center. Individual solar system bodies, including the Sun, describe complex orbits about the barycenter. The barycenter is the origin of the solar system inertial frame. The path of the Sun about the barycenter follows a curve resembling a cardioid or epitrochoid with a period of from 15 to 23.6 years. Nine successive orbits comprise a 179 year long cycle of climate, found in radiocarbon ^{14}C tree rings. A very close approach of the Sun to the barycenter occurs in AD 1990, signaling a possible prolonged minimum of solar activity.

GLOBULAR CLUSTERS IN M104 AS DISTANCE INDICATORS

Terry J. Bridges and David A. Hanes (Queen's University, Kingston)

We have recently (April 1988) acquired deep CCD images in several fields of the spheroid of M104 (NGC 4594; the Sombrero galaxy) using a double-density RCA CCD at the prime focus of the Canada-France-Hawaii Telescope (CFHT). This Sa galaxy has a prominent bulge and a demonstrably large globular cluster population (more than a thousand in total, according to Harris, Harris and Harris 1984 A.J. 89, 216). It lies in the southern extension of the Virgo cluster but may be a foreground object.

Our deep photometry, now in progress, in frames which total 7200 seconds in 0.8-0.9 arcsec seeing, will reach to beyond $B = 25$ mag. It is likely that we will have sampled the globular cluster luminosity function to well beyond the intrinsic turnover, and we will be able to address two important questions: (1) is the globular cluster luminosity function in M104 identical to that in the Milky Way and M31, the two Local Group spirals? If the answer is affirmative, what distance do we deduce for M104 itself? (2) Are the globular clusters distributed as is the M104 spheroid luminosity, especially in the central regions? Striking counterexamples are known, and may be diagnostic of distinct phases during galaxy formation.

DISTANCES TO NEARBY GALAXIES USING CEPHEID VARIABLES

N. CALDWELL (SAO), R.A. SCHOMMER (RUTGERS), AND JOHN GRAHAM (DTM)

WE HAVE BEEN MONITORING SEVERAL NEARBY GALAXIES OVER THE LAST FOUR YEARS FOR CEPHEID VARIABLES. WE PRESENT PERIOD-LUMINOSITY RELATIONS FOR IC 5152, THE PHOENIX DWARF IRREGULAR, AND THE SPIRAL GALAXY NGC 5236 (M83), AND THE DERIVED DISTANCES TO THOSE GALAXIES.

CEPHEIDS AND BRIGHT STARS IN NGC 3109

A. R. Sandage (MWLCO) and G. A. Carlson (Citrus College)

Cepheid variables have been found in the nearby Sm IV galaxy NGC 3109. Periods determined for 29 of the variables from blue plates taken over a four-year interval with the duPont 2.5m reflector at Las Campanas range from 31 to 5 days. The period-luminosity relation yields an apparent blue distance modulus of $(m-M)_{AB} = 26.4$.

The brightest supergiants, found by blinking blue and yellow plates, have absolute magnitudes of $M_B(3) = -7.6$ for the mean of the three brightest blue stars, and $M_V(3) = -7.7$ for the corresponding mean of the three brightest red stars. These absolute magnitudes for both the red and the blue supergiants in NGC 3109 agree with the previous calibration of the brightest star luminosities as a function of the absolute magnitude of the parent galaxy.

PECULIAR MOTIONS OF THE LARGE SCALE STRUCTURES IN THE SOUTHERN HEMISPHERE

R.R. de Carvalho (Caltech) and L.N. da Costa (Observatorio Nacional)

We have used independent photometric and spectroscopic data to derive the two-parameter distance indicator relation for elliptical galaxies. The distance indicator is a plane in the $R - \sigma - \mu$ space, similar to the "fundamental plane" solution by Faber et al. (1986), or Djorgovski and Davis (1987). Our derived distances compare well to those measured by Lynden-Bell *et al.* (1988), where our samples overlap. In the present work we have found some marginal evidence for systematic, coherent motions in the surveyed volume, which may be associated to the observed structures in the galaxy distribution. Furthermore, the amplitudes of these residual velocities are also significantly larger than the expected velocity dispersion of field galaxies. For example, we obtain for the peculiar velocity of the Fornax and Eridanus clusters $-348 \pm 172 \text{ km s}^{-1}$ and $-230 \pm 90 \text{ km s}^{-1}$, respectively. This may indicate that we have detected motions of, or within, the large scale structures, but the confirmation of this result will have to await until more data on groups, S0's and late-type galaxies become available. We are presently taking the first steps in those directions.

THE APM QSO SURVEY: A 60% COMPLETION REPORT

F.H. Chaffee, Jr. and C.B. Foltz (MMTO), P.C. Hewett (IoA), G.M. MacAlpine (U. Michigan), D.A. Turnshek (STScI), R.J. Weymann and S.F. Anderson (MWLCO)

In 1986 we embarked upon an effort to find a large sample of QSOs using well-defined and consistently-applied selection criteria. Our goal is to identify approximately 1000 QSOs brighter than $m_J = 18.5$ in the redshift range $0.2 \leq z \leq 3.3$ using machine-scanned direct and objective prism plates from the UK Schmidt telescope. Plates are scanned at the Institute of Astronomy's Automated Plate Measuring (APM) facility. Algorithms select approximately 3 candidates per square degree as possible QSOs. Slit spectroscopy at 6-10 Å resolution at the MMT, the Las Campanas 2.5 m, and the McGraw-Hill 2.4 m is used to classify each candidate.

As of June 1988, more than 600 QSOs have been found in the approximately 350 square degrees surveyed. This paper reports on the characteristics of the sample to date, its selection, redshift distribution and the distribution of Lyman α and C IV emission line strengths.

PLANETARY NEBULAE IN THE NGC 3379 GROUP: TESTING A NEW STANDARD CANDLE

R. Ciardullo (NOAO-KPNO), G.H. Jacoby (NOAO-KPNO), and H.C. Ford (U Mich)

There has been mounting evidence, both observational and theoretical, that the [O III] $\lambda 5007$ magnitudes of the brightest planetary nebulae in external galaxies are excellent standard candles. This hypothesis can only be verified, however, by comparing the planetary nebula luminosity function (PNLF) of several different galaxies. We have done this for the well mixed galaxy cluster in Leo, which includes the Sab galaxy NGC 3368 (M96), the E0 galaxy NGC 3379 (M105), the SB0 galaxy NGC 3384, and the E6 galaxy NGC 3377. Using the Kitt Peak 4 m telescope with a 30\AA wide filter centered around redshifted $\lambda 5007$, we measured a homogenous sample of planetaries in each of the four galaxies mentioned above, and obtained luminosity functions complete to nearly 1 mag below the brightest PN. The agreement between the luminosity functions is excellent, with the [O III] emission from the brightest objects differing by only a few percent. The luminosity specific number density of planetaries also appears to be invariant in the cluster, further improving the utility of bright planetaries as distance indicators. When we combine our sample of ~ 200 planetaries and form a single PNLF for the group, we obtain a distance modulus of ~ 5.3 relative to M31, implying a distance of 8.1 ± 0.3 Mpc. These encouraging results will enable us in the coming year to derive accurate distances to galaxies as distant as Virgo.

ASYMPTOTIC GIANT BRANCH POPULATIONS IN IC1613 AND THE SAGITTARIUS DWARF

K.H. Cook (MWLCO and Steward Obs.) and M. Aaronson (Steward Obs., deceased)

We have identified asymptotic giant branch stars in nearby galaxies using an intermediate-band photometric technique which distinguishes carbon from M stars. In this poster, we present the surface distribution of carbon stars and M giants in IC1613. The carbon stars are a tracer of an intermediate age population, and the carbon-to-M-star ratio is high compared to The Galaxy. The M giant metallicities as estimated from our intermediate-band photometry and a high carbon-to-M-star ratio suggest $[\text{Fe}/\text{H}] \leq -1.0$ for this population. The IC1613 carbon star luminosity function yields an estimate of IC1613's distance in agreement with other techniques adding credence to its use as a distance indicator. We also present the results of a study of the Sagittarius Dwarf (Sagdig). Its stellar population was found to contain bright red and blue stars as well as carbon stars. There is evidence for a bimodal distribution of carbon stars in both color and luminosity. The red stars in Sagdig extend well beyond its central, blue body. We estimate Sagdig's distance modulus to be $(m-M)_0 \approx 25.4$ using the carbon star luminosity distribution or the red giant branch tip luminosity.

ANALYSIS OF BULK MOTION FROM A LARGE SAMPLE OF SPIRAL GALAXIES

Stéphane Courteau and Sandra M. Faber (Lick Observatory, UCSC)

We are studying the motions of a collection of field Sb–Sc galaxies in the northern hemisphere out to 6000 km/s to test for large scale deviations from a uniform Hubble flow. Distances are derived from the R-band Tully-Fisher relation with ΔV 's measured optically using $\text{H}\alpha$ rotation curves. The correspondance between optical and radio ΔV 's is shown to be good for galaxies that are not directly edge-on ($55^\circ \leq i \leq 75^\circ$). Such a calibration should be of great importance in mapping out the distribution of galaxies in space around us out to several thousand km/s. The sample (~ 250 galaxies statistically sampled from the UGC) will comprise the largest library of rotation curves and surface photometry yet collected and, by its selection, will provide an ideal comparison of cluster galaxies versus the field. Work on the morphological and kinematic properties of these galaxies with a view to better understanding the relationship between the rotation curve and the light distribution has also been undertaken. It has been proposed (Madore and Woods, 1987) that these in combination may offer a good distance indicator for spiral galaxies. A comparison analysis for cluster galaxies will be presented.

ASTROMETRIC DISTANCES OF GLOBULAR CLUSTERS

K. M. Cudworth (Yerkes Obs., U. of C.) and R. C. Peterson (Whipple Obs.)

With high precision radial velocities and proper motions of individual stars in globular clusters one can equate the radial velocity and proper motion dispersions to obtain distances independent of any standard candle. Distances to $\sim 10\%$ can be obtained with samples ~ 100 stars. Our best data so far are for M22, where we find a distance of 2.4 kpc, significantly smaller than previous values, but consistent with the larger cluster reddening and fainter RR Lyrae $\langle M_V \rangle$ favored by other recent work.

Observations are essentially complete and reductions in progress for M15, M4, and 47 Tuc. Previous proper motions can soon be significantly improved in M92, M5, M3, and possibly M13, to be combined with radial velocities by others.

OPTICAL IDENTIFICATION OF THE X-RAY SOURCE IN NGC 6712

K. M. Cudworth (Yerkes Obs., U. of C.) and N. B. Suntzeff (CTIO)

In conjunction with a large astrometric and photometric study of the globular cluster NGC 6712 we have used plates taken in subarcsecond seeing with the 2.5-m DuPont telescope at Las Campanas to identify a highly probable optical counterpart of the x-ray source in this cluster. The star in question lies within 1" of the x-ray position and has $B \sim V \sim 20$. (The cluster reddening is $E(B - V) \sim 0.42$, at a distance of 6.5 kpc) Bailyn, et al. (1988, Ap.J. in press) have also identified this star as very blue in U - B from CCD frames with poorer resolution, and concur that it is the optical counterpart of the x-ray source. Palomar 5-m plates taken in 1955 by Sandage clearly show the star, but blended with a brighter neighbor 1" south. There is some hint of variability (< 1 mag.), but this is very uncertain due to blending of images.

DISTANCE MODULUS AND NOVA FREQUENCY OF M33

M. Della Valle (Dep. of Astronomy, University of Padova)

One hundred and ten blue plates of M33, obtained at the 122 and 182 cm telescopes of Asiago Observatory, between 1960 and 1986, have been examined to search for extragalactic novae. The analysis of the whole set of data yields two main results: a) using the strong dependence of the period of visibility of novae on distance (van den Bergh and Pritchett 1986), we have found a difference between the distance modulus of M33 and M31 of $\Delta(m - M) \leq 0.3$ mag. b) With a distance modulus of $(m - M)_{M33} = 24.5$, we derive a control time $t_c \simeq 1000^d$ and a nova rate for M33 of $R_{M33} = 4 \pm 2$ novae/yr. If we assume for the Andromeda Nebula a total B-luminosity $L_B \simeq 6.85 \cdot 10^{10} L_{B\odot}$ (Tammann 1982), and $L_B \simeq 0.66 \cdot 10^{10} L_{B\odot}$ for M33, it seems reasonable to expect a nova rate for M33 of $R_{M33} \approx 3$ novae/yr, in agreement to the one estimated from observation.

DISTANCES TO M81 AND NGC 2403 FROM CCD I-BAND CEPHEIDS PHOTOMETRY

WENDY L. FREEDMAN (MWLCO) AND BARRY F. MADORE (D.D.O.O)

I-band CCD photometry has been obtained for the only two known Cepheids in M81, and for eight of the known Cepheids in NGC 2403 using prime focus CCD cameras on the CFHT 3.6m and on the KPNO 4m. For M81, an apparent I-band distance modulus and formal fitting error of $(m-M) = 27.64 \pm 0.09$ mag are derived; while for NGC 2403 $(m-M) = 27.57 \pm 0.14$ mag. Taking a true distance modulus of 18.50 mag for the Large Magellanic Cloud Cepheids used in the comparative fit, and by examining the accumulated random errors, a true modulus of 27.59 ± 0.31 is obtained for M81, and 27.51 ± 0.24 for NGC 2403 (foreground reddenings of $A = 0.05$ and 0.06 mag being adopted for M81 and NGC 2403, respectively.) These moduli correspond to distances of 3.3 ± 0.5 and 3.2 ± 0.4 Mpc, respectively, but they are still upper limits since we have not yet independently determined the reddening internal to the parent galaxies. Although separated by more than ten degrees on the sky, M81 and NGC 2403 appear to be at very similar distances along the line of sight.

DISCOVERY OF VARIABLE STARS IN SCULPTOR GROUP GALAXIES

W.L. FREEDMAN (MWLCO), I. HOROWITZ, B.F. MADORE, J. MOULD (CALTECH), AND J.A. GRAHAM (DTM)

IN AN ON-GOING EFFORT TO DETERMINE THE DISTANCES TO NEARBY GALAXIES SO AS TO BETTER CALIBRATE THE INFRARED TULLY-FISHER RELATION AND EVENTUALLY MEASURE THE HUBBLE CONSTANT, WE HAVE UNDERTAKEN A PROGRAM TO MONITOR THREE SCULPTOR GROUP GALAXIES IN SEARCH OF CEPHEID VARIABLES. AS PART OF A SERVICE OBSERVING PROGRAM AT THE CTIO 4M, BVRI CCD FRAMES OF FILED IN NGC 247, NGC 7793, AND NGC 253 HAVE BEEN OBTAINED FOR US OVER THE LAST THREE FALL OBSERVING SESSIONS. THE DATA FOR NGC 247 AND NGC 7793 ARE COMPLETELY REDUCED, AND THE ANALYSIS HAS PROCEEDED TO THE POINT WHERE NUMEROUS CANDIDATE CEPHEID VARIABLES HAVE NOW BEEN IDENTIFIED. ACCURATE PERIODS ARE NOT YET UNAMBIGUOUSLY AVAILABLE FOR THESE VARIABLES BECAUSE OF ALIASING AND THE INCOMPLETE PHASE COVERAGE; HOWEVER ALL OF THE FIELDS ARE NOW ACCURATELY CALIBRATED IN ALL FOUR COLORS. THUS, ONCE MORE COMPLETE LIGHT CURVES ARE AVAILABLE, WE SHALL BE ABLE TO OBTAIN PERIOD-LUMINOSITY RELATIONS AT FOUR INDEPENDENT WAVELENGTHS, THEREBY ALLOWING US TO SIMULTANEOUSLY DETERMINE APPARENT MODULI AND TOTAL REDDENING CORRECTIONS TO THE CEPHEIDS THEMSELVES.

H I OBSERVATIONS IN THE HERCULES SUPERCLUSTER

W. Freudling, M.P. Haynes (Cornell Univ., NAIC), R. Giovanelli (NAIC)

We have begun a H I line redshift survey of spiral galaxies in the region of the Hercules supercluster with the Arecibo 305m telescope. More than 650 spectra in that region are now available, including about 530 newly obtained. We are currently obtaining I-band CCD images for the late type spirals in that region. The survey volume contains a void in front of the supercluster. The application of the Tully-Fisher relation for the detection of large-scale deviation from the Hubble flow around a void is discussed. Current uncertainties in the detection of streaming motions via the Tully-Fisher relation are introduced by the uncertainties in the inclination of the galaxies and in the available blue magnitudes and their corrections. An all-sky I-band CCD survey of late type spiral galaxies with H I data also in progress will allow us to obtain more accurate inclination estimates and accurate magnitudes which need little corrections for internal absorption for a large, homogeneous sample of galaxies. This sample will be used to calibrate the I-band Tully-Fisher relation. The use of corrected Zwicky magnitudes and inclination estimates based on UGC diameters allows a preliminary estimate of an upper limit to the expansion (or contraction) velocity of the void in the Hercules region of about 400 km s^{-1} . The I-band CCD data will allow us to detect much smaller velocities or at least tighten this limit.

KINEMATICS OF OLD OPEN CLUSTERS

E.D. Friel (IfA, U. of Hawaii)

Radial velocities have been determined for six old open clusters in the Galactic anticenter. Moderate resolution spectra were obtained for three to six giants in each of the clusters NGC 2141, 2158, 2240, 2243, 2420, and 2506, which yield cluster mean velocities good to about 15 km/s. These measurements are supplemented with values from the literature to provide radial velocity information for a total of 12 open clusters with ages greater than about 2 Gyr. These data indicate that this small population of old open clusters is rotating with disk kinematics similar to those found for the field thick disk population in the solar neighborhood. This similarity in kinematics suggests that the field thick disk population may be more appropriately associated with the old open clusters than with the substantially older disk globular cluster population.

THE NGC 1399 GLOBULAR CLUSTER SYSTEM

D.P. GEISLER (CTIO/NOAO) AND J.C FORTE (IAFE)

NGC 1399, the central elliptical galaxy in the Fornax cluster, shares many properties with its counterpart in the Virgo cluster - M87. In particular it features a very populous globular cluster system.

Washington photometry was recently obtained on the NGC 1399 globular cluster system with the CTIO 4m PFCCD. The data will be used to derive abundances for a very large sample of globular clusters and to determine an accurate distance.

STUDIES OF IR-LUMINOUS ACTIVE GALAXIES AND QSOs

J.B.Hutchings (DAO) and S.G.Neff (GSFC)

The most luminous IR objects are found to be galaxies in severe tidal disruption. These objects frequently have dust-enshrouded active nuclei and total luminosities typical of QSOs. Direct images from the CFHT, together with radio and optical spectroscopic observations are presented, which suggest an evolutionary scenario connecting these objects and 'normal' active galaxies and QSOs.

PHOTOMETRIC PARAMETERS OF SS PISCIMUM

Scott B. Johnson (NSI) and Michael D. Joner (BYU)

We present uvby β photometric observations of the variable star SS Piscium, HD 8109 (the primary comparison star), and several nearby field stars. The times of maxima for the variable star are used to refine the period. The photometry of the field, comparison, and variable stars is employed to establish the reddening, $E(b-y)$. Intrinsic $(b-y)$ and c_1 values for the variable star are used to determine the variations in temperature and surface gravity during the pulsation cycle. The metal-strong nature of the variable star is evident from the index $\langle(m_1)_0\rangle$. We discuss the nature and classification of SS Piscium relative to the RR Lyrae and dwarf Cepheid variable star classes.

A RESEARCH NOTE ON LIGHT CURVE ANOMALIES IN XX CYGNI

MICHAEL D. JONER (BYU)

DIFFERENTIAL PHOTOMETRIC OBSERVATIONS OF THE DWARF CEPHEID VARIABLE STAR XX CYGNI WERE SECURED IN THE SUMMERS OF 1984 AND 1986. LIGHT CURVES ARE PRESENTED IN BOTH THE V AND R PASSBANDS. NEW TIMES OF MAXIMUM LIGHT ARE USED TO MAKE A SMALL CORRECTION IN THE PERIOD. THE SUGGESTION OF A SMALL AMPLITUDE MIGRATING BUMP ON THE LIGHT CURVE IS NOT SUPPORTED BY THE OBSERVATIONS. SUCH A BUMP APPEARS TO BE AN ARTIFACT OF OBSERVATIONAL INTERPRETATION.

ON THE EVIDENCE FOR A CYANOGEN GRADIENT IN 47 TUC

G. E. Langer and Russell F. Shipman (Colorado College)

We have re-examined the evidence for a radial gradient in the distribution of CN strengths among 47 TUC giants (Norris, J. and Freeman, K. C. 1979, Ap.J., 230, 179.) We find apparent differences between the distribution of cyanogen strengths determined from stellar spectra and the distribution determined from photoelectric photometry for stars in the same (outer) region of the cluster. This, together with the expected random variations in the observed distributions for a small number (~ 30) of stars, leads us to conclude that the available evidence for a CN gradient in 47 TUC is suggestive but not compelling. A more uniform set of observations for a larger sample of stars would obviously settle the issue.

PARALLAX CALIBRATION OF THE POPULATION II MAIN SEQUENCE.

T.E. Lutz (Wash. State U.), R.B. Hanson (Lick Obs., UCSC), W.F. van Altena (Yale)

We are investigating the trigonometric parallax calibration of the subdwarf main sequence because of its significance for determining the distance moduli of globular clusters. Our data sample consists of those main sequence stars which are found in both the Catalogue of [Fe/H] determinations (Cayrel de Strobel et al. A.Ap.Sup.59, 145,1985) and the forthcoming Yale Parallax Catalogue. Our procedure differs in several respects from our earlier investigation. There we assumed a slope for the main sequence and using eight stars, calibrated the deviation from the main sequence a function of [Fe/H]. Here we present the results of a multivariate analysis where we assume a relation of the form:

$$M_V(\pi) = A + B(B-V) + C[Fe/H] + D \log g.$$

The log g term allows for the range of ages in the field subdwarfs. We discuss problems we have with published values of log g, and the application of Lutz-Kelker ΔM corrections to our sample.

Deep CCD Photometry of Open Clusters Containing Cepheid Variables

Mario Mateo (MWLCO), and Barry Madore (U. Toronto, IPAC)

We summarize a systematic program to obtain deep CCD photometric observations of four open clusters that contain classical Cepheid variables (NGC 129, M 25, NGC 6664, and NGC 7790). Detailed results for one of these clusters, NGC 7790, are presented. Using this new photometry, we estimate the cluster's reddening and distance based on comparisons with recent models as well as observations of nearby open clusters. Some of the difficulties and sources of error in this procedure are identified and discussed. These results provide a direct estimate of the distance to NGC 7790's three Cepheids. We discuss our findings with regard to recent studies that suggest that the canonical Cepheid period-luminosity zero point (based on observations of Galactic Cepheids, including those in open clusters) may be significantly in error.

CEPHEID PHOTOMETRY IN M31, M33, NGC2403 AND M81.

N. Metcalfe (U. of Durham) and T. Shanks (U. of Durham)

We have checked the B,V secondary star sequences surrounding Cepheid variables identified in the nearby galaxies M31, M33, NGC2403 and M81 using a CCD detector at the 100 inch Isaac Newton Telescope on La Palma. In the case of some of these galaxies the Cepheid distances previously relied on 40yr old photographic photometry. Checking the Cepheid distances to these galaxies is important because these galaxies represent the fundamental local calibrators of the Tully-Fisher relation. We make the first report on this work at this meeting and compare our results with those of other authors.

A PROGRESS REPORT ON THE RAO BINARIES-IN-CLUSTERS PROGRAM
AND ITS RELEVANCE FOR DISTANCE SCALES.

E. F. Milone (RAO) and S. J. Schiller (South Dakota S. U.)

Since 1983 studies of selected eclipsing binary star systems have been carried out at the *Rothney Astrophysical Observatory* of the University of Calgary in order to improve our knowledge of the absolute parameters of individual stars at discernible stages of stellar evolution and to improve our knowledge of the galactic clusters of which these systems are members. Once the luminosities of the component stars of a particular system are found, the *distance* to the system, and thus to the cluster, follows. This has been carried out for HD 27130 in the Hyades cluster for example.

Analyses of light and radial velocity curves have been completed for *HD 27130* in the Hyades, *DS And* in NGC 752, and *OX Cas* in NGC 381; work continues on the systems *QX Cas*, *SS Lac*, *CN Lac*, *H 235* (in NGC 752) and others. We are grateful for the support provided by grants to EFM from the Natural Sciences and Engineering Research Council of Canada, and by the cooperation of the Dominion Astrophysical Observatory.

RESIDUAL MOTIONS OF ELLIPTICALS IN THE "GREAT ATTRACTOR" FLOW FIELD

R. A. Nolthenius (Lick) and S. M. Faber (Lick)

Lynden-Bell et. al. (1988) have demonstrated that large scale coherent motions are present in several samples of nearby galaxies. A major source of noise in the velocity data is internal motion within groups and clusters. This is particularly important in the elliptical galaxy sample of Faber, et. al. (1988). This noise can be reduced by properly identifying parent groups and averaging velocities over the group. Previous flow solutions have been based on group assignments from the grouping algorithm of Huchra and Geller (1982). We have used the algorithm of Nolthenius and White (1987) to more accurately assign ellipticals to groups, reanalyze the elliptical sample, and derive a new flow model solution and a better estimate of the rms peculiar velocity remaining after subtracting the Virgo- and "Great Attractor"- induced motions.

Faber, S. M., Burstein, D., Davies, R. L., Dressler, A., Lynden-Bell, D., Terlevich, R. J., and Wegner, G., 1988 Ap. J.

Huchra, J. and Geller, M., 1982 Ap. J. 257, 423

Lynden-Bell, D., Faber, S. M., Burstein, D., Davies, R. L., Dressler, A., Terlevich, R. J., and Wegner, G., 1988 Ap. J.

Nolthenius, R. A., and White, S. D. M., 1987 MNRAS 225, 505

AN UPDATE ON THE VELOCITY DISPERSIONS IN THE DRACO AND URSA MINOR
DWARF GALAXIES

EDWARD W. OLSZEWSKI (STEWART OBS.)

I PRESENT THE RESULTS OF SEVERAL YEARS OF DETERMINING THE VELOCITIES OF INDIVIDUAL RED GIANTS (MOSTLY K GIANTS) IN THE DRACO AND URSA MINOR DWARF SPHEROIDAL GALAXIES. AFTER DETECTING AND REJECTING SEVERAL VELOCITY VARIABLES, I DERIVE A VELOCITY DISPERSION OF APPROXIMATELY 10 KM/S FOR EACH GALAXY. THIS VALUE IS SUBSTANTIALLY LARGER THAN THAT WHICH IS EXPECTED FROM THESE GALAXIES IF THEY HAD A "NORMAL" MASS-TO-LIGHT RATIO. THIS RESEARCH WAS PARTIALLY SUPPORTED BY NSF GRANT AST86-11405.

QSO HOST GALAXIES AS POTENTIAL 'YARDSTICKS' FOR ANGULAR DIAMETER-REDSHIFT TEST

Leonid M. Ozernoy (Harvard-Smithsonian Center for Astrophysics)

According to available data, radio-quiet QSO host galaxy scale lengths (determined, for resolved luminosity, from the slopes of the $\log I$ vs R plots) are approximately the same and close to that of companion galaxies, $\ell = 2.1 \pm 0.1$ kpc ($\sigma = 1.0$ kpc), independently of any other parameters including redshift, up to $z \sim 0.6$ (Hutchings et al. 1987, *Ap. J.* 280:41). No substantial differences in scale-length distribution of optical, radio, or X-ray selected QSS have been found. Therefore, QSO host galaxies seem to be good candidates for serving as 'yardsticks' for the classical angular diameter-redshift test. The choice between a flat ($\Omega = 1$) and an open (e.g., $\Omega = 0.2$) Friedmann model could be made by finding a minimum in angular size $\theta(z)$ located between $z_{min} = 1.25$ and $z_{min} = 2.2$, correspondingly, i.e., by observations of moderately distant QSO host galaxies. Such host galaxies can be detected and their θ 's measured with the use of Hubble Space Telescope: one would expect $\theta_{min} = 0.37$ to 0.49 arc sec at $\Omega = 0.2$ to 1 ($H_0 = 100$ km/s/Mpc) if $\ell = 2.1$ kpc kept the same at $z \rightarrow z_{min}$. Possible evolutionary changes in ℓ (such as due to sinking the companions of the host galaxies) must be accounted for in order to obtain reliable constraints to the value of Ω . For looking at QSO host galaxies far beyond z_{min} , submillimeter wave range might be used. Since very large fractions of nearby QSO host galaxies have spiral morphology, are interacting, and are in groups or small clusters of galaxies, there are serious reasons to expect that they, like starburst galaxies, can have a powerful far infrared emission peak (at $\lambda \sim 100\mu\text{m}$) redshifted to submm wave lengths. A submm telescope array is able to detect both starburst and QSO host galaxies up to $z \sim 10$ (if they exist there!). Thus submm interferometric observations could detect the most distant objects seen so far and measure their sizes which would give invaluable astrophysical and cosmological information.

UBV PHOTOMETRY IN FOUR SOUTHERN OPEN CLUSTERS ASSOCIATED(?) WITH SUPERNOVA REMNANTS

C.J. Peterson (U. Missouri - Columbia)

New photoelectric photometry obtained at Cerro Tololo Inter-American Observatory for the four open clusters Stock 14, Trumpler 21, Lyngå 1, and Pismis 20 is presented. Distance moduli and extinctions have been determined by dereddening to the appropriate intrinsic two-color line using the computer algorithm REDD of FitzGerald, Harris, and Jylänne (1988), with the results that $(m-M)_0 = 12.14 \pm 0.12$, 10.52 ± 0.13 , 11.48 ± 0.12 , and 12.04 ± 0.19 , respectively. On the basis of these derived distances, only Pismis 20 may have a physical association with a radio supernova remnant, though any interpretation is complicated by the complexity of the history of recent star formation in its vicinity.

THE DISTANCES TO THE VIRGO AND URSA MAJOR CLUSTERS AND A DETERMINATION OF H_0

Michael J. Pierce (DAO) and R. Brent Tully (IFA, U. of Hawaii)

Multicolor CCD photometry of spiral galaxies within the Ursa Major and Virgo clusters is presented and combined with accurate 21 cm HI line width measurements in order to investigate the luminosity-line width (TF) relations as a distance indicator. There is evidence for a slight morphological type dependence of the TF relations, although the effect is present only at the 1-2 σ level. No difference in the slope of the TF relations is found between the two clusters, despite the considerable differences in densities and crossing times. A significant reduction in the dispersion of the TF relations is made possible from accurate total magnitudes and accurate inclinations derived from ellipse fitting to galaxy isophotes. In the Ursa Major Cluster the intrinsic dispersion in the TF relations is found to be only 0.25 mag. An absolute calibration was obtained by fitting to three nearby galaxies with reasonably accurate distances: M31, M33, and NGC 2403. These systems establish the distance to the Ursa Major Cluster to be 15.5 ± 1.2 Mpc and the mean distance to the Virgo Cluster to be 15.6 ± 1.5 Mpc, with a slightly greater uncertainty due to the possible presence of superposed galaxies. A determination of the value of the Hubble Constant was made by assuming a Virgocentric flow of 300 km s^{-1} at the Local Group, yielding a derived value of $H_0 = 85 \pm 10 \text{ km s}^{-1} \text{ Mpc}^{-1}$.

GLOBAL CLUSTER FORMATION IN RELATION TO ITS ENVIRONMENT.

F. Pinto (B.Y.U.)

The process of formation of globular cluster-like objects appears to be deeply affected by both external and internal factors. In the scenario where these stellar systems form out of massive protoclouds, magnetic field and gas turbulence determine the velocity dispersion of the subfragments where star formation actually takes place, and, as a consequence, the overall subsequent evolution of the stellar component. The eventual expulsion of the gas cloud from the cluster by the stars is an extremely critical process, which can result in the dispersion of the cluster. If the newly formed cluster remains bound, a change in radius is generally expected. This dynamical readjustment can lead not only to an expansion, but also to a collapse, depending on the relative importance of magnetic field and turbulence, and on the star formation efficiency. A model for the dynamical evolution of the bright young associations in the Large Magellanic Cloud shows the importance of stellar wind activity in the process of gas expulsion, and of the initial stellar birth rate. This approach is able to qualitatively describe the effect of a number of physical parameters on the general features of the globular cluster population that is produced. Possible applications to the case of primeval globular cluster formation in the Milky Way are discussed.

CCD PHOTOMETRY OF THE GALACTIC OPEN CLUSTER NGC 7790

G. Romeo (U. of Bologna), A. Bonifazi (Bologna Obs.), F. Fusi Pecci (U. of Bologna), M. Tosi (Bologna Obs.)

NGC 7790 is an open cluster of special interest in the field of distance scale determinations because it contains three classical Cepheids (CE Cas a, CE Cas b, CF Cas). It is located in proximity of the Perseus spiral arm and has an intermediate age (1.5×10^8 yr).

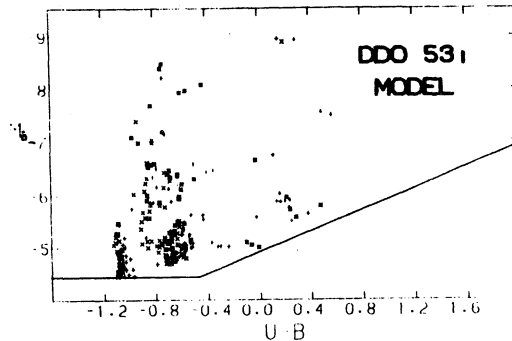
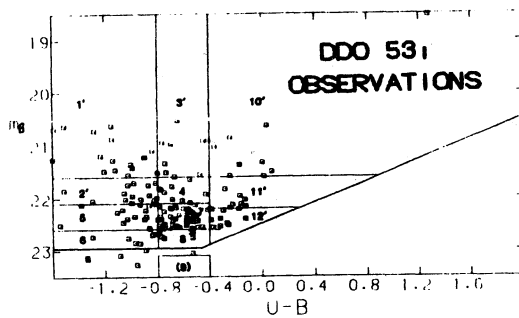
In order to obtain a very accurate photometry of this cluster, we have observed it in the V, B, R, and I bands with the CCD camera of the 1.5 m telescope of the Bologna Observatory and we have reduced the resulting data with the ROMAFOT package. The colour-magnitude diagrams thus obtained have been used to derive new and more accurate values for the reddening and the distance modulus of NGC 7790. The three Cepheids members of NGC 7790 have been used to check the period-luminosity and the period-luminosity-colour relations.

The age of the cluster is derived by means of an improved method of isochrone fitting. The luminosity function of the cluster, and the related membership problems are also discussed.

RESOLVED STELLAR POPULATIONS OF LUMINOUS STARS IN DWARF IRREGULAR GALAXIES

R. Ruotsalainen (Eastern Washington University)

The matchings of observational color-magnitude diagrams for the resolved stars in the galaxies DDO 53 and GR 8 to expected distributions based upon stellar evolutionary models yield values of the distance modulus μ for these galaxies. Presently, uncertainties in the derived distance moduli are of the order: $\delta\mu = 0.5$ mag (whose associated uncertainties in the derived distances are about 25%). Reductions in these uncertainties will result from the inclusion of larger numbers of resolved stars in these galaxies.



DARK MATTER IN SPIRAL GALAXIES AND HUBBLE'S CONSTANT

P. SALUCCI AND C.S. FRANK (DURHAM U.)

A DETAILED STUDY OF THE DYNAMICS OF SPIRAL GALAXIES REVEALS THAT THE FRACTIONAL AMOUNT OF DARK MATTER PRESENT WITHIN THE OPTICAL RADIUS DECREASES WITH THE LUMINOSITY OF THE GALAXY. NEGLECTING THIS EFFECT, AS IS USUALLY DONE IN THE STANDARD TULLY-FISHER RELATION (WHICH IMPLICITLY ASSUMES THAT THE FRACTIONAL AMOUNT OF DARK MATTER IS INDEPENDENT OF LUMINOSITY), LEADS TO A BIAS IN THE ESTIMATION OF DISTANCES. WE HAVE DEVELOPED A METHOD WHEREBY, USING OBSERVED ROTATION CURVES, WE CAN SEPARATE THE CONTRIBUTION TO THE CIRCULAR VELOCITY OF THE DARK MATTER FROM THAT OF THE VISIBLE MATTER. WE THUS OBTAIN A RELATION BETWEEN LUMINOSITY AND THE COMPONENT OF THE CIRCULAR VELOCITY DUE TO LUMINOUS MATERIAL ALONE. THIS RELATION IS ANALOGOUS TO THE STANDARD TULLY-FISHER RELATION, BUT HAS 0.2 - 0.3 MAG LESS SCATTER THAN IT AND THUS PROVIDES AN IMPROVED DISTANCE INDICATOR. WE SHOW THAT THIS NEW RELATION (OF WHICH THE STANDARD TULLY-FISHER RELATION IS JUST A FIRST-ORDER APPROXIMATION) FOLLOWS FROM THE ASSUMPTION OF CENTRIFUGAL EQUILIBRIUM OF AN EXPONENTIAL THIN DISK EMBEDDED IN A SPHERICAL HALO. OUR NEW RELATION IS FREE OF TWO PROBLEMS THAT PLAGUE THE TULLY-FISHER RELATION: A STRONG DEPENDENCE OF ITS SLOPE ON WAVEBAND AND AN EXCESSIVE MALMQUIST BIAS. THESE TWO PROBLEMS CAN BE SHOWN TO ARISE FROM THE VARYING AND UNACCOUNTED PRESENCE OF DARK MATTER IN SPIRAL GALAXIES. THE UNDERSTANDING OF THE PHYSICS UNDERLYING OUR NEW RELATION AND ITS SMALL SCATTER (0.5-0.5) MAG GIVE RISE TO A SIGNIFICANT IMPROVEMENT IN THE DETERMINATION OF THE EXTRAGALACTIC DISTANCE SCALE.

STAR FORMATION IN COMPRESSED GLOBULES IN THE H II REGION IC 1396

R. D. Schwartz and B. A. Wilking (U. of Missouri, St. Louis), and A. L. Gyulbudaghian (Byurakan Astrophysical Observatory, Armenian S.S.R.)

The H II region IC 1396, located at a distance of about 800 pc in the Cep OB2 association, is dominated by a single O6 star and a number of early B stars. The region, about 3° in extent, is rich in dark globules and other dust features outlined by the flow from the central O star. We have identified 17 globules associated with this system, and report results of an analysis of IRAS sources in or near the globules. Most of the globules and dust structures exhibit extended far-IR emission which is probably caused by external heating from O/B stars in the region. At least 8 IRAS sources in the PSC with $F(100 \mu\text{m}) > F(60 \mu\text{m})$ are found with bolometric luminosities considerably in excess of that which can be caused by external heating. Three of these sources appear to be embedded in globules, and one (21391+5802) has been investigated with ground-based $2 \mu\text{m}$ photometry. Four discrete $2 \mu\text{m}$ sources within a $40'' \times 40''$ region in the globule have been detected, and CO measurements suggest the presence of mass outflow from one or more young stellar objects within the globule. It is suggested that a small trapezium-like cluster of young stars has recently formed within this globule.

HIGH RESOLUTION IMAGING OF VIRGO CLUSTER GALAXIES

T. Shanks (U. of Durham), N.R. Tanvir (U. of Durham) and M. Redfern (U. of Galway)

Between the 9th and the 16th of April 1988 we used the new William Herschel telescope on La Palma to image two Virgo cluster galaxies in seeing of approximately $0.''5$ FWHM. The aim was to try and resolve the brightest stars in these galaxies and thus provide a powerful new indication of the Virgo cluster distance. The galaxies were selected from Sandage & Bedke's list of galaxies that are likely to be resolved into stars with the Hubble Space Telescope and that have bright overlapping stars which can be used as reference stars for "image sharpening". We observed using an IPD photon counting detector whose time resolution for photon detections was of order 1 millisecond. The field of the IPD was 12 arcsec with approximately 0.1 arcsec spatial resolution. In two 4hr overrides we obtained good data on the galaxies NGC 4639 and $7^\circ 27'$. If our data reduction is successful image sharpening could improve the seeing from $0.''5$ to $0.''2$ FWHM. In this case there is every possibility that the brightest stars in these galaxies could be resolved, giving a vital new clue to the Virgo distance in advance of the launch of the Space Telescope. The preliminary results of this investigation are reported in this paper.

A NEW VALUE OF THE HUBBLE CONSTANT FROM THE SIZE OF THE GALACTIC BULGE

D.M. Terndrup (CTIO - NOAO)

New surface photometry of the nuclear bulge of the Galaxy can be used to derive the relative distance between the Galactic center and the Virgo cluster. The data calibrate the velocity dispersion/size relation obtained for Virgo spirals by Dressler (1987 Ap. J. 317, 1). The surface brightness distribution of the Galactic bulge/spheroid is well represented by a de Vaucouleurs law with scale length $r_e \sim 1$ kpc, and is therefore somewhat more concentrated than the globular cluster system. A preliminary Virgo distance from this method, when combined with typical values of the Galaxy's infall velocity, gives $H_0 \sim 70 - 80 \text{ km s}^{-1} \text{ Mpc}^{-1}$.

A NEW TECHNIQUE FOR MEASURING EXTRAGALACTIC DISTANCES

John Tonry (MIT)

We describe a relatively direct technique of determining extragalactic distances. The method relies on measuring the luminosity fluctuations that arise from the counting statistics of the stars contributing the flux in each pixel of a high signal-to-noise CCD image of a galaxy. The amplitude of these fluctuations is inversely proportional to the distance of the galaxy. This approach bypasses most of the successive stages of calibration required in the traditional extragalactic distance ladder; the only serious drawback to this method is that it requires an accurate knowledge of the bright end ($M_V \leq 3$) of the luminosity function. Potentially, this method can produce accurate distances of elliptical galaxies and spiral bulges situated closer than about 20 Mpc. We explain here how to calculate the value of the fluctuations, taking into account various sources of contamination and the effect of finite spatial resolution, and we demonstrate via simulations and CCD images of various galaxies in the local supercluster the feasibility and limitations of this technique.

THE CASE FOR U CARINAE AS A LONG PERIOD CEPHEID CALIBRATOR IN A GALACTIC OB ASSOCIATION.

D.G. Turner (St.Mary's U.)

An examination is made of the likely membership of the 39-day classical Cepheid U Carinae in an extended subgroup of the association Car OB2. The evidence in this case consists of the Cepheid's spatial location and its remarkably close similarity in evolutionary status and radial velocity to nearby members of Car OB2. Association Cepheids are believed to be less useful as calibrators for the galactic PL relation than cluster Cepheids owing to greater uncertainties in their derived distances and reddenings. However, both of these parameters can be obtained quite reliably for U Carinae, making it a valuable reference object for the long-period end of the Cepheid PL relation.

CCD PHOTOMETRY OF MAGELLANIC CLOUD RR LYRAE VARIABLES

Alistair R. Walker (NOAO - CTIO)

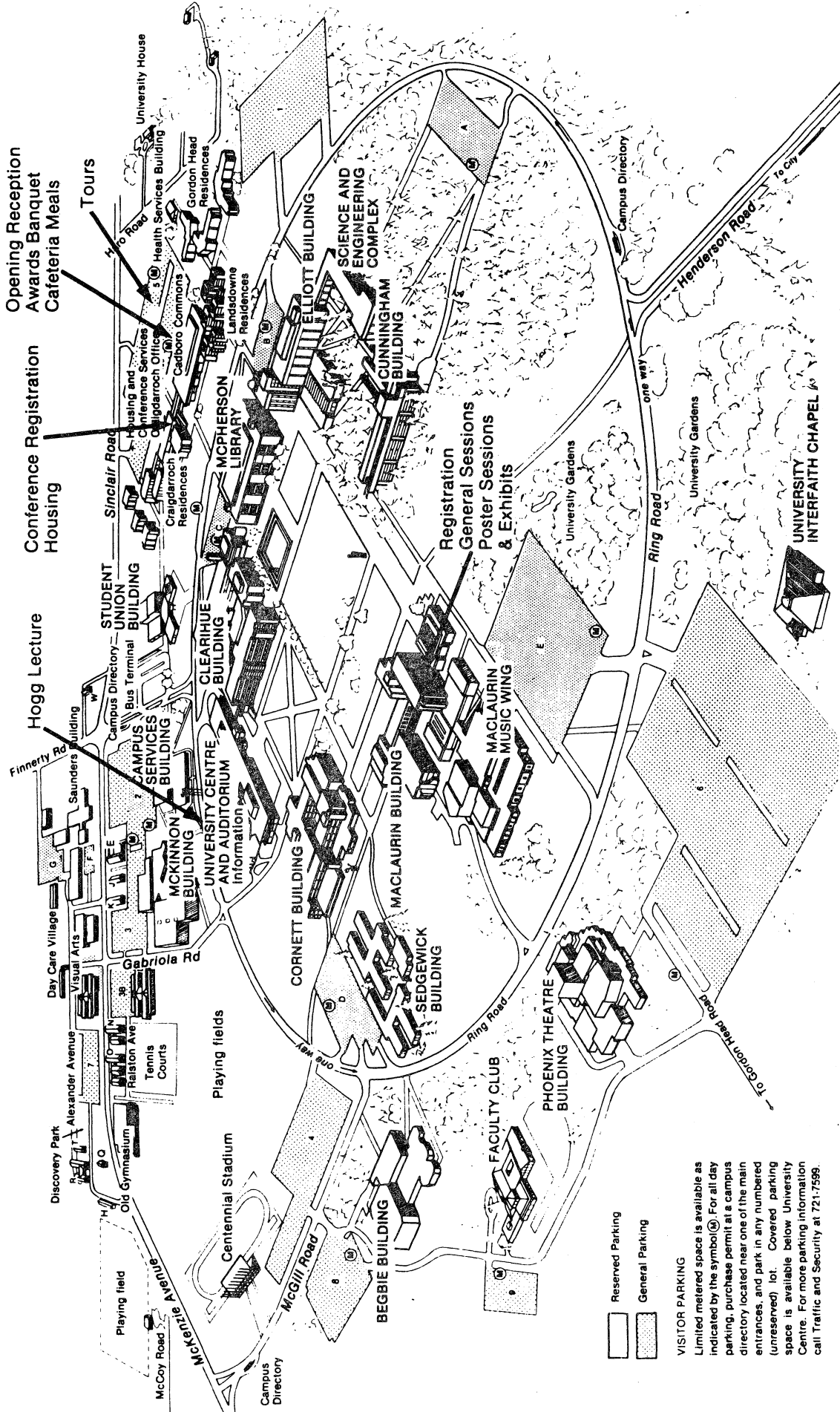
Light curves have been produced, using the SAAO 1.0m and CTIO 0.9m, 1.5m and 4m telescopes, for RR Lyrae variables in the Magellanic Cloud clusters NGC 121, 1786, 2210, 2257 and for field RR Lyraes near NGC 2257. The NGC 2210 data were used to demonstrate that the zeropoint of the Cepheid PL relation required revision by about 0.15 mag, since confirmed. The NGC 1786 and NGC 2210 data give an LMC distance modulus of 18.43 ± 0.05 mag if metal poor RR Lyraes have $\langle M_V \rangle = 0.6$. The NGC 121 data together with that for the LMC clusters produce a differential SMC to LMC modulus of 0.43 mag, rather greater than given by the Cepheids. This can be explained if the absolute magnitudes of metal poor RR Lyraes scale as $0.20 [\text{Fe}/\text{H}]$, but a geometric explanation is also possible.

TULLY-FISHER DISTANCES TO GALAXY CLUSTERS USING CCD PHOTOMETRY

JEFFREY A. WILICK, SPACE SCIENCES LABORATORY AND DEPARTMENT OF PHYSICS, UNIVERSITY OF CALIFORNIA, BERKELEY

RED AND NEAR INFRA-RED CCD IMAGES HAVE BEEN OBTAINED FOR OVER 160 SPIRAL GALAXIES IN 12 CLUSTERS. THE DATA HAS BEEN USED TO STUDY THE FORM OF AN OPTIMAL LUMINOSITY-ROTATION VELOCITY RELATION, AND TO DETERMINE ACCURATELY THE UNCERTAINTY IN DISTANCE ESTIMATES DERIVED FROM IT. THE RESULTS ARE IN GOOD AGREEMENT WITH THOSE OF PIERCE AND TULLY FOR THE NEARBY VIRGO AND URSA MAJOR CLUSTERS, BUT THE SLOPE AND SCATTER OF THE RELATION ARE BETTER DETERMINED IN THE PRESENT STUDY BECAUSE OF THE LARGER NUMBER OF CLUSTER GALAXIES IN THE SAMPLE. A BIAS ASSOCIATED WITH THE MAGNITUDE LIMIT OF THE SAMPLE IS DEMONSTRATED TO BE PRESENT, BUT IS CORRECTED FOR USING A NOVEL TECHNIQUE WHICH HAS BEEN VERIFIED BY NUMERICAL SIMULATIONS. THIS METHOD ALLOWS THE SLOPE, ZERO POINT, AND SCATTER OF THE TULLY-FISHER RELATION TO BE ESTIMATED IN A BIAS-FREE FASHION. DISTANCE ESTIMATES FOR THE CLUSTERS ARE OBTAINED, AND A HUBBLE CONSTANT IN THE NEIGHBORHOOD OF 80 KM/SEC/MPC IS INDICATED.

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HAIDA MOON

Artist: Clarence Steven Mills

Haida Name: Gah-ghin skuss (out of your own land)

Born: October 30, 1958

Member of the Eagle Clan, Skidegate

Crest: Raven, Grizzly Bear

Carvings in Argillite, Ivory, Yellow Cedar, Silver and Gold, Limited Edition Silkscreen Prints

Clarence Mills was born into the Wilson family at Skidegate, Queen Charlotte Islands. His grandmother Na-nai (Kathleen Hans) told his mother that he was destined to be a Haida carver -- a reincarnation of her late husband, Isaac Hans, a renowned Haida artist. Henry Young, his great-grandfather, was also a great Haida carver, and from this family Clarence received his Haida name. His objective is to continue to capture the beauty of the Haida art by carving traditional monumental size totems and plaques, and producing silkscreen prints and jewelry in silver and gold.

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