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OBSERVATORIO ASTRONOMICO
LA PLATA • REP. ARGENTINA

LA PLATA, December 18, 1970

Dr. Kees de Jager,
General Secretary of the I.A.U.,
Space Research Laboratory of the Astronomical Institute,
21 Beneluxlaan,
UTRECHT
THE NETHERLANDS

Dear Kees,

I am enclosing herewith the original and two copies of the report that Josip Kleckek and me prepared in relation to the School for Young Astronomers at Córdoba. The original is for you to send to Unesco (M. Fournier d'Albe) and the copies for you and for Edith Müller.

As you will notice from the list of expenditures with Unesco funds we have spent the whole amount of 8000 dollars, and since I have received a first installment of 6000 dollars, Unesco should send me now a check for the remaining 2000 dollars. However, I would suggest the following procedure:

- 1) That Unesco send the money to you
- 2) That you send out the following checks:

Dr. Luiz Muniz Barreto
Observatório Nacional de Rio de Janeiro
Rua General Bruce, 586
Rio de Janeiro
Brasil

485
150 dollars

Dr. Jurgen Stock
Departamento de Astronomia
Universidad de Chile
Casilla 36-D
Santiago
Chile

486
120 dollars

Dr. Víctor Blanco
Observatorio Interamericano de Cerro Tololo
Casilla 63-D
La Serena
Chile

487
150 dollars

Dr. Adalino G. de Anastro
Departamento de Astronomia
Universidad de Chile
Casilla 36-D
Santiago
Chile

488
90 dollars



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3) That you reserve 330 dollars for J. Kleczek and proceed according to the instructions you will receive from him.

4) The amounts listed under 2) and 3) add to 840 dollars, and are payments to be made as honoraria to the mentioned lecturers. The remainder, that is, 1160 dollars should be sent to me by registered air mail to reimburse for money that we have already spent. To speed up things perhaps the IAU could send me a check for the latter amount as an advance payment until the check from the Unesco reaches you.

I am keeping here the receipts of the expenditures made with Unesco money and shall render to the Argentine National Research Council the receipts corresponding to the expenditures made with their money.

With all best wishes,

Cordially,

Jorge Sahade

REPORT

of the UNESCO / IAU Summer School for Young Astronomers held in Córdoba,
Argentina in 1970

The 1970 International School for Young Astronomers was organized with the aim of promoting the growth of Astronomy in Latin America and was held at the Observatory of the National University of Córdoba in Argentina because of the astronomical level of this country and as an homage to the centenary of the Córdoba Observatory. The School run from October 5 through November 27.

The School was advertised all over Latin America by writing to the appropriate institutions and by publishing an announcement in the I.A.U. Information Bulletin. Thirty three applications were received of which 27 were accepted. Only 21 students were able to come and attend the courses regularly; one young astronomer from La Plata, Argentina, attended only the course on radio astronomy and a young astronomer from Uruguay attended only the lectures delivered the first week. The School attendance came from Argentina, Bolivia, Brazil, Colombia and Uruguay

The background of the young astronomers attending the School was not uniform. This was clear from the applications but it was thought desirable and challenging to have such a difference in levels.

The students from Argentina had a very high background in physics and mathematics and were already doing theoretical research in specific subjects of astronomy. Those from Bolivia had a very low level. The students from Brazil had a very good background in mathematics and physics and most of them also partially in astronomy as they are engaged in photoelectric work in their country. The young man from Colombia had also a very good background in mathematics and physics and as for the Uruguayans, two of them had a very good background in mathematics and physics and were doing some theoretical work in astronomy and the rest had a lower level of knowledge but their interest in astronomy was extremely high. One could say that, in general, all the students were very much interested in profiting as much as they could from the lecturers.

Because of the aim of the 1970 School and because of the conclusions from the applications received, emphasis was placed on practical work. The students were able to learn the things one could do with an instrument like the 1.50 m telescope at Bosque Alegre, with the Carte du Ciel astrograph, with the micrometer, and with all the auxiliary equipment that is at disposal in Córdoba.

The students had to give a colloquium and answer the questions in a final written examination. The colloquia given were in general of high quality. The results of the written examination were according to the expectations: they were below average in the case of the Bolivians and the Uruguayans with lower level of background; the rest were above the average.

Apart from the UNESCO funds, the School received a grant of the equivalent to u/s 4130,45 at the present rate of exchange of the Argentine peso, from the Argentine National Research

Council (Consejo Nacional de Investigaciones Científicas y Técnicas). This money was to pay the travel expenses of non-local lecturers and for general expenditures. Furthermore, the following organizations helped

- The University of Córdoba that allowed the School to operate at the Córdoba Observatory and use all of its equipments and facilities.
- The Government of Córdoba that sponsored the School; helped in many ways also by offering four excursions and a concert at the official theater.
- The car factory IKA - RENAULT that provided transportation for the students four times each day and also to the Astrophysical Station in Bosque Alegre when observing was scheduled. IKA - RENAULT also gave the School plastic briefcases where we could hand the appropriate material to the students and lecturers, and offered a lunch at the plant after which we made a short visit through it.

In general, one could say that the School was a success in every respect and that the main assets were the contacts that students from different Latin American countries made among themselves and with astronomers. It was too bad that no student from the other Latin American countries came although the invitations were extended to all.

This report is supplemented by tabulations that give the list of participants, the list of lecturers, the content of the lectures and a resumé of the expenditures.

LA PLATA, December 5, 1970



J. Sahade
Director
1970 International School
for Young Astronomers



J. Kleczek
Secretary
1970 International School
for Young Astronomers

PARTICIPANTS

Name	Country	Address
Lidia Coscia	Argentina	Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Perú 272
Eduardo R. Iglesias	Argentina	Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Perú 272
Michael Salem	Argentina	Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Perú 272
Zulema Beatriz Gamba *	Argentina	Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Perú 272
Edgar Delano Berdeja Chale	Bolivia	Departamento de Astronomía, Universidad Mayor de San Andrés, Av. Mariscal Santa Cruz N° 1175, La Paz
Gastón Pardo del Villar	Bolivia	Departamento de Astronomía, Universidad Mayor de San Andrés, Av. Mariscal Santa Cruz N° 1175, La Paz
Israel Saravia Unzueta *	Bolivia	Laboratorio de Física Cósmica, Universidad Mayor de San Andrés, La Paz
Macedonio Trujillo Rojas	Bolivia	Departamento de Astronomía, Universidad Mayor de San Andrés, Av. Mariscal Santa Cruz N° 1175, La Paz
Jair Barroso Junior	Brazil	Observatório Nacional, R. General Bruce, 586, Rio de Janeiro - GB - ZC - 08
Carlos A. Pinto Coelho de Oliveira Torres	Brazil	Comissao Brasileira de Astronomia, Observatório Nacional, Escritório de Belo Horizonte, Caixa Postal, 1527, Belo Horizonte, Estado de Minas Gerais
Rodrigo Dias Tarsia	Brazil	Comissao Brasileira de Astronomia, Observatório Nacional, Escritório de Belo Horizonte, Caixa Postal, 1527, Belo Horizonte, Estado de Minas Gerais
Eduardo Janot Pacheco	Brazil	Instituto Tecnológico de Aeronáutica, Observatório Astronomico, São José dos Campos, São Paulo
Germano Rodrigo Quast	Brazil	Instituto Tecnológico de Aeronáutica, Observatório Astronomico, São José dos Campos, São Paulo
Eduardo N. Vianna	Brazil	Centro de Rádio-Astronomia e Astrofísica, Universidade Mackenzie, Rua Maria Antônia, 403, São Paulo
Miguel H. Ibañez Sánchez	Colombia	Observatorio Astronómico Nacional, Apartado Nacional N° 2584, Bogotá, D.E.
Sayd Codina Landaberry	Uruguay	Departamento de Astronomía y Física, Facultad de Humanidades y Ciencias, Cerrito 73, Montevideo
Nelba Denis	Uruguay	Instituto Magisterial Superior, Facultad de Ingeniería y Agrimensura, Julio Herrera y Reissig 565, Montevideo
Rubens G. Freire Ferrero	Uruguay	Departamento de Astronomía y Física, Facultad de Humanidades y Ciencias, Cerrito 73, Montevideo

19.	Juan Carlos Gera	Uruguay	Facultad de Ingeniería y Agrimensura, Instituto de Mecánica Celeste Aplicada, Julio Herrera y Reissig 565, Montevideo
20.	Luis M. González Pérez	Uruguay	8 de Octubre 3255, Montevideo
21.	Carlos Schweizer	Uruguay	Facultad de Ingeniería y Agrimensura, Julio Herrera y Reissig 565, Montevideo
22.	Igor Mirabel *	Argentina	Observatorio Astronómico, La Plata
23.	Gladys Vergara **	Uruguay	Facultad de Ingenieros y Agrimensura, Universidad de la República, Julio Herrera y Reissig 565, Montevideo

* Mr. Mirabel attended the School only during the course on Radioastronomy.

** Mrs. Vergara attended the School only the first week.

LECTURERS

Name	Country	Institution	Subject	Number of lectures of 60 ^m each
Dr. V. Blanco	Chile	Cerro Tololo Interamerican Observatory	Stellar Interiors	10
Dr. A. Feinstein	Argentina	Observatorio Astronómico, La Plata	Photoelectric Photometry	18
Dr. G.M. Iannini	Argentina	Observatorio Astronómico, Córdoba	Photographic Astrometry	8
Dr. J. Kleczek	Czechoslovakia	Ondřejov Observatory	Modern Astrophysics The Sun	16 6
Dr. J. Landi Dessy	Argentina	Observatorio Astronómico, Córdoba	Astronomical Instruments The Magellanic Clouds	14 10
Dr. L. Milone	Argentina	Observatorio Astronómico, Córdoba	The Photographic Plate	2
Dr. L. Muniz Barreto	Brazil	Observatorio Nacional, Rio de Janeiro	Binary Stars	10
Lic. J.C. Muzzio	Argentina	Observatorio Astronómico, La Plata	Variable Stars	8
Dr. Adelina G. de Moreno	Chile	Observatorio Nacional, Santiago	Photoelectric Spectrophotometry	6
Dr. J. Sahade	Argentina	Observatorio Astronómico, La Plata	Spectroscopy and Stellar Atmospheres Close Binaries	12 10
Dr. J.L. Sérsic	Argentina	Observatorio Astronómico, Córdoba	Stellar Aggregates Some Problems in Extragalactic Astronomy	10 8
Dr. J. Stock	Chile	Observatorio Nacional, Santiago	Site Surveying	8
Dr. K. C. Turner	Argentina	Instituto Argentino de Radioastronomía	Radioastronomy	12

CONTENTS OF THE LECTURES

Subject	Name of the Professor
<u>Stellar Interiors</u>	V.M. Bianco
<u>Photoelectric Photometry</u>	A. Feinstein
Fundamental notions. Radiation laws. Magnitud, color. Description of photoelectric photometers. Photomultipliers and detectors. Photometric systems. Wide, medium and narrow band. Observational techniques. Atmospheric extinction. Application of photometry to the study of celestial objects: 1) stars 2) stellar clusters 3) galaxies Determination of the light curve of variable stars. Periods. Absolute magnitudes. Eclipsing binaries. Interstellar absorption. Dark clouds. Calibration of the absolute magnitude of stars. Photometry in wave lengths larger than 1 micron. Infrared stars. Study of the evolution of stars. Spiral structure of the Galaxy derived from photometric observations. General view of photometry in present and future investigations.	
<u>Photographic Astrometry</u>	G. M. Iannini
Reduction of astrometric plates. Method of the dependences. Method of the 3 constants.	
<u>I. Modern Astrophysics</u>	J. Kleczek
1. Elementary particles: stables, quasi-stables and non-stables. Its role in the structures of the universe. 2. Interactions of elementary particles in the universe: a) nuclear (thermonuclear reactions) b) electromagnetic (γ , X, UV, optical and infrared astronomy, radioastronomy; interactions in larger scale) c) weak (neutrino astronomy) d) gravitational (Newton, Einstein) 3. Evolutionary processes in the universe.	
<u>II. The Sun</u>	
1. Structure of the Sun. 2. Production of solar energy.	

3. Solar hydromagnetics.
4. Evolution of the Sun.
5. Interaction Sun-Earth.

I. The Magellanic Clouds

J. Landi Dessy

1. The local group. Its members. Galactic subgroup. Andromeda subgroup. Other galaxies in the local group.
2. The Magellanic Clouds, Shape, brightness and distance from the Clouds. Variable stars. Stellar spectra. Problems of spectral classification. S Doradus. Supertitans and Titans. Nebulae and clusters. General stellar content. HR diagram. Hydrogen in the Clouds. Some observational needs.
3. Spheroidal dwarf systems, their structure. HR diagram. Variable stars.
4. Galaxies with prevailing Population I. M 33. Andromeda and its companions. Comparison of the different systems with the Magellanic Clouds.

II. Astronomical Instruments

1. The theory of the optical errors. Refractors. Common, aplanatic and anastigmatic reflectors. Correctors in the prime focus. Field lens and focal reducers. Advantages in the use of different foci according to the instrument diameter. Tables for the computation of optical systems. Some ideas on the Ikonal. Optical quality in a space telescope.
2. Schmidt, Matsukov, Wright, Baker-Schmidt, Slevogt, etc. Cameras. Combined telescopes. Different types of azimuthal and horizontal mountings moved by computers.
3. Auxiliary equipment. Direct plates. Image tubes. Stellar and nebular spectrographs. Perot-Fabry interferograms. The photographic plate and its calibration. Determination of radial velocities by different methods. Spectrophotometry. Systems to increase the efficiency.
4. Spectral classification. Historical revision. Systems of two and of several parameters. Information problems concerning spectrograms. Quality, dispersion and information that is attainable. Stellar rotation.
5. Detectors in the infrared and in the extreme violet. Machines to measure radial velocities and interferograms.

Photoelectric Spectrophotometry

A.G. de Moreno

1. General considerations.
2. Instrumental effects.
3. Monochromatic atmospheric extinction.
4. Energy distributions; study of the continuum.
5. Spectral classification in two and three dimensions by spectrophotometric methods.
6. Equivalent widths.
7. Correlations among the different measured parameters.

Binary Stars

L. Muniz Barreto

1. The problem of binary stars.
Historical outline. Importance of double stars in Astronomy. Observational methods according to types. Instrumental limits.
2. Visual binary stars.

2. Visual binary stars.

Method of the filar micrometer. Method of the double image. Photographic method. Other methods. Determination of Δm and $\Delta C.I.$

3. Determination of orbits of visual binary stars. Apparent and relative orbits. Orbital elements. Principal methods of orbit computation. Results: stellar masses, dynamic parallaxes, distribution of double stars. Astrometric binaries.

4. Spectroscopic binaries.

The velocity curve. Determination of orbital elements. Principal methods.

5. Spectroscopic binaries.

Examples of the determination of orbital elements.

Variable Stars

J.C. Muzzio

1. General considerations.

2. Eclipsing variables.

3. Intrinsic variables.

4. Cataclysmic variables.

I. Spectroscopy and stellar atmospheres

J. Sahade

1. The continuum spectrum. Observational facts. Concepts of temperature. Opacity sources. Transfer equation. Model atmospheres.

2. The line spectrum. Observational facts. Line broadening mechanism. Profiles.

3. Electrical fields. Magnetic fields. Stellar rotation.

4. Curves of growth.

5. Forbidden and non-forbidden emission lines.

II. Close Binaries

1. Algol systems.

2. Beta Lyrae.

3. Wolf-Rayet stars (binary systems).

4. Eruptive stars.

5. Evolution of binary systems.

I. Stellar Aggregates.

J.L. Sérsic

1. Stellar aggregates of Population I.

Stellar associations. Open clusters. HR diagram. Functions of present and original luminosity. Velocity formation of Population I stars.

2. Stellar aggregates of Population II.

Globular clusters. HR diagram. System of the globular clusters. The nucleus of the Galaxy. The disc of the Galaxy.

3. **Interstellar medium.**
Neutral component. Ionized component. H II regions. Energetic balance. Magnetic fields and high energy particles.
4. **Extragalactic systems.**
The Milky Way as a galaxy. Morphology of the galaxies. Classification. Global properties. Systems of galaxies.

II. Some Problems in Extragalactic Astronomy

1. The cosmic scale of distances.
2. Peculiar galaxies and violent events.
3. Evolution of galaxies.

Site Surveying

J. Stock

I. **Limitations of ground-based astronomy.**

1. **Atmospheric turbulence.**
 - a) Limitation of resolution
 - b) Scintillation
 - c) Limiting magnitude
2. **Atmospheric extinction.**
 - a) Atmospheric windows
 - b) Variability of atmospheric extinction
3. **Sky background intensity.**
 - a) Man-made sources
 - b) Air glow, aurora
 - c) Natural extraterrestrial background

II. **The atmospheric turbulence.**

1. **Empirical and theoretical data.**
 - a) Dependence on aperture
 - b) Dependence on air mass
 - c) Model of turbulent cells for seeing effects
 - d) Model of turbulent cells for scintillation
2. **Methods and equipment for seeing determination.**
 - a) Danjon method
 - b) Image motion tracers
 - c) Double-beam telescope
3. **Methods and equipment for scintillation measurements.**

III. **Meteorology for astronomical sites.**

- a) Mechanical turbulence
- b) Temperature inversions
- c) Water vapor stratification
- d) Air motion and local topography
- e) Surface cover and astronomical climate
- f) Local cloud formation
- g) Meteorological equipment for astronomical site surveys.

IV. Site survey results

- a) Chile
- b) Argentina
- c) Western United States
- d) Mexico
- e) South Africa
- f) Venezuela

Radioastronomy

K.C. Turner

1. What can be observed at radio frequencies.
The spectra of various objects.
Very brief survey of physical mechanisms involved.
2. What we observe with I.
Antennas.
3. What we observe with II.
Receivers.
4. What an observation looks like.
Noise and problems of data analysis.
5. On drawing conclusions.
A few examples of the chain of reasoning from observations to models of objects in the universe.
6. What's left over.
This may come at the end, as in the middle, to finish something there wasn't time for.

PRACTICAL WORK

Coordinator: Dr. LUIS MILONE, Observatorio Astronómico, Córdoba, Argentina

Name	Subject
Gustavo Carranza	H α interferometry
José Colazo	Spectrophotometry
Horacio Dottori	Sabatier effect
Carlos Fourcade	Blink and Iris photometer
Raúl Laborde	" " " "
Miriani Pastoriza	Nebular spectrograph and image tube
Zenón Pereyra	Astrometry
Angel Puch	Spectrophotometry
Juan J. Rodríguez	Astrometry
Roberto Sистерó	Radial velocities and Photoelectric photometry

EXPENDITURES WITH UNESCO FUNDS

Lodging of students	U\$S	2392.75
Breakfast and meals of students	"	2099.75
Medical care and help to students	"	32.50
Honoraria professors and assistants	"	3012.50
Secretarial help	"	100.00
Travels of School Director from Buenos Aires	"	321.60
Guides in excursions	"	10.00
Bank commissions and check books	"	30.94
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TOTAL	U\$S	8000.04