and the other countries have small and inexpensive establishments for this purpose. All the national observatories but ours have purely civilian organizations. Why should ours be an exception?

Under these conditions what is wanted is that our astronomers and naval authorities should come together and agree upon a plan. Nothing can be worse than the continuation of a system under which the country goes to all the expense of supporting a great observatory without reaching results commensurable with the expenditure. It is sometimes claimed that naval officers will not give up any part of their control. It seems to us that this claim involves a reflection upon their patriotism and their regard for their country's interests which they should not tolerate. Congress gives its munificent support to the observatory under the belief that it is supporting a great and useful scientific establishment which is extending the fame of our country in the intellectual field as the observatories of Greenwich and Paris have extended the fame of the countries which have supported them. If this belief is ill founded the claim in question amounts to nothing less than saying that our naval officers will fight for the privilege of expending large sums for objects which neither increase the efficiency of the service nor promote the scientific standing of the country in the eyes of the world. We cannot suppose them animated by so low a spirit as this attitude presupposes. We believe that they are sincerely desirous of seeing the great institution established at such expense made a credit to the country, and that if fifty years' experience shows that this end can be reached only by separating the naval from the scientific work of the establishment, and placing the latter under the only sort of control that can ever be really successful, they will, in the words of Commodore Belknap, 'not stand in the way.' It is the duty of our astronomers to use their influence in making the exact facts of the case known, and in promoting such a solution of the problem as will conduce to the good name of American science.

Were we dealing with a small institution to which Congress extended only a niggardly support, we might look with indifference on a corresponding paucity of performance. But when Congress bestows a far more liberal support on our observatory than England, France or any other nation bestows on its national observatory, and does this in the belief that it is promoting astronomical science to a corresponding extent, patriotism demands that our astronomers should inform our authorities whether this belief is or is not in accord with the fact.

DISCUSSION OF A NATIONAL OBSERVATORY.

IN response to a letter sent to a number of leading American astronomers the replies printed below have been received.*

The letter asked for answers to the following questions:

1. Is it desirable that the government of the United States should support a national astronomical observatory?

* In addition to these replies a committee appointed at the Harvard Conference of Astronomers and Astrophysicists, consisting of Professor E. C. Pickering, Harvard College Observatory (Chairman); Professor George E. Hale, Yerkes Observatory, and Professor George C. Comstock, Washburn Observatory, has drawn up a report on the subject, which we hope to publish after it has been presented to the next Conference.

2. If so, what ends should such an institution have in view; especially to what classes of astronomical observation and research should it be devoted?

3. Does the new Naval Observatory fulfill the objects in question so completely that no other institution of the kind is necessary? If not, in what respects does its work differ from that required for the purposes in view?

To the Editor of Science: In answer to your questions as to the policy of supporting a national observatory, I would say that, making abstraction of features peculiar to astronomical science I see no reason why the government should support an astronomical observatory any more than a chemical laboratory for chemists to use in making their experiments. The exceptional reason in favor of an observatory is that there are branches of astronomical science of world-wide interest and importance which are not adequately cultivated by private enterprise. The greatest of these relate to the motions of the heavenly bodies, especially the fixed stars. Of late years it has been seen that the study of these motions may throw light on problems formerly regarded as insoluble, and supply posterity with records of priceless value in the advance of knowledge.

An institution to supply the want thus indicated should be organized and fitted up with its own special end in view, and should not be diverted from that end by the temptation of more attractive work in other directions. The later results of experience and research should determine the instruments to be used, and the whole arrangements should be such as to command the best talent and skill in planning and executing the work.

Simon Newcomb.

To the Editor of Science: The astronomical questions you propose to discuss in Science are interesting. Since I hold a position in the Navy it is not proper for me to discuss the conduct of the Naval Observatory. As to the other questions I may say briefly:

1. I think it is desirable that the government of the United States should support an Astronomical Observatory.

2. I think such an observatory should determine the positions of the stars, planets and satellites with the greatest accuracy possible, since theoretical astronomy rests on such observations. The astro-physical departments of astronomy are so attractive that they will not lack investigators.

Asaph Hall.

Harvard University.

To the Editor of Science: Replying to questions raised in your communication of December 4, 1898, I would say:

I. I think that unquestionably the United States ought to support a National Observatory, unless it is willing to fall to the rank of a third-rate nation. Besides, we already have a fine building, with a costly and valuable equipment of apparatus. It would be a disgrace to abandon it.

II. As to the ends to be kept in view, etc., I think a National Observatory, maintained by the government, should aim chiefly at kinds of work not easily within the reach of private and educational observatories—extended series of observations which require persistent prosecution without intermission or material change of plan—such, for instance, as:

(*a*) Continuous observations of the positions of the sun, moon and planets, partly by the meridian circle, and partly, perhaps, by photography, which is specially valuable in the case of such asteroids, as, for one reason or another, require attention. Observations of comets are also in order.

(*b*) The determination of the absolute positions of a reasonably large list of fundamental stars, and of such other stars as are needed for reference points by observers of planets or comets, or by those engaged in geodetic operations.

(*c*) I think it desirable also that certain astrophysical observations should be included, especially in the line of stellar spectroscopy, since the number of objects of investigation in this line is so great that the ground cannot be covered in any reasonable time without the general cooperation of all well-equipped observatories.

(*d*) The refined reduction and prompt publication of the results of observation. This implies a thorough mathematical study of the theories involved and investigation of their corrections, and requires that among the as-

tronomers of the observatory there be included able mathematicians as well as skillful observers. Joined with this work is very properly the calculation and publication of the National Astronomical Ephemeris, or some definite portion of an International Ephemeris, if such a work can be arranged for, as is now proposed in certain quarters.

III. I do not think that the National Observatory, whether organized as the present Naval Observatory or on any other plan, can wisely undertake to deal with all classes of astronomical observation. There are numerous lines of investigation which can better be followed up by institutions organized for the special purpose, or by individual amateurs. Nor do I believe that under its present organization, nor under any organization which leaves it distinctively a naval institution, managed and directed according to naval traditions and methods, can it ever well fulfill the ends of a National Observatory. The pursuit, and especially the superintendence and direction of astronomical investigation, is purely scientific work, and should be under scientific control.

As to the question whether another observatory (for astro-physical investigation I suppose) should be founded and maintained by the government I am hardly clear. The examples of France and Germany, and to a certain extent that of England, point in this direction. But so long as the observatories at Cambridge, Mt. Hamilton and Lake Geneva maintain their astro-physical activity it seems to me hardly necessary for us to move in the matter.

PRINCETON, N. J. C. A. YOUNG.

TO THE EDITOR OF SCIENCE: As I am not an astronomer there is no reason why my opinion should appear in your symposium on the National Astronomical Observatory. Your request that I should furnish it originated, doubtless, in the fact that I was appointed, at the Boston meeting of the A. A. A. S., a member of a committee of which Professor E. C. Pickering is Chairman, to consider and report upon the organization and work of the Naval Observatory at Washington, which stands for whatever we have or have not in the way of government astronomical research at the present moment. At any rate I will venture upon a very brief discussion of the questions involved as I see them.

To the first question I would reply that we already have and have had for many years a National Astronomical Observatory in the Naval Observatory at Washington. Congress has already shown its willingness to maintain such an institution in the magnificent buildings and expensive equipment for which it has generously appropriated money and for the support of which it makes liberal annual appropriations. It is too late, therefore, to discuss your first query, but the all-important question is the third: Does the Observatory as organized and managed at present fulfill the requirements of such an institution? On this point there is room for much discussion and, perhaps, some difference of opinion. My own answer would be: No. But there is likely to be a tendency to misrepresent the views and attitude of naval officers in this matter, and, without pretending to speak for them or by their knowledge or consent, I venture the opinion that a large majority of them, especially of those generally acknowledged by their comrades to be the foremost men in the service, would be found in substantial agreement with the leading astronomers of the country. It has been my privilege to enjoy rather intimate association with many of them, and I have always found them unselfishly devoted to the best interests of their corps, always ready to discharge in the most conscientious manner any duty with which they may be charged, doing the very best they can under the conditions and restrictions by which they are surrounded.

That they should have a pride in the development of the great institution which has been for so many years under their care is only natural. Originally the Naval Observatory was just what was required by the navy; but, by its gradual expansion into an establishment fitted for astromical research on an almost unrivalled scale, it has become very much of an elephant on their hands. But to expect that they will voluntarily relinquish all claim to or interest in it is to expect what is unreasonable. I am sure that the great majority of them know that the spirit of a military regime, which is at

once a virtue and a necessity in a military corps, is quite imcompatible with the spirit of scientific investigation pure and simple. So long as the Observatory is under a bureau of the Navy Department it must, of necessity, like a navy-yard or a receiving ship, be controlled by naval regulations, and any relations which naval officers may sustain to it must be governed by navy rules regarding rank, short details of service, assignments in regular order without regard to special fitness or taste and other established customs, absolutely necessary to military discipline, but utterly irreconcilable with the spirit of an institution devoted purely to scientific research. The only satisfactory solution of the problem is the removal of the Observatory from military control. No half-way measure, such as appointing a Director from civil life, will avail as long as it remains attached to the Navy Department. The amputation must be clean and complete.

If any attempt is made to accomplish this it must be kept in mind that it is a fundamental principle of bureau administration to get hold of all you can and hold all you get. It is accepted as an evidence of successful administration to have added one or more new functions to the office which you happen to hold, and it is considered almost disgraceful to allow another bureau to begin operations in a field which you have traditionally cultivated, however unrelated they may be to the work for which your corps was originally organized. Much of the useless duplication of government work is due to this.

It must also be remembered that Congress concerns itself very little with what ought to be done, but that it is very greatly influenced by what it is made to believe the people want done. As far as the interests of astronomy go, astronomers are the people. Whenever they are ready to unite in a persistent effort to secure reform in the Naval Observatory, whenever they are willing to exert their influence in favor of making it a real national establishment, directed by astronomers for astronomy they will succeed. Naturally there will be a few naval officers who will seriously oppose any measure which deprives them of such agreeable shore duty, but the great majority of them know very well that to them professional distinction is to be reached through skill in handling a 10-inch gun rather than a 26-inch objective and that the experience of commanding a battleship is vastly more valuable than anything to be gained in the performance of the petty routine duties of superintending an institution in whose work they have little real interest and no enthusiasm.

T. C. Mendenhall.
Worcester Polytechnic Institute.

To the Editor of Science: I beg to offer the following replies to the questions you raise with reference to a national astronomical observatory.

First, it is desirable that the government of the United States should maintain an astronomical observatory. The experience of the past two hundred years seems to demonstrate that there are certain kinds of scientific work that cannot be successfully carried on without the express sanction and support of stable governments.

Astronomy, geodesy and geology are the most striking instances of such work, and it is hardly conceivable that they could have attained their existing degree of utility except for the aid extended to them by the leading governments. That the maintenence of such work is second only in importance in national economy to the maintenance of law and order, and to the diffusion of education, is a proposition which few readers of Science are likely to controvert.

Secondly, the chief objects of a national astronomical observatory seem to fall under the following heads: (a) the registration of continuous series of observations of the sun, moon, planets and fixed stars; (b) the preparation of ephemerides of these celestial bodies for the use of surveyors, geodesists and navigators; (c) theoretical investigations with reference to the motions and physical properties of the celestial bodies, and with reference to the instruments, appliances and methods used in astronomical observations and computations; (d) the cooperation with other similar organizations in astronomical undertakings of international importance.

Thirdly, it may be said that the existing Naval Observatory has fulfilled and still fulfills

these objects. It must be admitted, in fact, that the Naval Observatory, during the half century of its existence, has done a large amount of first class work, and that its service has been dignified by the connection with it of some of the most eminent American astronomers. Nevertheless, it appears equally just to affirm that the administration of the Naval Observatory has never been favorable to the highest efficiency of such an organization. The scientific work of the Naval Observatory has been done in spite of a bad form of administration rather than by reason of a good one.

The radical defect of this administration lies in the assumption that the Superintendent of the Observatory should be, as he has been, generally, a naval officer, who may have little knowledge of or interest in astronomy. The position is one of pleasing prominence to an officer on shore duty, and is hence likely to fall to one who has 'pull' with the party in power rather than to one who has distinguished himself as an astronomor. The effect of such administration is much the same as would result in a university if the department of mathematics, for example, were placed in charge of a superannuated clergyman. The routine work goes on pleasantly, but with no scientific energy except that which the subordinates get from external professional associations. Subordinates who are exceptionally able may, as some have done, accomplish much good work under such depressing circumstances; but those less ambitious are apt to lapse into mere time servers. This form of administration leads also to pressure for position in the service by those little competent to undertake astronomical work. The way in which some of the highest positions on the Naval Observatory staff have been obtained in recent years, through 'pulls' and 'influence,' and competition of all kinds except that of merit, is a standing disgrace to all men of science.

To remedy these defects, and to make of the Naval Observatory a National Observatory, some rather radical changes are essential. The Observatory should cease to be a mere bureau of or appendage to the navy, and the surest way to accomplish this end will be to transfer the Observatory to some other department. The Director or Superintendent of the Observatory should be an astronomer of acknowledged ability, and the members of his staff should be chosen by reason of merit only. The conduct of the work of the Observatory should be subject to the approval of a board of regents, similar to that of the Smithsonian Institution, half of whom should be chosen from astronomers and physicists not in the government service, and half from members of Congress. Some such system of administration, free so far as practicable from the contamination of spoils and politics, appears to be absolutely indispensable to the maintenance of an Observatory worthy of American science.

R. S. WOODWARD.

COLUMBIA UNIVERSITY.

TO THE EDITOR OF SCIENCE: In reply to your questions relating to the United States Naval Observatory I assume that you do not expect an elaborate article, but merely the expression of my individual opinion in a few words. I take the topics in order.

I. If no such establishment existed, and it were a question of founding an observatory, I should say *no*. At least not before government methods had considerably improved.

With buildings and plant on hand, which have cost nearly a million of dollars, it is probably best to keep it up, though I am not quite sure of this.

II. Systematic work with meridian circle in determination of places of stars and planets. Measurements of double stars and positions of comets and minor planets with the equatorial. In short, the kind of work which Hall and Eastman kept up for many years and which is not likely to receive the necessary attention at private observatories.

III. I do not quite understand this question. If the meaning is as follows: Is it desirable for government to establish another observatory in order to atone for the shortcomings of that now existing? there can be only one answer.

The requisite conditions, in my opinion, are not likely to be fulfilled by any observatory established within the political atmosphere of Washington.

C. L. DOOLITTLE.

FLOWER OBSERVATORY.

To the Editor of Science: In reply to question number one I should say: Had we no observatory, no. It does not require a 26-inch telescope to test a chronometer. (2) Since we already have such an institution, it seems to me that the best work it can undertake will be large and expensive pieces of routine work, such as a private observatory would be unlikely to take up, and could only be accomplished by a combination of them. (3) The Naval Observatory certainly does not fulfill this idea. The work it is to undertake should, I think, be decided by a committee suitably appointed. It should have a civilian astronomer at its head.

W. H. Pickering.

Harvard College Observatory.

To the Editor of Science: The question whether the United States should maintain a National Astronomical Observatory must largely depend for its answer upon the opinion which we may adopt with regard to the propriety of employing money raised by taxation in the support of any branch of pure science. It may be held that the taxpayers should not be made to contribute to undertakings in which they cannot be supposed, as a whole, to feel any decided interest, and which, so far as they are beneficial, must benefit mankind at large, rather than the particular nation supporting them. But various branches of applied science must be cultivated at the national expense, and it is difficult to draw a definite boundary separating abstract inquiries and their practical applications. Some liberty of research, too, on the part of men engaged in any scientific work, seems desirable to prevent them from falling into too mechanical a routine. In this country, where the science of astronomy is so liberally supported by private munificence, there is, doubtless, very little occasion for a National Observatory; still, since such an institution exists, and has done much interesting work, as Professor Skinner shows, most of us would probably dislike to have it abandoned without further trial.

The most obviously valuable service which a National Observatory can render is the maintenance of such observations as are apt to be neglected elsewhere, from their want of immediate interest. Such, for example, are the determinations of position of the sun, moon and planets, which have been kept up assiduously at the Naval Observatory since 1861, as Professor Skinner assures us at the close of his article. It would hardly be advisable to confine the work of the institution rigidly to a routine of this kind, so planned as to leave the astronomers no time for pursuits more stimulating to the intellect; but if they should attempt to undertake all kinds of researches most in vogue at the present moment we could not expect from them many solid additions to human knowledge.

I do not feel myself competent to judge whether the Naval Observatory is to be regarded, comparatively speaking, as a success or as a failure, or whether any change in its organization would decidedly improve it. I know that complaints of the amount and quality of its work have often been made, and I have been puzzled by the manner in which these complaints have been met. In similar cases we usually find the persons criticised inclined to excuse what may seem to be their shortcomings by their want of means, or by the uncertainty whether their present pecuniary support will be continued, or, perhaps, in other instances, by a defective organization imposed upon them from without. But, unless I misunderstand what I have heard, the astronomers of the Naval Observatory generally agree that their chief has all necessary power to carry out his plans promptly and effectively; that this power hardly needs to be exerted, because they form a united and harmonious body, animated by purely scientific zeal; that Congress has supplied them abundantly with funds, and that they entertain no apprehension that this liberal support will be withdrawn, or that they will be under the necessity of neglecting their scientific pursuits in order to solicit its continuance. If this impression of mine, which I acknowledge to be a vague one, is correct, either the critics must be in error or there is something in the mere atmosphere of Washington, or in any connection with the government of the United States, which is unfavorable to the cultivation of astronomy.

Public criticism of a public institution must

not be blamed, even if it is ill founded; and I am inclined to depend upon it for the correction of any defects which may exist in the management of the Naval Observatory. If the critics cannot agree among themselves no change is probably required, but if there is a general accordance among them it will be difficult for the Washington astronomers to persist in opposition to the scientific sentiment of the country. For example, the publication of the Washington observations has often been considered needlessly irregular and dilatory. If this criticism is just, and if the Naval Observatory has ample means for the reduction and publication of its work, I can hardly doubt that the mere repetition of the complaint will before long succeed in removing the occasion for it.

ARTHUR SEARLE.

HARVARD COLLEGE OBSERVATORY.

TO THE EDITOR OF SCIENCE: Your questions are fundamental.

1. The right to existence of a National Astronomical Observatory supported by the United States seems to me beyond dispute, and this too for the reason that certain classes of astronomical observations, such as those of the positions of sun, moon and the larger planets, must be maintained with a regularity seldom attained in an observatory subject to the vicissitudes of a changing policy or to the fluctuation of available funds. In general, those researches which demand long series of observations whose accumulation is likely to outlast the activity of an individual astronomer require an institution having the stability of a National Observatory.

For example, Holden's inquiry as to the evidences of change of form in nebulæ, which appeared in the Washington Observations for 1878, is a preliminary discussion whose final answer can best be given by comparison of a series of photographs taken under identical conditions at regular intervals and accumulated perhaps for some centuries. Such a work seems eminently suitable for a National Observatory.

But (3) the New Naval Observatory does not now fulfill, and need never fulfill, these objects so completely that the cooperation of other institutions shall be unnecessary; and a carefully considered scheme for the division of labor and the cooperation of working astronomers would add to the efficiency of every observatory in the land. Indeed, it may be said that already, without any set compact, there is a tacit recognition of the fitness of individuals for special work, and a partial relinquishment of such work to the men whose attainments, or the institutions whose outfits, promise the best results.

It would be very easy to criticise the present Naval Observatory, but probably few of us could do better under the existing system, which is not sufficiently elastic, and which fails to recognize that Science is like a living plant and must have room to grow. I will confine myself to one example. The accumulation of accurate magnetic records, and their comparison with cosmic phenomena, ought to be an uninterrupted work, undertaken with the design of making it permanent, and as such it is suitable for a National Observatory. The folly of continuing magnetic observations in the rapidly altering environment of a great city, where electric currents generate a variable magnetic field of their own, has been abundantly demonstrated. Scientific opinion and common sense demand the immediate removal of the magnetic part of the working outfit of the Naval Observatory to one or more suitable localities, far removed from civilization, but the sluggish response of a conservative authority which finds it difficult to conceive of a National Observatory in any other place than Washington, D. C., bids fair to leave a gap in our records unless individual action comes to the rescue. Now, while it is not desirable that an institution having the especial character of permanence should shift its policy on small provocation, there ought be freedom to meet emergencies.

FRANK W. VERY.

BROWN UNIVERSITY.

TO THE EDITOR OF SCIENCE: In response to your significant enquiries:

1. *Is it desirable that the government of the United States should support a national astronomical observatory?*

Yes, the United States, as a leading nation of the globe, is virtually pledged to equip and

maintain an astronomical observatory of the first order.

2. *If so, what ends should such an institution have in view, especially to what classes of astronomical observation and research should it be devoted?*

Such classes of observation and research should be conducted as will be of the utmost practical utility:

(*A*) Observations for determining the precise positions of the stars upon the celestial sphere.

(*B*) Spectroscopic observations of precision for determining the motions of fixed stars toward and from the solar system.

One telescope of exceptional size should be devoted to this work.

(*C*) Determination of the distances of the principal fixed stars.

(*D*) Accurate evaluation of the elements concerned in the motion of the earth's pole of rotation.

A zenith telescope of the best construction, preferably photographic, should be constantly employed upon this research. Cooperation with the Coast and Geodetic Survey, and the uninterrupted support of an additional observer in Manila or Honolulu, is highly desirable. This service should be maintained with the utmost rigor for at least twenty-five years.

(*E*) Meridian observations of position of the sun, moon and major planets.

Planetary observations should be converted into errors of celestial longitude and ecliptic north polar distance, and equations formed connecting these errors with the elements of the planetary tables used in the preparation of the Nautical Almanac.

(*F*) Searching investigation of the constant of meridian refraction should be conducted uninterruptedly throughout a series of years.

(*G*) Equatorial observations not previously specified. These need be but few.

(*H*) Solar research in several departments.

1. The spots, their number and area, photographically and visually. An independent record should be maintained in either Manila or Honolulu, thereby supplementing, at half intervals, the similar work at Greenwich, Dehra Dûn and the Mauritius.

2. The prominences, photographically and visually.

3. The faculæ, with the spectroheliograph.

4. The corona, during total eclipses, chiefly photographically.

5. The Sun's Reversing Layer.

6. Bolometric investigation of the infra-red rays of the solar spectrum.

7. The permanency in character or the secular variation of lines in the solar spectrum.

8. The permanency or secular variation of the solar constant. In the prosecution of 6, 7 and 8 a high-level station might advantageously be maintained, in either Hawaii or southern California.

(*I*) The department of the Astronomical Ephemeris and Nautical Almanac should not only prepare and publish this work, at least three years in advance, but should issue also accessory publications of especial service to navigators.

(*J*) Magnetic observations ought to be maintained, as regards declination, dip and intensity.

(*K*) A time-service must be maintained, not only for the purpose of the Navy, but for the wide distribution of standard time and the dropping of time-balls at important localities.

The Superintendent or Director of the government observatory should be held responsible for the efficient prosecution of all branches of the work under his charge and for its prompt publication. Also he should be empowered to choose his subordinates, with or without examination, their recommendation for appointment to be subject to approval by a Board of Visitors at semi-annual sessions. Advancement and discharge should be regulated in a similar manner.

David P. Todd.
Observatory House, Amherst, Mass.

To the Editor of Science: To the three questions submitted to me a few days since by yourself I would reply as follows:

1. It is most emphatically desirable that the government of the United States should support a National Astronomical Observatory. There are certain important lines of astronomical research which are of a character such as not to appeal to the popular interest and which, if left to be taken care of by private endowment,

will not recieve proper attention. To these the institution should be devoted.

2. Such an institution should have in view research work primarily. The training of specialists should not be ignored. The lines of astronomical research which should receive special, if not exclusive, attention by such an institution should lie within the scope of what is recognized by astronomers as astronomy of precision, though I would not exclude from the realm of precise astronomy some lines of astro-physical research.

3. Most emphatically it does not. Routine work, such as the rating and testing of chronometers and operating a time system, etc., should be no part of the work of a National Astronomical Observatory. The organization of the observatory should not be such as to hinder the most efficient service of its officers nor to curb or discourage the ingenuity of subordinates. Individual initiative should be given freest play. The machine system of Sir George B. Airy, more in vogue elsewhere than in the New Naval Observatory however, and so enthusiastically befriended by directors of observatories, should have no place in its organization, or operation. It should not be a *one-man* institution in the sense that most institutions of this sort have been which have been called into existence among us in these latter days and have too frequently been made to play the part of machines to lift their directors into notoriety. In a single word, the organization of the institution should be democratic and not autocratic.

G. W. MYERS.

UNIVERSITY OF ILLINOIS.

TO THE EDITOR OF SCIENCE: I will briefly answer your questions even though I do not feel suitably prepared to offer unanswerable proofs or cite dates, events, etc.

1. I feel that it is imperative that the government of the United States should support a National Astronomical Observatory, not necessarily at Washington.

2. Only through the work of that Observatory the usual tables of coordinates and other data can be efficiently and officially produced to serve the purposes of navigation, etc.

3. The Naval Observatory does not fulfill all the conditions that it should, so as to bring to American science an amount of credit proportional to what is done in other branches of the government. The National Observatory should make investigations of all kinds with reference to astronomy, geodesy, meteorology and also in astro-physics. It should largely extend its list of apparent places and also add to the American Ephemeris a larger list of mean places for the better determination of latitudes throughout the country.

4. I can see no reason why the National Observatory should not engage in every branch of astronomy in which other observatories are at work. The only trouble lies in the administration of the National Observatory. I do not know how things are there at present; but our Observatory used to be a source of pride and usefulness to American scientists; and since it has been placed under the control of line officers it has done very little remarkable work, and several of its best men have gone elsewhere. It seems that military life leads even the best of men to do routine perfunctory work, and when the line officers look down upon the Naval Observatory professors as subordinates or inferior beings there are a large number of considerations which tend to diminish the ambition which is the result of industrious zest in scientific work.

I cannot see why the United States government could not have in this astronomical observatory great men adequately paid, in a perfectly defined high social position, and with sufficient appropriations to be engaged in useful research. The nature of the case demands the existence of several observatories, properly located geographically within our vast domain, which now extends around the earth.

E. A. FUERTES.

CORNELL UNIVERSITY.

TO THE EDITOR OF SCIENCE: In answer to the questions you have laid before me I may say:

1. In my opinion there can be but little doubt as to the desirability of a National Astronomical Observatory, supported by the government of the United States. Our geographical position on a meridian one quarter way or more around the globe from those of the great Euro-

pean national observatories affords the means of supplementing, in a valuable manner, the work carried on by them, while our more southern latitude extends the limit and increases the accuracy of useful observation below the equator.

2. The sphere of work of a National Observatory appears to me to comprise mainly such classes of research as cannot well be undertaken by university observatories. Of these we have quite a number, some with the most powerful of equipments, but in general they are likely, I think, to devote themselves to investigations which promise an immediate return of results. The systematic continuous observation of the bodies of the solar system for position, such as has been prosecuted at Greenwich; the construction of catalogues of fundamental stars, such as those furnished by the Pulkowa observatory; the procuring and measurement of photographic plates of the heavens on the plan inaugurated by the observatory at Paris, seem to me, for instance, fields which require such large resources as scarcely any but a national institution can command.

3. I should consider the present site of the New Naval Observatory an admirable one and the equipment in a considerable degree sufficient for the purposes of a National Observatory There should, doubtless, be added a powerful photographic apparatus.

W. L. Elkin.

Yale University Observatory.

To the Editor of Science: At your request I give my opinion on some questions relating to the establishment of a national observatory in this country, although I believe that it does not differ materially from the opinions of other American astronomers.

It seems to me highly desirable that the United States, like other leading governments, should support a national astronomical observatory. In the U. S. Naval Observatory, the honorable history of which has recently been so well told in these pages by Professor Skinner, the government already possesses suitable buildings and instruments and certain changes in the organization are alone required to convert this institution into a national observatory of the first rank.

The opinion, which is probably widely held among astronomers, that this observatory would be benefited by a change in its organization, is based on general considerations and does not reflect on any individuals or class of men. The splendid efficiency of our naval officers in their own profession is due not merely to natural ability and aptitude, but to a long course of preparatory technical training. Astronomy is likewise a science which demands the whole of a man's best energies. Common sense, therefore, as well as the example of other nations, clearly indicates that a national observatory should be under the charge of an officer who has made astronomy his life work. To place it under the charge of one whose training has been along different lines is as objectionable as would be the appointment of civilians to responsible military commands.

The work of a national observatory would naturally lie mainly in the field of the older astronomy, more particularly in the making and discussion of those fundamental observations of the positions of the heavenly bodies which owe a large part of their value to their continuity, and which, therefore, require permanent, thorough organization and secure financial support. The private or small observatory enjoys the privilege, in some degree compensatory for the many disadvantages under which it generally labors, of taking up researches of doubtful promise without being called to account in case of failure. The elaborately equipped and organized government institution devotes most of its energies to work of which the results are certain, the exploration of new fields and experiments in general having only a secondary place in its program.

Professor Skinner's article shows that only a small part of the work done at the Naval Observatory has any direct reference to the needs of the Navy Department, while by far the greater part is such as would properly come under the province of a national observatory. The requirements of the navy could, I think, easily be met by a national observatory by adopting such methods of coöperation as already exist in other parts of the government service.

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