

been likewise engaged in the study of the new instrument they have devised for the measurement of the stellar photographs, and in the preparation of tables of instrumental corrections, and of corrections for the effect of refraction; whilst M. Thiele has been inquiring into the degree of accuracy of which the measures are capable, with most encouraging results, and Admiral Mouchez considers that the precision thus attainable "will permit the carrying out under good conditions of the Catalogue of all the stars down to the 11th magnitude as decided by the Congress." It should be noted, however, that this interpretation of the resolution of the Congress has been challenged, and it has been urged that the Catalogue to be formed was to contain simply as many suitably placed stars as would be necessary as reference points for the great photographic chart, and that stars down to the 11th magnitude might be used for this purpose.

As to the publications of the Observatory, the first volume of the Catalogue, ch.-6h. of R.A., is shortly to be followed by the second, 6h.-12h., the first sheets of which were already in the printers' hands. The volume of Observations for 1882 was published last August, that for 1883 was passing through the press, whilst the reduction of apparent to mean places was completely finished for 1884. The nineteenth volume of the Memoirs was in course of publication, and would contain, besides the works mentioned in the Report for 1886, a memoir on the theory of the figure of the planets, by M. Callandreaux, and another on an allied subject, by M. Hamy. Amongst the works published by the individual members of the Observatory, the most important have been M. Lœwy's new method for the determination of the constant of aberration, and a work by M. Wolf, on the pendulum. M. Leveau is still engaged in his work upon Vesta, and M. Bossert is preparing for the determination of a definitive orbit of the Pons-Brooks comet. Under the head of "Matériel" the progress of the new equatorial *coudé* of 2 feet aperture and 60 feet focal length is referred to. Its completion is expected during the present year, but the building for it has not yet been begun.

The chief exception to the record of progress which Admiral Mouchez's Report supplies is found in the short paragraph which records the closing of the astronomical school, on financial grounds. The necessity for this step is to be most deeply regretted.

THE PHOTOGRAPHIC CHART OF THE HEAVENS.

WE lately reprinted from the *Observatory* (NATURE, May 10, p. 38) an article by the editors of that periodical on Dr. Gill's proposal that two million stars should be catalogued. The following is the reply of the editors, printed in the June number of the *Observatory*, to letters addressed to them on the subject by Admiral Mouchez and Mr. E. B. Knobel:—

We print above letters from Admiral Mouchez and from Mr. Knobel, concerning the remarks we made last month on Dr. Gill's proposition to catalogue 2,000,000 stars. There is a somewhat personal implication in both letters, to which we must at once reply before proceeding to treat of the real question at issue—a suggestion that we have been so emphatic in our disapproval of the scheme as to be discourteous to its supporters. We may perhaps venture to doubt whether either writer has done us the honour to read our remarks carefully enough. Admiral Mouchez "nous trouve bien sévère pour un projet aussi bien étudié et venant d'un savant aussi habile et compétent que le Directeur de l'Observatoire du Cap." We have not said a single word in disparagement of the skill and care with which Dr. Gill's paper has been written; we have vehemently objected to the question

being raised at all; and that we have objected so vehemently may be taken as a full recognition of Dr. Gill's prominent position, which makes it a matter of necessity to bring all our forces to bear against a scheme which he chooses to advance. Mr. Knobel is perhaps more unjust to us. We have not in an unqualified manner characterized a catalogue of 2,000,000 stars as "an utter waste of time, labour, and money"; but we did use even stronger language about cataloguing stars "for the purpose only of getting their places written down," in order to call attention to the *reductio ad absurdum* of cataloguing towards which we very much fear there is some apparent tendency. And, finally, if we have been so emphatic as to be accused of exaggeration, let us again point out that a scheme, which we contend has not been assented to or even considered by the members of the Astrophotographic Conference, has been quietly launched, and is now so far under way that it is referred to by the President in the opening sentence of his letter as a matter already accepted by the "Comité permanent," and as only remaining to be discussed in detail. Surely it is time for those who have the welfare of the scheme really sanctioned by the Conference to raise their voices loudly in protest!

So much in explanation of the tone we have adopted in speaking of this proposal, and we now return to the letters. The main point of both is that this scheme of a catalogue of 2,000,000 stars has not been originated by Dr. Gill, but was really considered and approved by the Conference. As we have stated above, we hold the opposite opinion,—that although two resolutions of the Conference do mention a catalogue, this term cannot be supposed to sanction a catalogue of 2,000,000 stars without further specification. The Conference met to discuss the advisability of making a chart. With the invitations sent out to the various astronomers to attend this Conference there was sent a "programme provisoire" (which, it is to be very much regretted, was not that considered by the Congress). This first "programme provisoire" was dropped, and at the first *séance* of the Congress another was produced. In the first, in article 19 a *catalogue of reference stars* was mentioned, and properly so, but in the second there was no mention of any such catalogue. Mention was made in section 4 of a means of publishing the chart and the form of publication, but up to this time there was absolutely no question before the Conference of publication of a catalogue either of 2,000,000 or any other number of stars. There was no doubt a feeling amongst some astronomers present that a catalogue would be as useful, in their judgment, as the chart; and they took the opportunity of putting forward their views when the question of a second series of plates was brought forward. The taking of this second series of plates was proposed to meet an anticipated difficulty in photographing parts of the heavens where the stars differed greatly in magnitude. It was decided (Resolution 17) that a second series of plates should be taken, in order to insure the greatest precision in the micrometrical measurement of the stars of reference, and to render possible the construction of a catalogue. Here we have the first mention of a catalogue in the resolutions noted. A reference to the minutes of the Congress will show that this resolution was a compromise, for there had already been before the Congress a direct proposition (that of M. Tacchini) for a catalogue, which, however, was not voted upon. The resolution was in fact an endeavour to settle a question that was before the Congress, viz. whether the plates should be so taken as to be capable of accurate measurement; and this is decided by the specification that they shall render possible the construction of a catalogue. The next two resolutions speak of the second series of plates as *destinés à la construction du catalogue*, but nowhere is any direct resolution to be found as to the construction of a catalogue of all the stars.

If these resolutions need interpretation by the light of

subsequent consideration at all, we may suggest a very different direction in which they might be modified in actual fact, and in which their spirit would yet be even better represented than by a literal fulfilment. It was pointed out that in taking the photographic plates of stars down to the 14th magnitude in parts of the sky where brighter stars existed, these with the exposure necessary to obtain the 14th magnitude would be very much over-exposed. And it was suggested that it would be advisable to take a second series of plates, as already mentioned (see Resolution 17). Now in some parts of the sky no second series of plates are, from this point of view, at all necessary; whilst in others not one or two, but many series of plates would be necessary in order to do justice to the various magnitudes in that particular part of the sky. For the present this is not the point at issue, but it may serve as an illustration of the sort of interpretation of the resolutions which we should consider legitimate.

In order to come to a proper judgment on the legitimacy of the derivation of Dr. Gill's proposal from the resolutions it is necessary to make some statements, which are not new, but of which the true significance does not seem to have been universally appreciated:—(1) When the plates are obtained they are actual representations of the stars as existing at a given time, and for every purpose except spectrum analysis are as good, if not better, than the visible heavens. If with these plates we have the absolute places of a certain small number of known stars, we have then all the data to make them valuable, either in the present or in the future. (2) The many questions concerning the stars which it is hoped a photographic chart of the heavens would do a great deal towards settling, such as their distribution, their proper motions, their changes of magnitude, and the presence of minor planets, of new stars and the like, can all be best treated by a direct comparison of plate with plate, in any of the various ways in which this can be done. (3) In order to obtain the best results from such an agent as photography it is necessary to use it in its own proper way; and astronomers must recollect that old methods of procedure adapted to other instrumental means may most probably be out of place. We might considerably enlarge on these statements, but for our present purpose it is sufficient to call attention to them.

Now, if Dr. Gill's catalogue were successfully constructed—and there are, alas, many difficulties in the way—its utility in the direction of comparison of our sky with that of the future is wholly limited by one condition, that in the future another exactly similar catalogue be constructed, occupying a similar time. Even then, if any changes were found by means of this comparison of catalogues which might very well be made in the course of fifty or one hundred years, the natural and indeed the proper thing to do would be to immediately compare the original plates. But can it be possible that any man or number of men really think of dealing with such a subject in such a way? If, on the other hand, the object of a catalogue be merely to allow of comets, minor planets, and other bodies being located, surely it would be better to measure the plates as occasion arises, and not to catalogue 2,000,000 stars on the off-chance of having some twenty or thirty positions to settle in the course of a year. And, further, such a catalogue would have this enormous disadvantage, that whilst in some parts of the sky stars of the 11th magnitude would be fairly well spread, in the Milky Way we should have stars clustered in such enormous quantities that it would be an extremely difficult thing to even identify them: in fact, speaking roundly, we should say that if such a catalogue were made, two-thirds of the stars catalogued would lie in the Milky Way. If, contrary to the opinion we have expressed, it is decided to form a very large catalogue, surely it would be better to determine the places of a certain number of stars, of such magnitudes as are found available, in each square

degree, and make these the reference stars from which the positions of the other stars on the plate could be obtained.

We are therefore of opinion that, supposing limitless time and money available for such a purpose, the advantages of constructing this catalogue would be doubtful; but even if we waived all these objections and agreed that such a catalogue would be a "nice thing to have," or admitted that since men of the ability and reputation of Admiral Mouchez and Dr. Gill consider such a catalogue necessary it is heresy to inquire the why and wherefore, there would still be left the serious objection that to form a chart of the heavens is the first thing to do, and, take it in as simple a form as possible, it will quite possibly tax the energies of astronomers to their utmost; and that stellar photography being as yet in its infancy it is suicidal to attempt anything which will commit us to a course of action extending over more than a very few years. We could not give a better illustration of the dangers of the opposite procedure than has been supplied by Admiral Mouchez himself. In a recent article he has suggested that there have lately been such improvements in the sensitiveness of plates that we could now go to the 15th magnitude instead of the 14th. With a little ingenuity and less arithmetic it could easily be shown that the whole plan of operations would have become hopelessly futile and obsolete before half the time allowed by Dr. Gill for its completion had elapsed.

But not for one moment do we wish to appear lacking in sympathy with those who have spent and are spending so much time and thought on this subject; it is our great anxiety for the success of the work in which they are co-operating which makes us eager to protest as far as we can against the grand mistake of attempting too much.

THE INCURVATURE OF THE WINDS IN TROPICAL CYCLONES.

THE question of the incurvature of the winds in tropical cyclones is one of such importance to mariners, to enable them to judge their position in a storm, and to escape the hurricane around the central calm, that no apology is needed for adding my independent testimony to that of Prof. Loomis, whose conclusions, given at length in his recent well-known memoir, "Contributions to Meteorology," are quoted in Mr. Douglas Archibald's paper on M. Faye's work "Sur les Tempêtes" in last week's NATURE (p. 149).

In the preparation of a forthcoming work on the weather and climates of India and the storms of Indian seas, I have lately had occasion to re-investigate the above question in the case of cyclones in the Bay of Bengal, on the evidence afforded by the numerous original memoirs and reports prepared by Messrs. Willson, Eliot, Pedler, and other officers of the Indian and Bengal Meteorological Departments; my object being the practical one of determining directly the bearing of the storm-centre from a ship's position; and instead, therefore, of measuring the angle between the wind direction and the nearest isobar, as was done by Prof. Loomis, I have measured with a protractor the angle included between the former and its radius vector, in all cases in which the position of the storm's centre has been ascertained on sufficient evidence. In one other important condition I have also departed from the method pursued by Prof. Loomis. I have restricted the measurements to wind observations of ships at sea, within the influence of the storm, and to those of good observatories on the coast, subject to the same proviso; and have taken no account of those of inland observatories. This difference of procedure is probably the reason that the amount of the incurvature shown by these measurements is somewhat different from