

but this truth can now be enforced by very definite examples. King's College, Cambridge, has a revenue from endowment of 34,000*l.*, and has from 20 to 30 undergraduates; Exeter College, Oxford, has an endowment of less than 6,000*l.*, and educates 180 undergraduates, from whose payments a profit is derived which exceeds the external income by nearly 6,000*l.* A comparison also between Corpus Christi College, Oxford, where the sum of 975*l.* in the year is actually drawn from the endowments to pay the balance of the kitchen and buttery accounts, and Keble College, which has absolutely no endowment and yet exhibits a profit of 500*l.* on the year's account, equally teaches the lesson that out of tutorial and other fees, and fair boarding charges, an unendowed institution is capable of paying its own way, even in the face of competition with extravagant endowments. It appears, then, that by far the larger portion of the University endowments are not applied to educational purposes proper, nor apparently is it desirable that more should be devoted to that object, so that those are proved to be not far wrong who have urged that all this wealth is in the main wasted upon sinecures, and is readily available for the direct advancement of science and pure learning. At Oxford, the Heads of Houses and Fellows, more than two-thirds of whom are non-resident, receive yearly 131,000*l.*, and the remainder of the revenue is expended upon various minor charges which are probably inseparable from the possession of large landed estates and considerable buildings and grounds. It is then to this 131,000*l.* that the attention of reformers must be directed, and the question of its proper uses becomes the more important when it is added that the Commissioners anticipate that in the next fifteen years the Colleges will receive an increase, due to the falling in of beneficial leases, of 123,000*l.* It is probable, nay, almost certain, that this total will be considerably increased, partly by a general rise in the value of land, and partly through building leases, so that by the end of this century Oxford will have a yearly sum of 260,000*l.* upon which there is no present claim of more importance than those of Headships and Fellowships. If the revenues of Cambridge are treated according to the same principle of calculation, the amount paid to scholars and expended in general purposes being knocked off and the probable increase being included, the Colleges of that University will have at the same date about 160,000*l.*, so that Oxford will then appear even more than now the richer of the two. In our next article we shall point out how this large sum might be yet further increased, if the connection with the Church of England, which has always hampered to so great an extent the usefulness of the Colleges, were finally severed, and if all the academical endowments were to be strictly applied to academical purposes; but even without such severance a sufficient surplus is shown to induce the much-desired agreement as to its proper application, so that it may not continue to be wasted, nor diverted, as some have suggested, to the great towns; a mode of action which will induce all towns to do nothing in order that the Universities may eventually help them, and more than ever justify the French criticism that our Universities are nothing more than *Hautes Lycées*, instead of being, as they should be, the active centres of learning and research. It is to a Liberal Ministry that we owe the Commission which has yielded

this valuable Report, but according to all appearances it will be a Conservative Government that must undertake the more important task of inaugurating the work of fundamental University Reform.

METEOROLOGICAL REFORM

WE would invite our readers' attention to an article which appears in this number of NATURE on the necessity for placing Physical Meteorology on a rational basis.

It forms the substance of a paper brought before the recent meeting of the British Association by Col. Strange, who has taken, as our readers well know, a very prominent part in the reconstruction of British Science, and to whom we are indebted for the present very earnest and lucidly argued protest in favour of a more rational way of treating meteorology.

He begins by dividing meteorology into two branches—one of these relating to weather and climate and their effects on organised life; while the other deals with the great physical motions of the atmosphere and with their causes.

To know beforehand the climatic peculiarities of a watering-place or country seat is no doubt of much importance, especially for an invalid who is in search of a healthy locality, but this does not constitute physical meteorology. It forms, we venture to think, a more important and certainly a more difficult branch of inquiry to study the earth's envelope as a whole, to ascertain the nature of the movements to which the moveable parts of it are subject, and finally to investigate the physical causes of these. It is in this latter aspect that the meteorology of the day is so lamentably deficient. The great fault in the present system has been well put by Col. Strange.

Two things have been taken for granted by meteorologists. In the first place, it has been imagined that the sun affects the earth in only one way, namely, by means of its radiation; and secondly, they appear to have taken for granted that this radiant influence is a constant quantity. So much indeed have these most important factors been overlooked, that we believe no systematic effort has yet been made to measure the sun's radiant influence, and indeed no proper instrument has yet been devised by which this can be done in a satisfactory manner. Without doubt the great question for meteorologists is that put by Col. Strange: "Is the sun a constant quantity?"

Now, if the evidence in favour of the sun's constancy were absolutely overwhelming, even then the present system would be at fault, inasmuch as no systematic attempts have been made to measure the strength of the solar influence: but how much more is the system deficient when it refuses to investigate an influence which is certainly predominant and most probably inconstant. To give our readers some idea of the evidence in favour of this latter assertion, let us quote the following words from a letter contained in a report presented to the British Association by a committee appointed to consider the question of scientific organisation:—

"Recent investigations have increased the probability

of a physical connection between the condition of the sun's surface, and the meteorology and magnetism of our globe.

"In the first place, we have the observations of Sir E. Sabine, which seem to indicate a connection between sun-spots and magnetic disturbances, inasmuch as both phenomena are periodical, and have their maxima and minima at the same times.

"On the other hand, the researches of Messrs. Baxendell and Meldrum appear to indicate a relation between the wind-currents of the earth and its magnetism, and also between the earth's wind-currents and the state of the sun's surface.

"In the last place, the researches of Messrs. De la Rue, Stewart, and Loewy appear to indicate a connection between the behaviour of sun-spots and the positions of the more prominent planets of our system. Whatever be the probability of the conclusions derived from these various researches, they at least show the wisdom of studying together for the future these various branches of observational science."

A further report by the same committee tells us that "It is not enough to obtain a record of the areas and positions of the various sun-spots. The velocity of cyclonic motion, the chemical nature of the outbursts, the disposition and character of the faculae and prominences, and many other points, are, as shown by Mr. Lockyer, even more characteristic of the nature of solar action than the magnitude of the spotted area, and are equally worthy of a careful and constant study."

The evidence in favour of some strange and variable action of the sun may, perhaps, be compared to that in favour of the existence of America before that continent was discovered by Columbus; and it might have been thought that in an age like the present the difficulty of organising solar research would be very much less than that experienced by Columbus in organising an American expedition; but this is not the case. Indeed, it is not very creditable to the scientific authorities of this country that they have not entered more readily into a subject of this importance. From the quotations given above, our readers will see that this is not the first time the subject has been brought before the British Association.

A large and influential committee, embracing in its ranks many of the most distinguished members of the Association, endeavoured to bring the subject before the Administrative Council of that body, but did not succeed in getting the Council to move in the matter, or even to pronounce any opinion upon the subject. We hardly think this was proper treatment of an important problem, which had found such advocates as Col. Strange, Drs. De la Rue and Joule, Messrs. Baxendell, Lockyer, and Meldrum, as well as the general support of the most distinguished physicists of the country.

Clearly Col. Strange is right in supposing that a problem of this importance and extent can be properly undertaken only by Government. His remarks on this subject are so well put that we will report them here. Starting with the fundamental axiom that private enterprise should be allowed the most perfect freedom from interference or competition by the State, he lays down the following conditions for Government action in any scientific problem:—

(a) That the probable results of the research be beneficial, in the widest sense of that term, to the community at large, or to the various departments of the State.

(b) That the research is too costly or commercially

too unremunerative to be undertaken and vigorously prosecuted by individuals.

(c) That the research requires continuous, uninterrupted work, extending over very long periods, and conducted by systematically organised establishments.

It will at once be seen that all these conditions apply to solar research; and the Governments of other nations have already perceived the fact. Our readers are aware that the Governments of France and America have it in contemplation to establish solar observatories, and a recent number of this periodical informs them that the German Government has already founded one on a large scale, of which it is possible the illustrious Kirchhoff will be the Director.

In conclusion, as we are advocating a question of reform, it is desirable that something in the shape of practical suggestions should be made. Now, in the first place and with reference to the great problem of Solar Physics, we think that this should certainly be encouraged by the establishment of a distinct central observatory devoted to the purpose; for it would be manifestly unfair to our illustrious Astronomer Royal to throw upon him the additional burden of an institution so very different from that over which he now presides.

In the next place, with reference to photographic delineations of the solar disc, Col. Strange has made a suggestion, at once so practical and simple, that we cannot do better than quote his own words:—

"With respect to sun-spot researches, it fortunately happens that the photographic records need not be all taken at the same station. The record of one day taken in England can be combined with the record of the next day taken at the other side of the globe. Hence, in order to obtain this daily record it is only necessary to select a certain number of stations in localities such that there shall always be clear weather at one of them. India offers peculiar facilities for such a selection of stations, owing to the great variety of climate to be found in that country during the same period of the year. Perhaps four or five such stations would suffice for India, and if absolute continuity of record could not be obtained by them, the deficiencies could easily be made good by stations in our colonial possessions."

It is well known how slowly such things march in this country; nevertheless we look with much confidence to the forthcoming report of the Royal Commission appointed to investigate matters of this nature, and to urge upon Government such means as they consider shall tend to the advancement of science and to the good of the country.

BALFOUR STEWART

VAN DER WAALS ON THE CONTINUITY OF THE GASEOUS AND LIQUID STATES

Over de continuïteit van den gas- en vloeïstofstand. Academisch proefschrift. Door Johannes Diderik van der Waals. (Leiden: A. W. Sijthoff, 1873.)

THAT the same substance at the same temperature and pressure can exist in two very different states, as a liquid and as a gas, is a fact of the highest scientific importance, for it is only by the careful study of the difference between these two states, the conditions of the substance passing from one to the other, and the phenomena which occur at the surface which separates a liquid from its vapour, that we can expect to obtain a dynamical