DAYTIME AND EVENING EXERCISES IN ASTRONOMY, FOR SCHOOLS AND COLLEGES

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649458967

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Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

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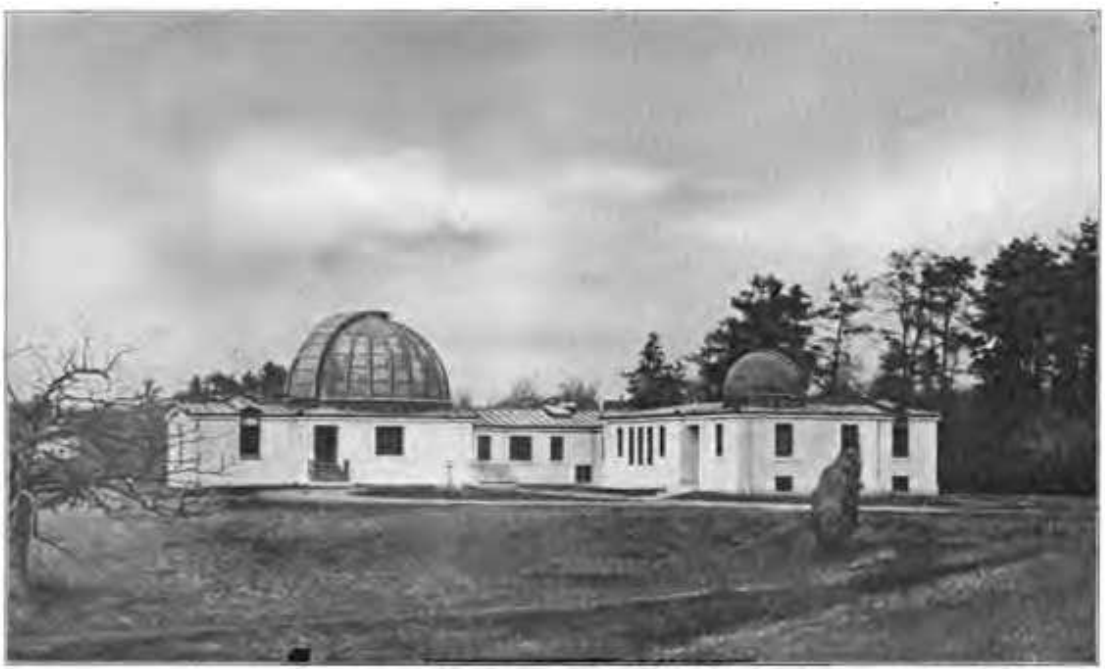

THE WHITIN OBSERVATORY OF WELLESLEY COLLEGE

Left to right: Bamberg prismatic transit, twelve-inch Clark telescope, concave grating spectroscope, libraries and computing rooms, laboratory with spectrum laboratory below, six-inch Clark telescope, small transit

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BY

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GINN AND COMPANY

BOSTON · NEW YORK · CHICAGO · LONDON

– 1912 –

512.8

The Athenæum Press
GINN AND COMPANY · PROPRIETORS · BOSTON · U.S.A.

PREFACE

Astronomy is the last of the sciences to use the laboratory method in teaching its elementary classes. The reason of this is not far to seek. Since no instrument has been invented capable of piercing the clouds, observational work has always been dependent on the caprice of the weather. Photography now furnishes perfect representations of sun, moon, planets, and stars, for daytime study; also many forms of illustrative apparatus can be used by the student to awake and cultivate his imagination and furnish, at first-hand, data for scientific reasoning.

This oldest of the sciences, which has heretofore been a rigid discipline for the few, should now take its place beside the others as a training in the scientific method for the many who pursue the subject chiefly for information and culture.

The management of schools and colleges should make the same allowance of time and money for laboratory instruction in this as in the other sciences; there should be a laboratory, a demonstrator, and fixed hours for students' daytime work. Besides the ordinary instruments of an observatory there should be collections of photographs, charts, and apparatus for the students' own handling.

The only astronomical laboratory books known to the writer are those of the South Kensington School of Science in London, and of Miss Byrd and Professor Robert Willson. These admirable handbooks outline comparatively little

work which can be done in the daytime, the only time which can be controlled independently of the weather.

The following exercises have been proved to be practical by several years' use with classes of sixty to a hundred, handled in divisions of about fifteen, working two hours a week during the academic year.

In this work the student is, whenever possible, left to draw his own conclusions from data discussed. The American Ephemeris is in constant use, photographs of objects in the sky furnish the "specimens" for inspection, and in this subject, as in botany or zoölogy, "sharpening the pencil sharpens the eyes" — to draw the object fixes the attention upon details of structure. The graph is often used to show the relation between variables, and from it the student can often discover for himself great laws.

Moreover the intelligent person, as well as the professional astronomer, should understand the methods by which, through the daytime study of photographs of the sky taken at night, the great advances in astrophysics have been made. In this subject, as in physics, laboratory exercises can show the methods of research and prepare for it. Most plate work must be left for a second-year course, but a few sample exercises are given. The greatest modern advances in astronomy have been made by the spectroscope, and none of these can be discussed with any degree of comprehension without some laboratory work in spectrum analysis. It would be well if in the high schools simple work with the spectroscope were substituted for some of the less "juicy" experiments now included in the beginning course in physics. As it is, no knowledge of the subject can be counted on, and spectroscopes and their accessories should be provided for work in astronomy.

While this daytime work has high value, it cannot for a moment be advocated to take the place of observation in the open. All is but a means to an end, and the student should never be permitted to bend over chart or plot without fully realizing that it is a strip of the sky overhead that he is considering.

By means of daytime preparation, however, the regular program of evening observations can be greatly helped. With this, a short time out of doors, often under circumstances of more or less uncontrollable discomfort, accomplishes wonders. Directions for the record of observations with the telescope are given, with suggestions for the consultation of the Ephemeris or other publications for accurate descriptions and data.

Every student should, of course, be able to identify the constellations in the sky, and to point out objects which a field glass will reveal. The star names and the mythological figures pictured on the old maps should not be omitted, because of the allusions to them which constantly occur in both modern and classic literature. It is best not to study all the constellations at once, but to prepare for observation as they appear in succession during the academic year.

As one looks at the sky the brighter stars seem to form geometrical figures which catch the eye; within and around these the other stars can be found by alignment. It is worth while to become very familiar with these "catch figures" by sketching them on the star atlas with a pencil in the daytime; they are then quickly recognized in the sky at night. The catch figures used in these exercises are those longest in use; many of them from the old atlas of Burritt.

It can be seen then that the ideal equipment for astronomy is an observatory near enough to the centers of

student life to be accessible, equipped with the best instruments. There should be a large laboratory where the students may meet for one of their astronomy exercises in the week, in sections of about fifteen, for the accustomed two consecutive periods of individual work under the direction of a demonstrator. The best books, photographs, charts, and valuable material of the observatory should be brought out for the first-year class. From this class may come the astronomers and the patrons of astronomy of succeeding years.

In general, it is desirable to have the exercises follow as nearly as possible the plan of the lectures and recitations, but orderly arrangement does not seem possible when the objects for consideration are beyond control. Jupiter or Saturn may be visible only in the fall, when students hardly know the difference between a planet and a star; or a comet or "new star" may appear. In these cases students can obtain records of personal observation, and thus have a body of facts to work with when the topic comes up in its proper sequence.

Suggestions for these exercises have come from many sources through a long period. Professor Pickering, director of Harvard Observatory, who opened the first students' laboratory in physics, inspired the writer to attempt students' daytime work in astronomy. General acknowledgment is hereby made for all help, and the hope expressed that these exercises may form a slight contribution to the better teaching of the only science dealing with matter which takes thought off this little planet, and gives those larger conceptions of time and space which stretch the mind and furnish proper perspective for other subjects.

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