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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COMMITTEE OF ONE HUNDRED

FUNDS FOR RESEARCH IN ASTRONOMY

WHEN drawing up the report upon Research Funds made to the American Association in December, 1915, and subsequently printed in SCIENCE there seemed to the committee to be good reason for believing that it would be advisable to place the data relative to astronomical observatories in a separate article, together with certain additional facts which would be of value to those particularly interested in astronomical research.

For this reason a circular letter of inquiry, dated February 1, 1917, was sent to the principal American observatories asking a reply to the following questions in each case:

1. What are the principal and annual interest of observatory funds available for research as distinguished from teaching and what fraction of the income as far as can be estimated may be credited to research?

2. What are the stated publications of the observatory or other papers indicating the results of researches accomplished?

The replies to this letter are uniformly clear and full. Abstracts of them are given below with data taken in some cases from official publications. It is thought that this form of presentation is preferable to a mere tabulation inasmuch as a more definite idea may thereby be secured as to the conditions which obtain in each of the observatories concerned. Especially does this seem desirable in that those interested in astronomy though not professionally engaged in its pursuit may find a brief but intelligible statement of what provision has been made in this country up to the present for the actual advancement of the science by research.

The undersigned will be glad to receive cor-

rections of any omissions or errors in statement.

Dudley Observatory, Albany, N. Y. Benjamin Boss, Director.

1. Principal of Observatory Funds, $140,000. Interest $6,300, wholly devoted to research, including miscellaneous running expenses.

Appropriation received from the Carnegie Institution (department of meridian astrometry); $29,656 annually is entirely devoted to research, with the exception of $1,500 appropriated for miscellaneous purposes.

2. The researches of the observatory are largely printed in the Astronomical Journal which is published by the observatory, and which is, moreover, a general organ for astronomy in the United States. Researches have also been published separately by the observatory and by the Carnegie Institution, not in serial form.

Amherst College Observatory, Amherst, Mass. David Todd, Director.

1. No funds available for research are possessed by the observatory.

Ten astronomical expeditions have, however, been undertaken by it, eight for total solar eclipse observations. The funds requisite for these were supplied from various sources, among which were the National Academy of Sciences, the United States government and the Alumni of Amherst College.

2. The observatory has no funds available for publication.

The results of the researches referred to above have been published by the Smithsonian Institution and in the Astronomical Journal, the Monthly Notices of the Royal Astronomical Society and the Astrophysical Journal.

Detroit Observatory, University of Michigan, Ann Arbor, Michigan. Wm. Joseph Hussey, Director.

1. Supported by annual appropriations made through board of regents of the university, with occasional gifts from interested friends of the observatory.

2. Investigations are printed in The Publications of the Observatory. Two volumes have been issued thus far.

Students' Observatory, University of California, Berkeley, Calif. Armin O. Leuschner, Director.

1. No endowment devoted exclusively to astronomical research. This is maintained so far as pecuniary aid is concerned by funds available from annual budget of laboratories (about $300 for equipment) and private gifts. About one quarter of the time of members of the staff is available for research. Special grants from university funds are made to individuals on recommendation of a research board. Great aid has been given from the Watson Fund of the National Academy of Sciences.

2. Results of researches are published in Publications and Bulletins of Lick Observatory, and in Memoirs of the National Academy.

The principal need of the observatory, the researches in which are theoretical, is that of trained research assistants and computers, which is now met to some extent by graduate students. "There is a crying need for income from regular endowment. Library facilities are amply available. Many important problems in theoretical astronomy and celestial mechanics can not be tackled until endowed research assistantships are available. The country needs a bureau for theoretical research, for numerical investigation of problems of motion, solar and stellar systems, including in the latter binaries, visual, spectroscopic, variable, etc. This important branch of astronomical science is sadly neglected. It should be kept apace with the work of the great observatories."

Harvard College Observatory, Cambridge, Mass. Edward C. Pickering, Director.

1. Principal of funds, July 1, 1915, $860,659.03. Income for preceding year, $53,808.15. Entire income is devoted to research.

2. Publications:

Annals, quarto, of about two hundred fifty pages each; seventy-seven volumes are complete, six in process of publication.

Circulars, quarto, one to four pages, two hundred issued.

Bulletins, octavo, one page, six hundred twenty-four issued.

Annual Report, octavo, ten to fifteen pages, last issued the seventieth.

Several Reports of the Visiting Committee and numerous miscellaneous pamphlets, generally octavo.

Students' Astronomical Laboratory, Harvard University, Cambridge, Mass. Robert W. Willson, Professor of Astronomy.

1. Is primarily intended for teaching the science to undergraduate and graduate students. A certain amount of research is carried on, but no stated appropriation therefor is made.

Leander McCormick Observatory, University of Virginia, University, Charlottesville, Va. Samuel Alfred Mitchell, Director.

1. No permanent research fund. There are at present available for research and thus used the "Special Adams Fellowship" from Columbia University for five years, giving $1,000 per year, devoted to determination of stellar parallax by photography; and temporary grants from the Smith Fund of the National Academy of Sciences, for meteor research, that for the present year being $300.

2. The Publications of the Leander McCormick Observatory now in its second volume.

University Observatory, University of Cincinnati, Cincinnati, Ohio. Jermain G. Porter, Director.

1. No definite provision made for research.

Laws Observatory, University of Missouri, Columbia, Mo. Robert H. Baker, Director.

1. No definite income specially devoted to research. A certain amount is available for appropriations for laboratory purposes in connection with teaching.

2. Publications: Laws Observatory Bulletin, printed at expense of university. Twenty-eight numbers issued thus far and three additional are in press (February 26, 1917). These are paid for out of the general printing fund of the university.

The observatory has under way the investigation of a list of eclipsing variable stars by the extra-focal photographic method. The photographic results already accumulated are far in advance of measurements and computations, so that there is great need of funds for securing suitable assistance for these purposes.

Emerson McMillin Observatory, Ohio State University, Columbus, Ohio. Henry C. Lord, Director.

1. No funds available for research as distinguished from teaching.

2. No stated publications.

Dearborn Observatory, Northwestern University, Evanston, Ill. Philip Fox, Director.

1. Research Fund of $1,500; a gift from the Chicago Astronomical Society.

Maintenance of observatory and salaries met by the university. Annual appropriation for equipment of $500. It is estimated that about half of salary appropriations, amounting at present to $4,975, may be credited to research.

2. Earlier researches have been published in various astronomical periodicals, which will continue to be the case to a certain extent.

One volume of Annals of the Dearborn Observatory published thus far, and it is expected to issue others later.

Lowell Observatory, Flagstaff, Arizona. Guy Lowell, Trustee.

1. Constitution of astronomical staff and amount of funds available for research are not at present determined pending the settlement of the estate of the late Professor Percival Lowell.

2. Publications:

Lowell Observatory Annals.

Lowell Observatory Bulletins.

Lowell Observatory Memoirs.

Lowell Observatory Observation Circulars.

Results of observations are frequently published in astronomical journals.

Shattuck Observatory, Dartmouth College, Hanover, N. H. John M. Poor, Director.

1. Aside from salary of director for teaching paid by trustees of the college, there are available annually $100 from "Library" Fund and $400 income from permanent fund of $10,000 for instrumental and library equipment. The college has at times paid a graduate student for part-time service as a computer. "The one thing needed here is assistance to do computing and routine work," the lack of which holds back greatly the progress of research which otherwise might be carried out.

2. The observatory has no stated publications. Papers from it have been printed in the Astrophysical Journal and Astronomische Nachrichten.

Cornell University Observatory, Cornell University, Ithaca, N. Y. Eugene E. Haskell, Dean of College of Civil Engineering.

1. The new observatory is but recently completed. There is no endowment for research. The work at present is almost wholly instruction.

Washburn Observatory, University of Wisconsin, Madison, Wis. George C. Comstock, Director.

1. No specific fund available for research.

2. Publications of the Washburn Observatory. Twelve volumes issued.

Van Vleck Observatory, Wesleyan University, Middletown, Conn. Frederick Slocum, Director.

1. No special research fund as yet provided, as it is only a short time since the new observatory was finished.

2. Results of the researches of the director have been published in various astronomical and astrophysical journals.

Lick Observatory, University of California, Mount Hamilton, California. William W. Campbell, Director.

1. Devoted exclusively to research. There is no formal teaching. Several graduate fellowships are

maintained by the university, the holders of which, usually for three years, are in training for professional astronomers. In the last year of their fellowship they habitually devote their whole time to their own investigations as a basis for their Ph.D. thesis. There is also available for a like purpose the Martin Kellogg Fellowship, income $1,200 per annum, the holder of which must have received the degree of Ph.D. or its equivalent.

The observatory is mainly supported by an annual appropriation from the regents of the university of approximately $33,000.

The D. O. Mills Expedition to the Southern Hemisphere, a temporary branch of the Lick Observatory, is maintained by direct personal gifts from friends of astronomy amounting to about $7,000 per year.

2. The researches of the Lick Observatory are printed in the following:

Publications, Vols. I.–XII., 4to, 1887–1914.
Bulletins, Vols. I.–IX., 4to, 1901–1917.
Contributions, 8vo, Nos. 1–5, 1889–1895 (now discontinued).
Moon Atlas, 1897.

Maria Mitchell Observatory, Nantucket, Mass. Margaret Harwood, Director.

1. Principal of Observatory Funds, $38,100; annual interest $1,730 approximately. Nine tenths of the income may be credited to research.

2. Results of researches are published by the Harvard College Observatory in its Annals.

Winchester Observatory, Yale University, New Haven, Conn. Mason F. Smith in charge.

1. No teaching is done at the observatory. The total funds, $450,000, are applicable to research and maintenance but are at present subject to large annuity charges. Income for 1916 was $13,000.

2. Researches are printed from observatory funds as memoirs.

Columbia University Observatory, New York, N. Y. Harold Jacoby, Professor of Astronomy.

1. Participates in research funds of the university.

Smith College Observatory, Smith College, Northampton, Mass. Harriet W. Bigelow, Professor of Astronomy.

1. No endowment for research. "Computing Fund" of $100 annually is used for assistance in preparing observations of the observatory for publication. Work is limited closely to teaching.

2. "Comet Observations" from the observatory have appeared in the Astronomische Nachrichten and the Astronomical Journal, in about fifteen numbers.

Goodsell Observatory, Carleton College, Northfield, Minn. Herbert C. Wilson, Director.

1. No funds specifically devoted to research.

For several years past the college has made appropriations of small amounts for this purpose. Aid ($650) has also been received during the past two years from the Watson Fund of the National Academy of Sciences, to assist the work of the director in determining the photographic positions of asteroids.

2. Five numbers of Publications of the Goodsell Observatory have been issued, 1890–1917, the cost of which has been defrayed mostly by private subscription, and in part from the earnings of the magazine Popular Astronomy. The college will publish future researches if not too costly.

Wheaton College Observatory, Wheaton College, Norton, Mass. Laura M. Lundin, Assistant Professor of Mathematics, in charge.

1. At present devoted wholly to purposes of instruction.

Dominion Astronomical Observatory, Ottawa, Canada. Otto Klotz, Director.

1. Work of observatory is wholly research and is supported by direct vote of public money.

2. Publications of the Dominion Astronomical Observatory issued from time to time.

Mount Wilson Solar Observatory, Pasadena, California. George E. Hale, Director.

1. Appropriation from Carnegie Institution for 1917, $178,294, entirely devoted to research.

The appropriation stated above includes salaries, current expenses and provision for considerable additions to buildings and equipment, including completion of 100-inch telescope.

2. Publications:

1. Short Communications, which appear from time to time in the Proceedings of the National Academy of Sciences.
2. Longer Contributions, most of which appear in the Astrophysical Journal. Six volumes of Contributions have already been published.
3. Publications in quarto form, issued by the Carnegie Institution of Washington, containing the details of extensive investigations. Few publications of this character have yet been issued.

Flower Astronomical Observatory, University of Pennsylvania, Philadelphia, Pa. Eric Doolittle, Director.

1. No funds especially assigned to research as distinct from teaching, though a large part of the labor of the director and his assistant is devoted to research.

2. Publications of the Flower Astronomical Observatory.

Three complete volumes, each consisting of three parts, have been issued, and also Part 1 of a fourth volume.

Various papers by members of the staff are published in astronomical journals.

Allegheny Observatory, University of Pittsburgh, Pittsburgh, Pa. Frank Schlesinger, Director.

1. The institution is wholly devoted to research. Annual income at present is $13,500.

2. Publications of the Allegheny Observatory contain most of its researches. Occasional papers published in Astrophysical Journal, Astronomical Journal, etc.

Vassar College Observatory, Poughkeepsie, N. Y. Caroline E. Furness, Director.

1. Research fund, $2,000, yielding about $100 per annum, and not available for academic work or apparatus for students.

2. Publications of Vassar College Observatory. Three volumes have thus far appeared.

Princeton University Observatory, Princeton, N. J. Henry Norris Russell, Director.

1. Total funds appropriated as follows:

Thaw Fellowship, principal $10,000, annual income $500.

Annual gift for research of $1,000 from Mr. A. D. Russell promised until 1919.

Half of annual budget of department from university, which may be credited to research, a minimum estimate, $3,200.

Total, $4,700 per annum.

2. Contributions from the Princeton University Observatory. Four numbers thus far published—300 quarto pages—dealing with variable stars.

Articles published in Astrophysical Journal, Astronomical Journal, Monthly Notices R. A. S. and other journals.

The material published by the Observatory during the past five years amounts to very nearly 500 pages, dealing with variable stars, especially eclipsing variables, stellar statistics and evolution, planetary albedo and various other subjects.

Ladd Observatory, Brown University, Providence, R. I. Roland G. D. Richardson, Acting Director.

1. Is devoted to teaching only.

Blue Hill Observatory, Harvard University, Readville, Mass. Alexander McAdie, Director.

1. Devoted wholly to research. Research fund of $50,000, yielding income of $2,300 annually, applicable to maintenance of observatory and research.

2. Results of investigations published in the Annals of Harvard College Observatory.

Sayre Observatory, Lehigh University, South Bethlehem, Pa. Charles L. Thornburg, Professor of Mathematics and Astronomy.

1. None.

2. No stated organ of publication for occasional papers.

John Payson Williston Observatory, Mount Holyoke College, South Hadley, Mass. Anne S. Young, Director.

1. No permanent funds available for research.

2. Work accomplished, a portion of which has been in cooperation with workers in some other observatory, has been published in various places.

Sproul Observatory, Swarthmore College, Swarthmore, Pa. John A. Miller, Director.

1. No permanent research funds.

The work of the observatory is chiefly carried on by teachers of the college and is sustained by appropriations from the college and outside sources.

2. Publications of Sproul Observatory. Four numbers issued, chiefly devoted to stellar parallax.

Department of Astronomy, University of Arizona, Tucson, Arizona. Andrew E. Douglass, Professor of Physics and Astronomy.

1. Department of astronomy is in process of organization.

The university possesses a fund of $10,000, the income of which is available for the purchase of instruments of precision.

A certain amount of astronomical research is in progress.

University of Illinois Observatory, Urbana, Ill. Joel Stebbins, Director.

1. Observatory is supported entirely by current appropriations from university.

Of these $3,000 per annum, including proportion of salaries and expenses, may properly be charged to research.

2. Scientific results published principally in Astrophysical Journal.

Dominion Astrophysical Observatory, Victoria, B. C. J. S. Plaskett, Director.

1. This observatory is devoted entirely to re-

search and no teaching is engaged in. It is supported by the Dominion Government, but as it is only very recently established, and is neither fully equipped nor staffed, its income is not yet fixed. The sum of $7,500 was granted for maintenance and additional equipment, and from this the salaries of secretary and engineer have to be paid. Salaries of the scientific staff are provided from a separate vote, so that the total income for the current fiscal year may be put at $13,000.

2. The work of the observatory will be issued in the form of separate publications as completed. These will probably be printed at the Government Printing Bureau, and their cost will be charged against the maintenance appropriation.

U. S. Naval Observatory, Washington, D. C. Admiral Thomas B. Howard, U. S. N., Superindent.

1. Work of the observatory is entirely provided for by appropriations made by Congress. This covers observational data for and preparation of astronomical tables and other material and publication of the American Ephemeris and Nautical Almanac, provision of a longitude station, distribution of correct time, the care of all navigation instruments for navy, coast guard and lighthouse service. Also, for 1918 the cost of special eclipse expedition.

2. Publications of the U. S. Naval Observatory. Second Series, Vol. IX., now in press. Earlier papers, 1845 to 1891, published in a series of volumes, mostly annual.

Nautical Almanac Office publishes annually the American Ephemeris and Nautical Almanac and the American Nautical Almanac and Astronomical Papers of the American Ephemeris, irregularly. Also an Annual Report.

An Annual Report of the Naval Observatory is also published.

Astrophysical Observatory, Smithsonian Institution, Washington, D. C. Charles G. Abbot, Director.

1. The entire income of about $13,000 per annum is appropriated by annual acts of Congress, and is devoted wholly to research.

Publications comprise:

2. Annual Reports of the Director to the Secretary of the Smithsonian Institution printed in Smithsonian Report.

Occasional papers by members of the staff generally printed in Smithsonian Institution Miscellaneous Collections.

Annals, published by Act of Congress from time to time and printed by the Government Printing Office. Three quarto volumes have thus far appeared in 1900, 1908, 1913.

Whitin Observatory, Wellesley College, Wellesley, Mass. John C. Duncan, Director.

1. No fund for research as distinct from teaching.

2. Papers by members of the staff published chiefly in Astrophysical Journal and Popular Astronomy.

Yerkes Observatory, University of Chicago, Williams Bay, Wis. Edwin B. Frost, Director.

1. Income ($34,000) applied principally to research but in part to teaching. Four fifths, as nearly as can be estimated, of the total income is expended in research.

2. Publications:

Publications of the Yerkes Observatory, quarto. Vols. I. and II. have appeared; Vol. IV., Part 1, is in type and will soon be issued. Parts 1 and 2 of Vol. III. will be sent out at the same time, without further waiting for the completion of the volume.

The Astrophysical Journal, of which the director is managing editor, is employed as the medium of publication of the more important astrophysical work. Astrometric and other observational work, classified under astronomy of position, is published chiefly in the Astronomical Journal, although some communications are sent to the Monthly Notices of the Royal Astronomical Society. Communications of a more popular interest are frequently sent to Popular Astronomy.

The Student's Observatory of the University of Chicago is organized as a part of the general department of astronomy and has no separate appropriations.

Hopkins Observatory, Field Memorial Observatory, Williams College, Williamstown, Mass. Willis I. Milham, Director.

1. No definite provision made for research.

It will be observed from the data obtained that contrary to the impression which is generally prevalent among the public the funds which are directly and statedly available for astronomical research are far from being large. Very few of the observatories are adequately endowed and most of them rely for their maintenance upon regular grants from the universities with which they are connected. While in the case of the greater institutions reasonable support is thus virtually guaranteed, with

the smaller ones there is often much difficulty in securing the funds which are essential to efficient work. A considerable initial equipment may fail to give the results that might be expected because of inability to procure auxiliary apparatus, to secure suitable assistance in making or reducing observations, or to pay necessary expenses of publication.

Furthermore, attention should be called to an important fact which is referred to in some of the more detailed answers to the questions of the circular and which has been emphasized in earlier considerations of the subject of aid for astronomical research made by the chairman of the Committee of One Hundred.

The help most needed in a large majority of cases is found to be that of a trained assistant to aid in any and all the duties which are called for from an astronomer and especially in computing and other routine work. For such purpose a person not subject to the distractions affecting the ordinary graduate student is desirable. To furnish an observatory with well-equipped aid of this character would often increase its output by an amount far in excess of the necessary outlay.

CHARLES R. CROSS, *Chairman,*
Subcommittee on Research Funds

GEOLOGICAL TERMS IN GEOGRAPHICAL DESCRIPTIONS

LAST January Dr. John L. Rich, of the University of Illinois—now Captain in the Intelligence Division of the War Department—sent a letter to SCIENCE expressing his regret that no mention of geological dates was made in a geographical article on the "Block Mountains of New Zealand," by Dr. C. A. Cotton, of Victoria College, Wellington. I have been waiting to see if other geologists would support Captain Rich's view, or if any geographers would take sides with Dr. Cotton; but the discussion has not been continued. As Dr. Cotton was more or less influenced in his method of presentation by several conferences that we had on this subject during an excursion with Professor James Park, of Dunedin, across the New Zealand block-mountain district in 1914, I wish to say a few words on the principles that his method of presentation involves.

The first point to bear in mind is that geological science is much more actively cultivated by trained experts, and is therefore much further developed than geographical science. The second point is that the development of geographical science will be best promoted if geographers follow a discipline of their own, by giving the same single-minded attention to geography that physicists give to physics, astronomers to astronomy, philologists to philology, and so on. The third point is that the best methods of preparing geographical descriptions are still in discussion, and hence experiment on various methods, each one consciously analyzed and intentionally adopted for the time being, is a helpful means of discovering the kind of treatment best adapted for various needs.

Cotton's article is an admirable experiment in the analytic, systematic and regional treatment of a geographical problem. It is to be hoped we may have many more pure geographical cultures of this kind. The gain that such articles contribute to the imperfectly developed science of geography fully compensates, in my opinion, for any loss that the omission of geological dates entails upon the thriving science of geology. Cotton's success must therefore not be measured by the dissatisfaction that his article may create among geologists, but by the satisfaction that it creates among geographers. They should recognize that this excellent study gives, after a careful historical review of the problem under discussion, a critical analysis of the origin of the Block Mountains; that the results of the analysis are systematized or standardized sufficiently for New Zealand needs; that the systematized standards are effectively used in the final pages on regional description; and that the graphic illustration of all its parts is exceptionally good. The only adverse comment that I am disposed to make is that the unlikenesses of the three phases of work, analytic, systematic and regional, are hardly enough emphasized to impress them upon the reader; and that the introduction of some