their work has to form a connected whole, but that does not involve a selection of the public which is to profit from the offerings.

It is true the rumor may have been reenforced by the fact that a limited number of scholars received, indeed, a special invitation to attend in form of a circular, but there was not the slightest intention to indicate that those who did not receive it were less welcome in the audience. To invite all who might have an interest in the proceedings of one of the hundred and thirty sections would have meant to invite half a million persons; every school teacher, every lawyer, every physician, every engineer, every political man, every literary man, yes, every educated business man, would have relations to some of the sections. No committee would have had the right to pick out among that half million those who are especially welcome at the congress, and the fact is no one dared to undertake any such selection. The only thing which the committee believed to be its duty was to send a program and invitation to at least a few thousand from whom special interest could be expected, that is, to the members of the leading national scholarly societies. It is clear that this means not a personal selection; the greatest scholars of the country may by chance not belong to any of these national societies. And thus it has happened, indeed, that some have received such invitations while others of the same high standing did not receive them; a differentiation was not intended at all. The membership lists of some dozen societies were used merely as help in spreading our programs, and it was hoped that every one who received the program would circulate it in his circle and interest his friends in the participation. We should have liked better to send it to half a million, leaving out no student who feels himself interested in any one part of the feast.

Of course the misunderstanding is limited to some quarters; many other symptoms show that the attendance will, indeed, come up to the unusual opportunity. Especially welcome is the movement which seems under way in some western colleges which begin as early as the middle of September. It is planned there to give leave of absence to those instructors who want to attend the congress. The eastern universities, of course, begin late enough to make it possible anyhow for the whole teaching staff to attend the meetings. It is to be hoped that the schools too will adopt a liberal policy and give leave to every teacher who is anxious to go to St. Louis, as this chance to come in close contact with the leading scholars in every field and to take part in this organized effort to bring harmony into the scattered mass of human knowledge is certainly a liberal education for every high aiming teacher. This six-day autumn school promises, indeed, to offer more than all the summer schools of this country and abroad together. Such a combination of speakers was never before brought together—may the combination of listeners and participants show worthy of the unique occasion.

Hugo Münsterberg.
Harvard University.

THE ENDOWMENT OF ASTRONOMICAL RESEARCH.

In order to attain as great an advance in astronomical research during the twentieth century as in the nineteenth, careful plans must be made for its endowment. The same skill in organization, combination of existing appliances, and methodical study of detail, which in recent years has revolutionized many commercial industries, should produce as great an advance in the physical sciences. Astronomy in particular, through the striking progress it has made during the last half century, and its appeal to the imagination, has received

more liberal aid than almost any other science. This has enabled astronomers to develop well-organized observatories, and to carry on large pieces of routine work. They are, therefore, especially fitted for undertaking researches on a scale that will constitute a real advance. It is the object of the present pamphlet to show how this work can be carried still further, how the quality of the work can be raised to a new plane, and how a large or small sum of money may be expended so as to obtain the best results.

There are seven methods by which astronomy can be aided, each of which may be considered in turn.

1. *Fellowships for Astronomical Students.*—A large sum of money would not be required for this purpose. Ten fellowships, each yielding annually $500, would probably be sufficient. They should be used for students especially interested in astronomy, proposing to make it their profession, and showing a capacity for original research. The successful candidates should be sent to universities where special courses in advanced astronomical work are given. It is not desirable that there should be too many such fellowships, since the number of permanent positions for astronomers is limited. This difficulty is partly remedied by No. 7, described below. A large part of the expenses therein contemplated will be for personal services, and as work of the highest grade will be demanded, it is only fair that suitable salaries should be paid. The future of astronomy will depend largely on giving a proper preparation to the men to whom the most important equipments will be intrusted.

2. *Astronomical Expeditions.*—Large sums of money have been wasted in sending out expeditions, in charge of incompetent persons, to observe total eclipses of the sun. If the weather is cloudy at the time of the eclipse no result is obtained; if clear, the newspapers at once announce that a great success has been attained, and results secured which may prove of vast scientific value. In many instances, nothing further is ever heard of such work. The real addition to our knowledge of solar physics during the last thirty years, from such expeditions, considering the money expended upon them, is discouragingly small when compared with what might have been obtained by a more judicious expenditure of the same amount of money at a fixed observatory, where some results of value would surely have been obtained. It is often said that a discovery of so great importance may be made that it would compensate for the entire outlay, but this applies with equal force to almost any other plan of work. The fact that a government or individual will often make the appropriation desired for a special expedition, and would not make it for other astronomical work, in no way lessens the responsibility of those who ask for such aid.

Undoubtedly, every eclipse should be photographed by at least one skilful observer, and especial pains should be taken to solve particular problems, as the existence of an intermercurial planet, sudden changes in the corona, etc. The best method for securing results of real value appears to be that adopted by the English astronomers. A permanent committee is appointed which attempts, year after year, to solve certain problems of great importance. The experience gained during each eclipse aids later expeditions. Government assistance is often obtained in sending warships. Even then, the expenses are likely to be very great, and clouds may cause entire failure. If, therefore, good photographs are obtained, neither time nor money should be spared in making a careful examination and discussion of them.

3. *New Observatories.*—A new observatory of large size should only be established

after careful consideration. The gift of a large telescope, to a university unprepared to receive it, is often worse than useless. Not only can no work of much value be done with it, without a large annual expenditure, but the existence of large telescopes which are idle discourages other donors who see that there is no return for the great outlay. For teaching purposes, a telescope of eight to twelve inches aperture and a three-inch transit instrument are large enough. The best work in observation can never be done except when the atmospheric conditions are excellent, and this would seldom occur near a university or large city. On the other hand, a fruitful field is open in the application of photography to a very large reflector, but the best possible location, preferably in the southern hemisphere, as in South Africa, should be chosen. Such an instrument would be of little value unless means were provided for keeping it at work, and for discussing and publishing the results obtained.

There is one class of astronomical institution, a computing bureau, which might be established to great advantage at a large university, where work of the kind proposed was already in successful operation. At one institution the work undertaken might be the measurement and reduction of photographic plates, and at another the computation of orbits of comets and asteroids. An astronomer particularly successful in photographing the stars might find on his plates the trail of an asteroid of great interest, like Eros. Such an observation would be of no value unless he measured its position and, after taking additional photographs, determined its orbit. This he would do to great disadvantage compared with those who devote their entire time to such work, and could easily procure additional assistants as required.

4. *Publication.*—The cost of publishing many important investigations is too great to be provided for by existing periodicals. Means ought to be supplied so that no really good work should fail to reach the public for this reason. Provision should also be made for lengthy memoirs, the cost of which is sometimes very great, since they include extensive tables or require elaborate illustration. The work of deceased astronomers, when of sufficient value, should also be promptly completed, reduced and published. Probably the Astronomisches Gesellschaft and the Royal Astronomical Society would expend money to great advantage in this way.

5. *Aid to Working Astronomers.*—There is no way in which a more prompt and effective return can be obtained for a moderate outlay than by grants to astronomers qualified to expend them. The replies to the Circular of 1903, described below, and also to the Bruce Circular of 1890, show this very clearly. The number of good applications from German astronomers is particularly large. The sum of $10,000 would permit from ten to twenty valuable researches to be undertaken at once. Many of the ablest astronomers in Europe, and in this country, are obliged to devote nearly all of their strength and energy to teaching. In many cases, their interest is so great that they would gladly give much of their own time to researches of the greatest importance if, by a grant of a few hundred dollars, they could obtain the needed instruments, or employ assistants or computers. A donor could thus obtain, at a trifling expense, the services of some of the most eminent astronomers in the world, in expending his gifts. Care should be taken to make the restrictions as light as possible. A man of genius, in many cases, can not work at all, except in his own way, and at his own time.

6. *Aid to Existing Observatories.*—Several of our large observatories have now

the appliances for a greatly increased amount of work. Large sums of money could be expended for salaries of additional assistants, for publications, buildings, instruments, etc. As the executive organization is already provided, the returns from additional gifts should be very great. Many of the most important advances to be expected in astronomy will be obtained from large pieces of routine investigation. Astronomers having learned the best methods of determining the position, motion, brightness, spectrum and other properties of a star, should be prepared to apply them to great numbers of similar objects. Generally, the person who devises a new method is not the one best qualified to superintend a large corps of assistants, and to carry out an extensive routine investigation which may occupy many years.

7. *International Cooperation.*—This is probably the most important problem of all, and that most likely to lead to a real advance in astronomical science. The best illustration of the work contemplated is the determination, under the direction of the Astronomisches Gesellschaft, of the positions of northern stars of the ninth magnitude and brighter. A committee of experts should hold lengthened meetings and discuss plans in detail. It might be best to publish a provisional plan and invite criticism before beginning work. The observations should then be divided among those best qualified to make them, leaving to each observer greater or less freedom in carrying out the work. Preliminary observations would probably show which was the best method, and it is difficult to see why, in routine work, all should not conform to that. In determining a single quantity, like the solar parallax, of course the greatest variety of methods possible should be used. The reductions, publications and discussion should be made by those best qualified, and not necessarily by the observers.

As an example of the method of procedure, we may suppose a committee appointed who would first consider in turn, and in detail, the present needs of each department of astronomy. The answers to the circular described on page 298, give the views of the leading astronomers of the world, on this question. For instance, in considering the measurement of double stars, they would correspond with all astronomers now engaged in such observations. They would decide whether an undue, or an insufficient, amount of time and energy was directed to this work. They would then attempt to induce observers to adopt the best methods of measurement, and would supply micrometers of the most approved form, when needed. Observers displaying especial skill might be furnished with recorders or assistants who would learn their methods. In discussing orbits of double stars, complaint is often made that certain stars are neglected while a needless number of observations is made of others. If the subject was being neglected, an appropriation might induce a competent observer to take it up. All these difficulties could be reduced or avoided by proper organization, or, when necessary, supervision. The one object would be to secure the greatest scientific return for the given expenditure, and to avoid the reproach of the astronomer of the future, who may say that present opportunities have been neglected.

While a large sum of money, the equivalent of that required to establish an observatory of the first class, would be needed to carry out this plan in full, it will be seen that a moderate amount would permit a portion of it to be tested. The immediate expenditure of $50,000 to $100,000 would show results that would amply justify a larger outlay. Very different ends would

be attained by the different methods. Thus, No. 1 is educational, and insures the efficiency of the astronomer of the future, No. 5 aids the individual man of genius, while No. 6 and especially No. 7 undertake to solve the great problems now before us, and to advance the science to a new and higher plane.

The organization required to carry out this plan must next be considered. It may be divided into two parts, the care of the principal, and the expenditure of the income. The first of these is easily provided for and, if the amount is large, may well be left to the donor. Permanency, a relatively high rate of interest, and certainty that the wishes of the donor will be fulfilled are the three essentials. The expenditure of the income is a more difficult matter. If intrusted to an international committee, frequent meetings can not be held, and correspondence is slow and unsatisfactory in many cases. Such a committee, however, would be able to discuss problems from the broadest standpoint, and would be the best judge, in international work, of what part each country should undertake. A local committee could meet frequently and secure the active interest of several persons, but it could not consist of experts who would have a good technical knowledge of the researches to be undertaken. A national committee would occupy an intermediate position, with some of the advantages, but unfortunately some of the disadvantages, of both. The experience of the writer is that all the work of such a national committee is likely to be left to one man, and even if well attended meetings are held, it often happens that the wishes of the most aggressive member, and not the combined opinions of all, are carried out.

On the whole, the following plan is recommended: The appointment of a local committee consisting of men interested in astronomy but not necessarily familiar with its technical details. Investigators in some department of science, and men of affairs qualified to judge of other men, and of the work done by them, should be selected. With the proper machinery to collect the views of experts, such men could easily carry on successfully the first six of the methods described above. As a parallel case, the board of trustees of a university can select the best man for a professor of Sanskrit, or with expert aid can organize a technical school, although as individuals their knowledge of either subject may be very slight. The duties of this committee would be, first, absolute fairness. They should spend the income so as to secure the greatest scientific return, and should be wholly independent of all personal considerations, and of all local conditions. Secondly, their work should be active, not passive; they should try to spend the income, not to preserve it. Whenever an unusually able memoir was prepared by an astronomer hitherto unknown, they should make a business of learning his needs, what he would require to carry his work still further, and if possible induce him to undertake better or more extensive researches. In many cases, they could excite local interest and could secure aid for him from the friends of his observatory, who might not otherwise know how important it was that his work should be aided. When a grant was made to an astronomer he should be made to feel that, in accepting it, it is he who confers the favor. He aids the committee in securing better results for their expenditures than they could otherwise obtain. Many astronomers are unwilling to ask for aid, owing to modesty, to motives of delicacy; or from fear that the results will not be considered adequate. If the members of the committee are satisfied that the object is a good one, they must take the responsibility of success or failure.

In many cases, they must ask advice of experts; in some cases they must employ them to investigate, or to try preliminary experiments. Often a preliminary appropriation should be made, its continuance or increase depending upon the results attained.

The seventh method described above stands on a wholly different basis from the others. Here the work must be done by experts, the greatest specialists in their departments. Many important investigations have been undertaken by international societies, and such work could be greatly increased if large sums of money were at their disposal for this purpose. As this is, perhaps, the greatest problem in astronomy it might seem presumptuous to discuss it further here.

A brief description of the attitude hitherto maintained by this observatory to other astronomers, is given below, and may explain its present policy in this matter.

One of the objects of the astronomical observatory of Harvard College, as stated in its statutes (*Annals,* Vol. I., p. lix), is 'in general, to promote the progress of knowledge in astronomy and the kindred sciences.' Various examples of the attempts to carry out this plan, by cooperation, publication of work done elsewhere, and in other ways, will be found in the *Annual Reports* and *Annals.*

In 1886 a definite attempt was made to secure the sum of $100,000, the income to be used in aiding other astronomers, and a pamphlet was published describing this plan. Four years later, Miss Catherine W. Bruce gave the sum of $6,000, to show what results could be obtained in a single year. This appropriation was distributed among fifteen astronomers, eight in Europe, one in Asia, one in Africa and five in North America.

The next attempt made by the writer was in 1901. It was thought that a committee representing the principal research funds of the country might render them more effective, and secure harmony in the expenditures of the money now available. Also, that a local committee could do more work than an international or even a national one, since more frequent meetings could be held. Delegates were therefore appointed by the Rumford Committee of the American Academy, and by the trustees of the Elizabeth Thompson Fund. The acting president of the National Academy agreed to attend the meetings unofficially. The members of the committee thus formed, the writer being also included, believed that a larger committee would render the work more effective. Additional members were invited, but no results were obtained.

Other plans were at once prepared, when the establishment of the Carnegie Institution entirely altered the prospects for original investigation in science in the United States, and rendered it probable that the immediate needs would be supplied from this source. No provision, however, has thus been made, so far as the writer is aware, for general aid to astronomers in other countries.

In April, 1903, a pamphlet was published showing how a large sum of money could be usefully expended each year for extending astronomical research. It was stated that much better results could be obtained by cooperation, avoiding duplication of work, providing astronomers with assistants and other means for undertaking neglected investigations, furnishing the means for employing the many large telescopes now idle, and, in general, attempting to improve the present quality and quantity of work done, regardless of individual or country. It was further proposed that the fund should be administered by a committee of astronomers, wholly unselfish and unprejudiced, the only object being to secure the greatest scientific return for the expendi-

ture, and that Harvard should act as trustee of this fund, on the ground of its security, permanency and success as an investor, and since the desire to aid astronomers throughout the world has not been made a part of the policy of observatories elsewhere.

A circular of inquiry was then printed and sent to all the members of the Astronomisches Gesellschaft, of the American Astrophysical Society, to about two hundred members of the Royal Astronomical Society and to a few others. It is believed that few astronomers widely interested in the progress of science, and whose opinion would be of much value, were thus omitted. The replies to this circular were very instructive and valuable, and I take this occasion to thank my friends for the trouble they have taken in the matter.

The following five questions were contained in the circular:

1. How do you think money could be spent most advantageously on astronomy at the present time?

2. Can you recommend any definite plan, in form for presentation to a possible donor?

3. In what way could money be most usefully expended at your observatory, or under your direction?

4. Can you give (not for publication) the names and addresses of any persons who are interested in your observatory, and who are able and might be willing to aid it, if the matter were properly presented to them?

5. What improvements do you suggest in the plan proposed for the endowment of astronomical research?

A discussion of the replies to questions Nos. 1, 2 and 3 would be given here, but it is believed that the writers would prefer a postponement of such action, until the establishment of a fund would enable a part at least of the proposed work to be undertaken.

Question No. 2 should have followed No. 3, as it was intended to refer to either No. 1 or 3. It was hoped that plans would be sent which could be enclosed in the letters proposed below, in discussing No. 4. If a large sum of money were already available, many definite plans would doubtless have been presented. The answers to No. 2 were in some cases covered by No. 1 or No. 3.

But few answers were given to question No. 4. I had hoped that an influential advisory committee could render important aid through this question. If the members were satisfied that an astronomer was doing excellent work and needed money for an important investigation, they could call the attention of the friends of his observatory to the matter very effectively. In many cases an astronomer would hesitate to do this himself, and the opinion of unprejudiced experts ought to have a weight that would not attach to the views of the individual concerned. I should be very much gratified if astronomers considered the work of the Harvard Observatory so important that they would take such action regarding the additional work I wish to undertake.

An excellent suggestion in reply to question No. 5 was made by Mr. A. R. Hinks, of the Cambridge Observatory, England. He recommended the publication of proposed forms of investigation, in order to secure the criticism of astronomers before, instead of after, it is too late to alter them. This seems to be especially important in the case of large pieces of routine work.

Few improvements or criticisms of the plan were suggested by foreign astronomers. One or two advised that the committee should be international, but probably the general feeling was that, as it was hoped to collect the funds in the United States, it

was only fair that they should be controlled by Americans.

Among American astronomers, however, strong objections were made to the part it was proposed that Harvard should take in the plan. For this reason two leading astronomers declined to serve even on an informal advisory committee. It was explained that this objection did not arise from jealousy of Harvard, or from fear that the plan would not be well carried out there, but from a belief that one observatory should not be more prominent than another in such a scheme, and that the control of such a fund and of its expenditure should be wholly independent of any one institution. I believe that the selection of a trustee for the care of the proposed fund should be made by the donor, and had expected that the informal advisory committee would have recommended some method of appointing the final committee, which would have secured unprejudiced action. The function of the first of these committees would have been to propose a plan like that described above. This want has been supplied, in a great measure, by my friends, Mrs. Henry Draper, Major E. H. Hills, Professor Simon Newcomb and Professor H. H. Turner, to whom I am indebted for important suggestions in preparing this pamphlet.

There are certain advantages to be gained by throwing the responsibility upon a single individual or institution, as all mistakes or failures can then be located and remedied. Continued efforts will accordingly be made by the writer to accomplish the desired results. As other observatories have not expressed a wish to aid astronomers elsewhere, there seems to be no objection to making it a part of the policy at Harvard.

The present discussion has been published to supplement that issued in 1903, a copy of which will be sent to those who desire it. It is believed that present conditions are unusually favorable for securing great progress in astronomical science. It is hoped that a sum of at least $50,000 may be obtained for immediate expenditure, so that a beginning may be made at once, and astronomers may have an opportunity to show what results they might obtain with unrestricted means.

My one object is to secure a real advance in astronomy. Any plan that will attain this will have my hearty support, if desired. If this advance is made, it is a matter of little importance whether the part taken by the Harvard Observatory, or by myself, is large or small.

EDWARD C. PICKERING.

July 11, 1904.

THE CHANGING ATTITUDE OF AMERICAN UNIVERSITIES TOWARD PSYCHOLOGY.

IN this adolescent period of its growth, psychology may be pardoned for wondering if its elder brothers understand the manhood it is attaining. The distortion by the public prints, in their eagerness to be a little more than up-to-date, has thrown numerous fads of 'mental science' out of all perspective, and resulted undoubtedly in the injury of psychology. At the present time, however, the general reader is learning to discriminate 'yellowness' in what purports to be psychological news. When the Sunday special announced in January of this year that the soul of a rat had been observed in the laboratory of a Washington psychologist, few had difficulty in pigeon-holing the article with another which declared, about the same time, that a California physicist expected to turn negroes into white men by the use of radium. In the following pages the writer collects certain facts which bear upon the recent development of psychology in American institutions of higher learning, with the hope of giving more adequate means for judging the present status of this sci-