

tions. For this reason, if for no other, promulgation of the knowledge of modern geography should be furthered wherever possible.

When geography and geology, and subjects which have similar advantages, occupy larger places than they now do in our educational system, I believe that our young men and women will be better equipped than they are now to do their part in transforming a contentious world into a world of righteousness, based on mutual consideration.

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THE REPORT OF THE COMMITTEE TO VISIT THE HARVARD COLLEGE OBSERVATORY

TO THE BOARD OF OVERSEERS OF HARVARD COLLEGE: The committee which you appointed to visit the astronomical observatory begs leave to submit the following report.

Both individually and as a committee we have kept in touch with the work of the observatory, visiting it from time to time and receiving statements from the director as to the condition and progress of the work.

Your committee finds the many researches going on in a most efficient and satisfactory way, and the results are published from time to time in bulletins and in the *Harvard Annals* which now number eighty volumes. The large amount and the high quality of the scientific output keeps the observatory in the position it has occupied for many years as one of the greatest observatories of the world.

In recent reports to you we have given in some detail the results of various special lines of investigation which the observatory has undertaken. In this report we desire to touch on the efforts of Professor Pickering to co-ordinate the general progress of astronomical science and to bring about a larger cooperation among the different observatories of the world.

One of the objects of the Harvard Observatory as stated in its statutes is "in general to promote the progress of knowledge in astro-

nomical and kindred sciences." This, Professor Pickering has interpreted in the largest and most unselfish sense by laboring to advance the science in any and all ways, whether the particular credit for the work should come to the Harvard Observatory or not. As the object of the study was the same over-arching sky he has always believed that the most successful prosecution of the work would come from the fullest cooperation of those devoting their talents to the common aim.

Modern astronomy has demanded the most extended effort and the greatest concentration of resources extended over many years to produce the large amount of work which lies at the foundation of the astronomy of to-day. These investigations have demanded labors which no individual or institution could produce but have required the combined efforts of great observatories extending over many years.

In addition to this the best results are only obtained by division of labor and a condition where the special man and the particular problem are brought together. The science has now become so diversified that no astronomer has the versatility or the interest to carry on all the required branches of investigation. There is the problem of finance and the man; there is the problem of producing astronomical instruments as well as the man to use them; of taking photographs as well as measuring them; and, finally, the problem of estimating values and drawing reasonable conclusions from all the previous work.

In short, the progress of astronomy, like the advancement of civilization, requires many and diverse talents. It was the early realization of this truth which made Professor Pickering a pioneer in an unselfish policy to secure cooperation among astronomers so that each might be enabled to carry on the particular lines of work for which he is was best fitted.

As early as 1877 he published a pamphlet on "The Endowment of Research" and advocated a closer cooperation looking to the larger interests of the science.

In 1886, a second paper was published asking for an endowment of one hundred thou-

sand dollars, the income of which should be used to aid astronomers in existing observatories to work out their special problems.

In 1890, Miss Catherine Bruce, inspired by this idea, gave six thousand dollars to be distributed in whatever way promised the greatest scientific return. Eighty-six applications were received, showing the great need that was felt by astronomers for just this sort of aid. Fifteen grants were made to men of eight different countries. Among those thus aided we find the well-known names of Adams, Gill, Newcomb, Rowland and Turner. Appropriations were also made to international associations of astronomy and geodesy. It was through this gift that the true explanation of the variations in latitude was discovered, which was in itself a complete justification of the plan.

In 1903, Professor Pickering published a pamphlet showing the valuable results which might be expected by greater cooperation among observatories. He said we find "a great observer but no telescope, a great telescope but no astronomer to use it, and an astronomer whose valuable observations, the results of many long years of hard work, were rendered useless by the lack of a few hundred dollars to publish them." He showed how the appropriation of small sums would add greatly to the scientific output and advocated a sort of astronomical clearing house which would coordinate and support the best good of the science. But the results showed that the time was not ripe for such a forward step, for two leading astronomers declined to serve even on an informal advisory committee. A circular at this time was issued asking astronomers to state the needs of their work. Over one hundred replies were received and gave the best and most complete information ever collected on the subject.

In 1904, the director issued another paper to meet the adverse criticism which the project had aroused. Though the ideas of Professor Pickering were not entirely realized, the plan had the effect of improving the relations between astronomers, and eventually a very large degree of cooperation was realized.

In 1906, an address on "An International Telescope for Southern Latitudes" was given before the American Philosophical Society and the plan received serious consideration by a man of means.

In *SCIENCE*, 41: 82, Professor Pickering issued a questionnaire to twelve leading American astronomers asking them how they would use five thousand dollars if it were given them for research work. As a result of the replies it was found possible, through gifts and grants from existing research funds, to provide for a large part of these needs.

Probably the director of no observatory of the world has done so much for the cooperative ideal in astronomy nor has shown more unselfishness in the practical work of cooperation than Professor Pickering. Instead of trying to build up Harvard Observatory as a separate institution exclusively, he has had deeply at heart the advancement of the science regardless of who should receive the personal credit for the discoveries.

At the present time a large amount of work is carried on in cooperation with other institutions. One of the best illustrations of the value of this method is the determination of positions of the moon by the united efforts of Princeton, Yale and Harvard. Each observatory has carried on the part of the work for which it was best fitted, and which the others practically would have been unable to accomplish. The combined research has resulted in photographic positions of the moon which are, on the whole, the best so far obtained.

The most extensive cooperation in astronomical investigation is the *Astrographic Catalogue* and *International Chart of the Sky*. In this great work, now well advanced, the determination of stellar magnitudes was assigned to Harvard, and a large part of the work has now been completed.

By cooperation with the Mount Wilson, Lick and Yerkes Observatories the work has been extended to the faintest stars which now appear on photographic plates.

At present the observatory is determining the standard for the magnitudes of Professor Kapteyn's "Selected Areas." The work is

complete for the northern stars. Professor Kapteyn has thus determined the magnitude of about seventy thousand stars, which are now in print in *Harvard Annals*, Vol. 85.

Professor Pickering has also shown great interest in developing useful work among amateur astronomers. It is through him that the chairman of the visiting committee has been able to do some work on the asteroids. Through lack of expert direction a large part of the efforts of amateurs has proved of little value. An exception to this rule has been the Association of Variable Star Observers, which was formed five years ago and has received much encouragement and help from the director.

During the last year this association of enthusiastic amateurs, consisting of thirty observers, has made eleven thousand two hundred and fifty-two valuable observations of two hundred and ninety variable stars of long period. For this work the observatory has furnished suitable charts and determined the magnitudes of nearly five thousand stars needed for reference, so that all are now measured on the same scale. At a meeting of the Association of Variable Star Observers held at the observatory in November, 1916, nineteen skilled observers made estimates of the magnitude of the same object with the twelve-inch telescope which showed an average difference of less than one-tenth of a magnitude—an experiment altogether unprecedented.

As these observers generally have access to only small telescopes and are therefore unable to measure variables when they are faint, Professor Wilson and Professor Mitchel have shown their spirit of cooperation by kindly agreeing to continue the work with their sixteen-inch and twenty-six-inch telescopes when the stars are too faint to be measured by smaller instruments.

Also it should be mentioned that the observatory is cooperating with the other observatories of the world by furnishing magnitudes and classes of spectra in advance of their regular publication in the *Harvard Annals*, which has been spoken of in previous reports.

These are some of the facts which show the large way in which the observatory of Harvard is interpreting its work, and give some idea of how much Professor Pickering has done to encourage friendly scientific cooperation both here and abroad.

The fruits of much of this work will mature only in the future.

Some of this cooperation the war has temporarily broken but we look to the speedy re-establishment of it when this world calamity be overpast, and it will help to bind up the wounds and soften the animosities which now divide the nations.

The publishing of astronomical discoveries has not entirely ceased even now, and when peace is at last declared the common interest in the heavens will assert itself and bind together those whom the war has separated and estranged. Thus the cooperative study of astronomy will help to give us a new heaven through the interpretation of a nobler science and, through the good will which cooperation always brings, a new earth, in which dwelleth righteousness.

JOEL H. METCALF, *Chairman*,
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SCIENTIFIC EVENTS

THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA

AT THE close of its free public lecture season the officials of the University Museum call attention to the recent progress of the institution and to some facts in connection with its activities.

Although only in its twenty-third year the University Museum is already recognized everywhere as one of the most important institutions of its kind in the world. Some of its collections are the finest in existence, its expeditions have gone to all parts of the globe,