

THURSDAY, DECEMBER 2, 1869

SCIENCE REFORM

A MOVEMENT has been for some time on foot, of a character so important to the Science of England, that we can no longer delay consideration of its object and prospects. It is proposed to submit to a Royal Commission the entire question of the relation of Science to the State; both what now is, and what should be, that relation.

In order to centre the attention of the scientific world on the leading features of the proposed inquiry, we will confine this present opening of the subject, as much as possible, to a narrative of the events which have brought the movement to its present stage.

At the meeting of the British Association at Norwich in 1868, a paper was read by Lieut.-Colonel Strange, in the Mathematical and Physical Section, entitled, "*On the Necessity for State Intervention to Secure the Progress of Physical Science*," an abstract of which was published in the Report of the Association of that year. Colonel Strange stated verbally that he desired to be considered as merely putting into language the thoughts which had long occupied the minds of many eminent men of science. No one who mixes much in the scientific circles, indeed, can fail to recognise in his paper ideas which, in one form or other, have for some years been gathering strength. Discussion followed the paper, but, as might be expected, it branched off into many of the innumerable details which are involved in so large a question. A practical result, however, was arrived at by the Section, namely, that a committee should investigate the whole matter during the recess, and report to the Association at its next meeting.

This committee accordingly presented its report to the Association this year, at its late meeting at Exeter; and, since the future steps that may be taken must be based, more or less, on this document, we cannot do better than here print it *in extenso*.

The Recommendation adopted by the General Committee at the Norwich Meeting was, that Lieut.-Col. Strange, F.R.S., Professor Sir W. Thomson, F.R.S., Professor Tyndall, F.R.S., Professor Frankland, F.R.S., Dr. Stenhouse, F.R.S., Dr. Mann, F.R.A.S., Mr. Huggins, F.R.S., Mr. Glaisher, F.R.S., Professor Williamson, F.R.S., Professor Stokes, F.R.S., Professor Fleeming Jenkin, F.R.S., Professor Hirst, F.R.S., Professor Huxley, F.R.S., and Dr. Balfour Stewart, F.R.S., be a Committee* for the purpose of inquiring into, and of reporting to the British Association the opinion at which they may arrive concerning the following questions:—

- I. Does there exist in the United Kingdom of Great Britain and Ireland sufficient provision for the vigorous prosecution of Physical Research?
 - II. If not, what further provision is needed? and what measures should be taken to secure it?
- and that Dr. Robert James Mann be the Secretary.

The Report was as follows:—

Your Committee, having sought the counsel of many of the most eminent men of science of the United Kingdom upon these questions, so far as it was found practicable to do so, and having carefully deliberated thereon, have arrived at the following conclusions:—

I. That the provision now existing in the United Kingdom of Great Britain and Ireland is far from sufficient for the vigorous prosecution of Physical Research.

II. It is universally admitted that scientific investigation is

* The following names have since been added to the Committee:—Alfred Tennyson, F.R.S.; Lyon Playfair, F.R.S., M.P.; J. Norman Lockyer, F.R.S.

productive of enormous advantages to the community at large; but these advantages cannot be duly reaped without largely extending and systematising Physical Research. Though of opinion that greatly increased facilities are undoubtedly required, your Committee do not consider it expedient that they should attempt to define categorically how these facilities should be provided, for the following reason:—

Any scheme of scientific extension should be based on a full and accurate knowledge of the amount of aid now given to science, of the sources from which that aid is derived, and of the functions performed by individuals and institutions receiving such aid. Your Committee have found it impossible, with the means and powers at their command, to acquire this knowledge. A formal inquiry, including the inspection of records to which your Committee have not access, and the examination of witnesses whom they are not empowered to summon, alone can elicit the information that is required; and, as the whole question of the relation of the State to Science, at present in a very unsettled and unsatisfactory position, is involved, they urge that a Royal Commission alone is competent to deal with the subject.

Your Committee hold that this inquiry is of a character sufficiently important to the nation, and sufficiently wide in its scope, to demand the most ample and most powerful machinery that can be brought to bear upon it.

Your Committee therefore submit, as the substance of their Report, the recommendation that the full influence of the British Association for the advancement of Science should at once be exerted to obtain the appointment of a Royal Commission, to consider:—

1. The character and value of existing institutions and facilities for scientific investigation, and the amount of time and money devoted to such purposes.
2. What modifications or augmentations of the means and facilities that are at present available for the maintenance and extension of science are requisite; and,
3. In what manner these can be best supplied.

To proceed with our historical narrative. The report passed through the ordeal to which all such matters are subjected according to the rules of the British Association; namely, First, the consideration of the committee of the Section in which it originated (Section A); Secondly, that of the Committee of Recommendations; Thirdly, that of the General Committee. By this last it was submitted to the Council of the Association, "*for consideration and action if it seems desirable*," and the report was considered by a sub-committee of the Council on Saturday last.

As the matter now stands, it is for the Council of the British Association to determine whether science in this country stands, or does not stand, on a settled, satisfactory foundation; and if not, then the further question, whether anything short of an inquiry conducted by the State will suffice to redress existing evils and to initiate desirable reforms.

If we refer to the list of names of the Norwich Committee, given above, we find that it includes men of the highest eminence in almost every branch of scientific inquiry,—men whose whole lives are, and have long been, devoted to actual scientific work—professors, investigators, and writers, members of many learned societies, and of universities, leaders of philosophical thought, and persons possessing every available means of insight into all that passes in the scientific world,—and what do they tell us? Why, virtually this, that the provision for extending science in England is derived from so many sources, is subject to so many authorities, is so entirely without consistency and system, that even their joint knowledge fails to grasp and arrange the heterogeneous mass of confusion; they say, however, with an absence of circumlocution that bears the stamp of well-founded conviction, that this

provision, such as it is, not merely fails as to system and quality, but that, as to extent and quantity, "*it is far from sufficient for the vigorous prosecution of Physical Research.*"

Now, the opinions of men like these, so clearly and strongly expressed, must have carried great weight, whatever recommendations they might have founded on them; but when we consider their recommendation our faith in the soundness of their advice receives a strong accession. They do not say, as they might have done,—Establish such institutions, abolish others, alter the constitution of some, create great scientific offices, elevate the condition of scientific men, form us into a body for setting everything to rights, ourselves included. No; with an impartiality that does them honour, they say,—Place this matter before the highest tribunal known to our constitution for the deciding of such questions—before men selected for their high station and unquestionable independence; let all branches of science come in succession under their scrutiny; let the truth appear openly before the world without a possibility that an imputation of partiality and favouritism, which might attach to *our* decision, should cast a shade over their proceedings and their judgment and so damage the cause.

If we next consider the composition of the Council of the British Association, we shall feel the most positive assurance that a Report coming to them from so strong a Committee will be considered with the utmost care. For our own part we cannot feel doubtful of the result. But the question whether or not the Government shall be asked for a Royal Commission on Science is at this moment in their hands, and having said this we have brought down the history of the movement to the present moment.

A few words in conclusion. This is precisely one of those subjects which is liable to be dealt with in detail by minds before which it is definitely presented for the first time. Let us, therefore, indicate briefly the main questions, the discussion of which is, in the present stage of the matter, desirable. These are: First, does scientific investigation labour in England under disabilities and disadvantages for want of the necessary funds and material appliances? Secondly, on what principles should the State assist scientific exertion; are these principles settled and acknowledged; and are they acted on? Thirdly, if the answers to these questions be, as we may almost assume they will be, unfavourable, is there any chance that piecemeal rectification will suffice to correct existing evils, or must we go to the root of the matter with the help of a Royal Commission?

When these questions are settled, it will be time to go more into details—but not before.

PHYSICAL METEOROLOGY

II.—SUGGESTIONS

AT the end of a previous article, I ventured to say I should make some suggestions touching a method by which I think meteorology might perhaps be made a branch of physical inquiry. In doing so, I will borrow the thought, and very many of the words which were brought before the Exeter meeting of the British Association. And furthermore, no allusion will be made in the present article to the elements of pressure and temperature.

With respect to the motion of our atmosphere, it

cannot be anticipated that we shall ever possess the same complete knowledge which astronomy gives us of the motion of the heavenly bodies; for in the latter case the identity of the object is not lost sight of, while in the former case it is clearly impossible to ascertain the motions of individual particles of air. Our inquiries into the distribution and motion of the elements of our atmosphere must, therefore, be pursued by that method which enables us to ascertain the distribution and motion of any other substance or product with the individual components of which we find it impracticable to deal.

Suppose, for instance, we wish to ascertain the wealth of our country in grain or in spirits, and the distribution of this commodity over the earth's surface. We should first of all begin by taking the stock of the commodity corresponding to a given date; we should next keep a strict account of all the imports and exports of the material, as well as of its home production and home consumption.

Now, if we have taken stock properly at first, and if our account of the imports, the exports, the production, and the consumption of our material is accurate and properly kept, it will obviously be unnecessary to take stock a second time. But if these accounts are not kept with sufficient accuracy, or if we suspect that our material leaves us by some secret channel which we wish to trace, it will clearly be necessary to take stock frequently; and thus a comparison of our various accounts may enable us to detect the place and circumstances of that secret transit which has hitherto escaped our observation.

Applying these principles to the vapour of our atmosphere, what we wish to know is the amount of this material present at any one station at any moment, and also the laws of its motion. It would appear that the best way of measuring the amount present at any moment is by ascertaining the *mass* of vapour present in a *cubic foot* of air, mass and volume being fundamental physical conceptions.

Next, with regard to the motion of the atmosphere, including its vaporous constituent, the method of co-ordinates suggested by Dr. Robinson would appear to be the natural way of arriving at this. Let us set up at a station two imaginary apertures (strictly imaginary, of course), one facing north and south and the other east and west, and gauge the mass of dry air and the mass of moisture that passes each of these openings in one hour; we shall by this means get the nearest attainable approach to the elements of motion of the atmospheric constituents from hour to hour. We shall not, however, obtain by this means a complete account of this motion, for we have at present no means of measuring its vertical component. This vertical component corresponds in fact to the secret channel in the illustration given above, which we must endeavour to detect by some indirect method. Another thing that ought to be determined is the production or consumption of the vaporous element of our atmosphere as it passes from place to place. This might be done could we keep an accurate account of the evaporation and the precipitation, the two processes by which this element is recruited and consumed. This would, however, be a very difficult observation.

Let us now recapitulate what information regarding moisture we can obtain from such complete meteorological