

FOR INDIVIDUALS AND AGENCIES INTERESTED IN

SKY INTERPRETATION

Selected information prepared by:

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ALL MALE IN

I PLEAD WITH YOU - - - INTERPRET THE SKY !!

Historians of science agree that astronomy is the oldest of all the sciences; the forerunner out of which the sciences emerged. Humanity has invested enormously in its attempts to interpret the sky and its contents. Astronomical research and teaching facilities are among the most elaborate and expensive to be found in our modern world. Consider the resources of time and precision technology represented in modern observatories, space probes and planetariums and the extremely significant contributions these have made in our attempts to comprehend the universe and inform people about it.

Realizing this, it is ironical to note that the most natural, and probably the most effective, procedure for informing people about the sky and space has essentially been ignored; the procedure of gathering groups of people together under the stars (or day sky) directed by specialists in environmental interpretation. What more positive opportunity can we find to familiarize people with the sky and interpret its significance than that provided when they migrate from the cities to visit our natural areas, away from metropolitan and industrial obscuration.

And so it seems strange that the current attempt to persuade naturalists to actively recognize the sky as a domain for planned interpretation is a "new" emphasis.

The following lists have been carefully selected to inform interpreters of sources of knowledge, ideas and materials which are useful in sky interpretation. It is hoped that they will be <u>used</u> in gathering sets of sky interpretation materials to take their appropriate places in library collections at national parks, monuments, recreation areas and other locations where environmental interpretation takes place.

Von Del Chamberlain

BOOKS, MAPS, ATLASES ON OBSERVING THE SKY

- Olcott's Field Book of the Skies, William T. Olcott, revised by R.N. Mayall and M.W. Mayall, fourth edition, G. P. Putnam's Sons, New York, 1954. An important guide for sky interpreters. Information about each constellation of the sky, emphasizing mythology and observation with unaided eye, binoculars and telescopes.
- Patterns in the Sky, Julius D. W. Staal, third printing by Econi-Co. Press, Atlanta, Georgia for Julius D.W. Staal, 1972. Order copies from the Fernbank Science Center, Atlanta, Georgia. One of the few books available specifically on the mythology of the constellations.
- Star Maps for Beginners, I.M. Levitt and Roy K. Marshall, Simon and Shuster, 1964. A set of sky maps for each month of the year and associated information. Designed for the beginner. Includes only the brighter stars easily seen with the unaided eye. Designed for use at mid-northern latitudes.
- Constellations, Josef Klepesta and Antonin Rukl, translated by Olga Kuthanova, The Hamlyn Publishing Group LTD, London, New York, Sidney, Toronto, 1969. A set of maps of each constellation containing considerable observational information in brevity.
- <u>A New Popular Star Atlas</u>, R. M. G. Inglis, Gall and Inglis, 12 Newington Road, Edinburgh, 1967. An intermediate sky atlas intended for observers with naked eye, binoculars or very small telescope.
- Norton's Star Atlas and Reference Handbook, Sky Publishing Corp., 1969. A detailed atlas and descriptive material for the serious observer. The combination is one of the best available.
- Pronunciations, Derivations, and Meaning of a Selected List of Star Names, George A. Davis, Jr., reprinted from Popular Astronomy, Jan. 1944. Available from Sky Publishing Corp. Very important for anyone teaching sky features.
- The Sky Observer's Guide, R. N. Mayall, M. Mayall and J. Wyckoff, Golden Press, 1959. A pocketbook with lots of illustrations on how to observe stars, moon, sun and planets with unaided eye, binoculars and telescope.
- Stars, A Guide to the Constellations, Sun, Moon, Planets and Other Features of the Heavens, Herbert S. Zim and Robert H. Baker, Golden Press, 1956. A highly illustrated pocketbook for the interested beginner.
- <u>The Friendly Stars</u>, Martha Evans Martin, revised by Donald H. Menzel and William W. Morgan, Dover, 1964. An easy-to-read introduction to the sky. Excellent for the sky interpreter.

- Making Friends with the Stars, Arthur J. Zadde, revised by Theodore A. Smits, Barnes and Noble, Inc., 1964. Takes the approach suggested by the title in introducing the sky.
- Astrophotography with Your Camera (Kodak Pamphlet AC-20), Available from Consumer Markets Division, Eastman Kodak, Rochester, New York 14650. A valuable source of information for anyone interested in simple sky photography.
- <u>Skyshooting Photography for Amateur Astronomers</u>, R. N. Mayall and M.W. Mayall, Dover, 1968. This and the following reference are both excellent for the sky photographer.

Outer Space Photography for the Amateur, Henry E. Paul, Amphoto, 1967.

- <u>Telescopes for Skygazing</u>, Henry E. Paul, Amphoto, 1970. Information about the variety of small telescopes; how to select and use them.
- The Finest Deep-Sky Objects, James Mullaney and Wallace McCall, Sky Publishing Corp., 1966. An excellent booklet describing deep sky objects for study with small telescopes.
- The Nature of Light and Color in the Open Air, M. Minnaert, Dover, 1954. An outstanding detailed description and explanation of the visible qualities of the sky. Important background for the outstanding sky interpreter.
- <u>The Universe of Light</u>, Sir William Bragg, Dover, 1959. An outstanding book about sight and light. Topics range from vision to radiations from bodies in space. Comprehensive. Easy to read and fairly well illustrated.
- Eye and Brain, The Psychology of Seeing, R.L. Gregory, McGraw-Hill, 1970. A very well written book on both the physiology and psychology of sight. Discusses light, the eye, the brain, brightness, movement, color, illusions etc.
- NOTE: A variety of the better atlases and other books for the sky interpreter are available from: Sky Publishing Corp., 49-50-51 Bay State Road, Cambridge, Mass. 02138 (write for catalog).

PERIODICALS

- Sky Calendar, Abrams Planetarium, Michigan State University, East Lansing, Michigan 48823 (\$1.50 per year). A monthly sheet highlighting the most interesting visible astronomical objects and events. Specially designed for teachers, sky interpreters and others who want to be continually aware of what is going on in the sky.
- Sky and Telescope, Sky Publishing Corp., 49-50-51 Bay State Road, Cambridge, Mass. 02138. A monthly magazine on astronomy and closely related subjects written for the amateur astronomer and others interested in astronomy. The best astronomy magazine on the market.
- <u>The Planetarian</u>, Frank C. Jettner, Executive Editor, Department of Astronomy, SUNY at Albany, Albany, New York 12222. A quarterly journal of the International Society of Planetarium Educators. Articles on planetarium teaching and related subjects. Suggested for anyone interested in teaching astronomy and sky interpretation.
- Griffith Observer, Griffith Observatory, P.O. Box 27787, Los Angeles, California 90027. A small monthly magazine with popular astronomy articles.
- Graphic Time Table of the Heavens, Maryland Academy of Sciences, 7 West Mulberry Street, Baltimore, Maryland 21201. A graphical chart for quick and easy determination of the times of visibility of astronomical objects. Includes times of rising and setting of the sun and moon and other objects. Published annually and designed for use at mid-northern latitudes. A very handy item for the sky interpreter.
- Observer's Handbook, Royal Astronomical Society of Canada, 252 College Street, Toronto, Canada. An annual booklet listing most of the essential information for the sky interpreter. Includes tables of astronomical data on the solar system and deep space and calendars of astronomical events for each month of the year. Designed for use at mid-northern latitudes.

ASTRONOMY TEXT BOOKS

- Astronomy: Fundamentals and Frontiers, Robert Jastrow and Malcolm H. Thompson, John Wiley and Sons, Inc., 1972. A new, up-to-date and easy to read descriptive textbook. A reasonably complete reference source for the sky interpreter.
- <u>New Horizons in Astronomy</u>, John C. Brandt and Stephen P. Maran, W.H. Freeman and Co., 1972. New, up-to-date and sensitive to the type of information the sky interpreter is apt to need in a reference source.
- Astronomy One, J. Allen Hynek and Necia H. Apfer, W.A. Benjamin, Inc., 1972. Another new text with chapter arrangements modified from the usual. Written for the most elementary college level descriptive course.
- Exploration of the Universe, George Abell, Holt, Rinehart and Winston, 1969. Probably the most widely used elementary textbook in astronomy until recently. The newer ones are challenging this one.
- Moons and Planets: An Introduction to Planetary Science, William K. Hartmann, Bogden and Quigley, Inc., 1972. A well written, up-to-date text on the solar system. Includes information and topics not found in most astronomy texts. Makes a very good companion volume with any of the above.

HISTORY OF ASTRONOMY

- <u>The Sleepwalkers</u>, Arthur Koestler, The Universal Library, Grosset and Dunlap, 1959. One of the best known histories covering from the dawn of astronomy through Newton.
- <u>Theories of the Universe, From Babylonian Myth to Modern Science</u>, edited by Milton K. Munitz, The Free Press, 1957. Selections from the best known philosophers and scientists presenting the changing panorama of theories of the universe. A classic collection of articles.
- Watchers of the Skies, Willey Ley, Viking Press, 1969. An informal history of astronomy from Babylon to the space age.
- Star Names, Their Lore and Meaning, Richard H. Allen, Dover Publications, 1963. A handy reference source containing hard to find information about star names. Useful, but not meant to be read from cover to cover.
- <u>The Dawn of Astronomy</u>, J. Norman Lockyer, The M.I.T. Press, 1964. A study of the temple worship and mythology of the ancient Egyptians.

ADDITIONAL SELECTED BOOKS FOR SKY INTERPRETERS

- <u>The Milky Way</u> (third edition), Bart J. Bok and Priscilla F. Bok, Harvard University Press, 1957. A long time classic explaining the structure and composition of the Milky Way galaxy in considerable detail. Written in an interesting, descriptive fashion. Ideal for the sky interpreter.
- Earth, Moon and Planets, Fred L. Whipple, Harvard University Press, 1963. An easy to read volume about the solar system. Another of the good ones for sky interpreters.
- <u>Cosmic View of the Universe in 40 Jumps</u>, Kees Boeke, John Day Company, 1957. This little book presents an effective method for teaching the scale of the universe.
- Dr. Isaac Asimov is a first class interpreter of science (and other things). A few of his many books which include information on the sky are listed below. Interpreters are encouraged to also become familiar with his other books which include many ideas for interpreting various realms of nature. His science fiction books and stories are among the best available and many include sky information.

Fact and Fancy, Discus Books (Avon), 1962.

The Solar System and Back, Discus Books (Avon), 1969.

View from a Height, Lancer Books, 1963.

The Universe, from Flat Earth to Quasar, Discus Books (Avon), 1966.

Intelligent Life in the Universe, I. S. Shklovskii and Carl Sagan, Dell Publishing Co., 1966. One of the best known books on the subject.

The Air Around Us, T. J. Chandler, Aldus Books, London, 1967. A well illustrated book about the atmosphere and the forces within it, producing climate and weather phenomena.

<u>The Lightning Book</u>, Peter E. Viemeister, Doubleday and Company, Inc., 1961. An interestingly written, descriptive book on lightning. An excellent source of ideas for the sky interpreter.

The Nature of Violent Storms, Louis J. Battan, Doubleday-Anchor, 1961. One of a number of books in the Science Study Series.

The Thunderstorm, Louis J. Battan, New American Library (a Signet Science Book), 1964. The title indicates the contents.

Weather, Armand N. Spitz, Bantam Science and Mathematics, 1967. A pocketbook with "everything you want to know about the world of weather." Written by a foremost sky interpreter.

ASTRONOMICAL AND RELATED SLIDES AND PRINTS

Hansen Planetarium 15 South State Street Salt Lake City, Utah 84111

Tersch Enterprises Box 1059 Colorado Springs, Colo. 80901

Astrographics 521 California Blvd. Claremont, California 91711

The Photographic Services Dept. Yerkes Observatory Williams Bay, Wisconsin

Lick Observatory University of California Santa Cruz, California 95061

American Meteorite Laboratory P.O. Box 2098 Denver, Colo. 80201

Movie Newsreels 1621 Cahuenga Hollywood, California 90028

Space Photos 2608 Sunset Blvd. Houston, Texas 77005

Astro Research Laboratories P.O. Box 15015 Baton Rouge, Louisiana 70815

Audio Visual Division Public Information Office NASA Headquarters 400 Maryland Avenue S.W. Washington, D.C. 20546 Hale Observatory slides and prints, Gemini and Apollo slides and other slides.

General astronomical and related slides.

Astronomy and related slides.

Slides and prints from Yerkes Observatory.

Slides from Lick Observatory.

Slides of meteorites and the Arizona meteorite crater.

Apollo slides.

Apollo and other space slides.

Apollo and other space slides.

Information about NASA slides, prints, films. Can sometimes get single copies of NASA black and white prints.

SKY PHOTOGRAPHY WITH THE STATIONARY CAMERA

Color photographs (slides) are among the most effective aids for sky interpretation. Cameras with "fast" lenses combined with high speed color photographic films make it possible to obtain high quality night sky pictures with a stationary camera. Color slides of star patterns show essentially what the eye sees and, when used effectively, greatly simplify identification of sky features.

The following equipment is desirable for obtaining constellation and other night sky pictures.

- 1. A camera with f 1.2, f 1.4, f 1.8 or f 2.0 lens and with "time" or "bulb" setting to permit long exposures.
 - 2. A sturdy tripod.
 - 3. Color film rated at ASA 160 or greater.
- a. Kodak High Speed Ektachrome ASA 160. Can be developed at ASA 400 or faster for \$1.00 extra processing cost at Kodak processing centers and many photography shops.
 - b. Ansco GAF 500 ASA 500. Can be developed at ASA 1,000 for \$1.00 extra processing cost at Ansco processing centers.

4. Cable release.

The exact photographic procedures depend upon the light conditions and the type of picture desired. A little experience combined with keeping records of the conditions, film used, and camera settings will give you general knowledge of the factors which result in outstanding pictures. The following information will get you started and is given for film rated at either ASA 400 or 500.

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Constellation Photography

After loading the camera with the appropriate film, place it securely on the tripod. Set the camera shutter for a time exposure (time or bulb). Focus to infinity. Open the lens to f 1.4, f 1.8 or f 2.0. The greature the aperture, the more stars you will pick up at a given exposure time. However, you will get some distortion (coma) of the star images at the edges of the field when using small f-numbers. This is especially noticeable when a bright star or planet is at the edge of the field.

Direct the camera toward the region of the sky for the desired picture by locating the star group of interest in the view finder. Open the shutter using the cable release, count off (or use a timer) the appropriate number of seconds, and close the shutter. Repeat for the next picture.

The length of exposure time depends upon sky lighting conditions and the range of star brightness you desire to obtain in the photograph. The limitation for a 50 mm lens is about 45 sec. Longer exposures produce star trailing due to rotation of the earth. The best all around exposure time for pictures taken in the dark of night (after twilight has ended) is 30 seconds. Expose for less time to show fewer stars and more time to pick up fainter ones. An exposure of 30 seconds at f 1.4 will show more stars than the eye can see.

Earth and Sky

A very impressive and useful type of picture is one which shows the starry heavens beyond landscape features. Three techniques, each with different qualities, may be used to obtain this type of picture.

- (1) Start photography in the evening just as the stars become visible. The sky is still bright enough from lingering twilight to silhouette landscape features against the starry sky. Try exposures ranging from 1 sec. to 15 seconds. As it gets darker, lengthen the exposure range until twilight is over when optimum exposure time is 30 seconds.
- (2) Make use of moonlight to light landscape features. From first quarter (half-full) to last quarter moon there will be sufficient natural light, when the moon is in the sky, to record moon-lit landscape features with stars above. Try a range of exposures up to 30 sec. at f 1.4 to 2.0.
- (3) Use a strobe light to illuminate selected landscape features. This technique will yield nearly any type of desired lighting of trees and other landscape features in the immediate neighborhood. Considerable experience is needed to obtain exactly the desired lighting.

Earth and sky pictures can be useful, stimulating and even breathtaking in their beauty. A live or dead tree, rock pinnacles, the human figure or other features silhouetted against the star studded sky illustrate man, his world and the immense universe in a striking way.

Star Trails

Both artistic and illustrative pictures can be made by using the earth's rotation. The camera attached to a tripod on the earth's surface will move with the earth as an exposure is being made. If the shutter is kept open longer than 30-45 seconds, star trailing will begin to be noticed. Stop the shutter down and leave it open longer to purposely draw light trails on the film. Try f 2.8 for 20 minute exposures and f 5.6 for exposures up to two hours. Stopping down beyond f 8 will eliminate most of the stars (all except the brightest ones).

If the camera is directed toward the north star and exposed for several minutes, the star trails will be circular arcs. If directed to the east or west, the trails will be nearly straight with some curvature noticed on either side of directly east or west. If directed toward the south, arcs will again be apparent, but this time they will be over the horizon since the south celestial pole is below the horizon.

Short exposures preceding or following longer ones on the same frame are especially interesting. For example, suppose one wants to show the rising of Orion. Start the exposure as Orion comes over the horizon and continue exposing as these stars move upward in the field of view. Before Orion passes out of the camera view, stop the exposure (by capping the lens) for five or ten minutes, then expose again for 30 seconds. The resulting picture will show trails for each star in Orion ending with Orion in point outline.

Star trail pictures are very useful for illustrating the earth's rotation. If one describes how the picture is made, people should understand how the sky appears to move as the earth rotates. The pictures are also very colorful since each trail of light will show the color of the star which made it.

Use of Sky Photography

Sky pictures can be useful both indoors and outdoors. Many outdoor interpretation areas contain amphitheaters with projection screens. Others have buildings with electric power so that a portable screen could be used near the building. One can also use a light colored wall or other material as a projection screen. Pictures of star groups projected on an outdoor screen, with clear night sky overhead, can be very helpful in identifying sky features. Begin by describing the direction and appearance of the star group of interest. Try to get members of the audience to be able to locate the selected stars from your description. Follow this with the same star group projected on the screen. Now people can compare what they see on the screen and sky to confirm proper identification. Using a projection pointer or white stick you can indicate each star in the group to make sure that everyone is able to locate the features correctly.

But suppose weather prohibits direct sky interpretation and you still desire to stimulate interest in the sky. What can you do? Try giving an indoor program which includes real sky photography to simulate what is seen in the sky. You should be able to stimulate enough interest so that people will plan to study the sky on their own when weather permits.

Real sky photography will also be useful as supplementary material for lectures about any environmental topic. The most effective sky interpretation is that which is related directly to the surrounding region. The program need not be entirely devoted to the sky, but should discuss the sky in context with other interesting elements of the environment.

Why not begin your own collection of sky photography to enhance your ability to interpret the earth and its setting in space?

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