THURSDAY, MARCH 11, 1897.

THE NEED OF ORGANISING SCIENTIFIC OPINION.[1]

II.

WHATEVER may be the deductions from statistics, it cannot be denied that, as a rule, the attitude of our manufacturers has hitherto been antagonistic to the introduction of a scientific element into our industries ; and it is beyond question that the country at large has never learnt to favour the introduction of such an element into our affairs generally.

Admitting that our strongly-marked individuality, our insular habits and prejudices, over-reliance on our powers, and our prosperity and unchallenged commercial preeminence throughout a long period, in some or even a large measure account for our worship of King Rule of Thumb and our apathy as a nation to science, we must go further to find the full explanation.

There can be no doubt that such apathy arises from the fact that "the idea of *science* has been absent from the whole course and design of our education"—words used thirty years ago by Matthew Arnold. It is still true that, as the same writer said, "we hardly even know the use of the word science in its strict sense, and only employ it in a secondary and incorrect sense." We are, in fact, an uncultured nation ; which is mainly, if not entirely, the fault of our Universities—for although but a small proportion of English attend the Universities, it is from the Universities that the teachers, as well as the heads of our public schools, are taken, and these set an example which permeates our whole educational system.

Whilst, however, our Universities have *failed* to help us, Germany undoubtedly *owes her success* to her Universities ; but hers are real Universities, not "superior boarding-schools"—"places where the youth of the upper class prolong to a very great age, and under some very admirable influences, their school education." They are Universities in which "*Lehrfreiheit* and *Lernfreiheit*, liberty for the teacher and liberty for the learner, and *Wissenschaft*, science, knowledge systematically pursued and prized in and for itself are the fundamental ideas"

Although, in comparing the condition of education in the two countries, Arnold recognised that our Universities were in the main but superior schools, he failed to point out the origin of the difference—that long before he wrote, at the beginning of the century, in fact, they had succumbed to the colleges, so that we had no Universities in the German sense ; whilst Germany, happily, was without colleges. But this fact was recognised over fifty years ago by Charles Lyell, who drew special attention to it and discussed the consequences in a most interesting chapter in his "Travels in North America," published in 1845.

Higher education in Germany, in so far as secondary schools are concerned, may be said to date from the reforms introduced by Wilhelm von Humboldt during the brief period (1810–12) in which he was Prussian Minister of Education. Although less well known than his renowned younger brother Alexander, he appears to have been a man of remarkable philosophical power and insight, whose administration of public instruction was clearly based on the fullest understanding of its immense importance, and who recognised that it must be conducted scientifically. We should probably be well satisfied even now if we could secure a Minister of Education, and he were no more than an animated phonograph ; one who could repeat with understanding words the Prussian Minister of Education used near ninety years ago —"The thing is *not* to let the schools and Universities go on in a drowsy and impotent routine ; the thing is, to raise the culture of the nation ever higher and higher by their means"—words so striking that Arnold attaches them as a motto to his report, would throw the whole body of educational enthusiasts among us into wild delirium, but the country at large would certainly rate him unpractical, if not as a lunatic.

Probably the greatest service to education rendered by von Humboldt was the establishment of a State examination for all schoolmasters ; he also, as Arnold points out, took the most important step towards making the *Abiturienten* or school-leaving examination—which plays so vital a part in the German system—what it now is. But von Humboldt was not the only statesman in Germany to take the most enlightened and active interest in the affairs of higher education, and those who followed him in the work of organising public secondary education were able to achieve success because German Universities generally had laid the necessary foundation : otherwise, a satisfactory system could not have been called into life. In witness of this, take the following passage in Carlyle's review of Heeren's "Life of Heyne," in reference to the celebrated scholar's activity, now a century ago, at Göttingen :—

"We have long details of his procedure in managing the Library, the Royal Society, the University generally, and his incessant and often rather complex correspondence with Münchhausen, Brandes, or other ministers who presided over this department. Without detracting from Heyne's skill in such matters, what struck us most in this narrative of Heeren's was the singular contrast which the 'Georgia Augusta,' in its interior arrangements, as well as its external relations to the Government, exhibits with our own Universities. The Prime Minister of the country writes thrice weekly to the director of an institution for learning ! He oversees all ; knows the character not only of every professor, but of every pupil that gives any promise. He is continually purchasing books, drawings, models ; treating for this or the other help or advantage to the establishment. He has his eyes over all Germany ; and nowhere does a man of any decided talents show himself, but he strains every nerve to acquire him. And seldom even can he succeed ; for the Hanoverian assiduity seems nothing singular ; every state in Germany has its minister for education, as well as Hanover. They correspond, they inquire, they negotiate; everywhere there seems a canvassing, less for places than for the best men to fill them. Heyne himself has his Seminarium, a private class of the nine most distinguished students in the University ; these he trains with all diligence, and is in due time most probably enabled, by his connexions, to place in stations fit for them. A

[1] Continued from page 411.

hundred and thirty-five professors are said to have been sent from this Seminarium during his presidency. These things we state without commentary; we believe that the experience of all English and Scotch and Irish university-men will, of itself, furnish one. The state of education in Germany, and the structure of the establishment for conducting it, seems to us one of the most promising inquiries that could at this moment be entered on."

So wrote Carlyle in 1828! In truth, a lesson is slowly learnt in this country. And how many of us even now are able to appreciate the value of the services rendered to their nation by Wilhelm and Alexander von Humboldt and by Liebig, and the way in which they have been the true founders of Germany's industrial success—the Moltkes of scientific method.

One of the requirements of a teacher who is a candidate for the Government certificate of *Oberlehrer* in Germany is that he has spent *at least three years* in study at one or more of the Universities; and in the memorandum submitted by Mr. Findlay to the late Secondary Education Commission, we are told that most candidates spend four, many five years there, before presenting themselves for the test. I cannot discover that they are required to prove capacity to take part in the school games—either cricket or football—the primary qualification in an English secondary schoolmaster, if I am not wrongly informed. The difference appears marvellous when we note the extraordinary extent to which the teacher is required to prepare himself for his office in Germany and then reflect on the conditions prevailing here—on the fact that but a few months ago, through a great Royal Commission, we openly confessed to the world that we had absolutely no organisation of secondary education, no check whatever on the competency of the teachers in our schools; and the indifference with which such disclosures have been received, shows what is still worse—that as yet we have no public opinion formed throughout the country which can be brought into operation to enforce the necessary changes.

Nor is this surprising when we consider what our Universities have done for us. To take the case of Oxford. At the close of last century, owing to the operation of causes which cannot be considered here, both teachers and students were thoroughly demoralised, and it became necessary to introduce drastic reforms: examinations having proved useful in some few of the colleges in maintaining orderly habits, to improve matters, in 1800 an examination statute was enacted for the University; but it soon turned out that this had been so framed that it was to be worked by the College tutors, on whose behalf the range of studies was advisedly restricted, all the more progressive branches of knowledge being excluded. As Lyell tells us, the new statute did not pass without a severe struggle. The rector of Lincoln College, in particular, opposed it, as a measure that would extinguish all "thirst of knowledge." "There would thenceforth," he said, "be no *University* at all, but a system of cramming and partial teaching, after which the student would go out into the world with a narrow mind and darker understanding." Never was prediction more thoroughly fulfilled!

It is clear, indeed, that there was "wisdom" at disposal even in those black days; and had wisdom been allowed to govern, the nation might now have been in a very different position. Instead, the horrible system of competitive examinations was allowed to grow up, and worst of all, a new aborted species of teacher, the "coach" or "crammer" was evolved, and the highly lucrative business of "cramming" was established.

"The examinations for degrees were made more and more stringent, and emulation at length stimulated to so high a pitch that health was often sacrificed in the effort to gain the prize. Useful habits of application were often acquired, but the system was not calculated to foster a love of knowledge for its own sake. To some there was even danger of injury both bodily and mental; for if they succeeded, they were tempted to believe that they had already achieved something great; if they failed, their abilities were underrated, both by themselves and their contemporaries."

Notwithstanding the many changes introduced within recent years, whereby some of the defects which Lyell deplored have been remedied, these words of his still afford an accurate presentment of the state of affairs. Moreover, the professoriate still occupy an entirely subordinate although an improved position: for how can they be otherwise than mere mechanical units in a system so long as we fail to recognise that the sole aim of University education should be to develop faculties and to give training in research—so long as "students are treated more as boys and children than as men on the very point of entering on their several duties in life, and who ought, without loss of time, to be acquiring habits of thinking and judging for themselves." We are so absolutely given over to dogmatic and didactic methods of teaching in order to meet the inexorable requirements of examiners, that research work is an entirely post-graduate exercise—a luxury in which but very few indulge, therefore, and the consequence is that a nation priding itself on individuality and originality has an educational "system" in which everything operates towards deadening and maiming the spirit of inquiry, of self-helpfulness, and of thoughtfulness.

How different is the University system abroad. There examinations occupy an entirely subordinate position. From the outset, the student has forced upon him the fact that he cannot gain admission to the degree examination until he has completed a satisfactory thesis embodying some piece of original work; his *Arbeit* is the one absorbing subject of contemplation filling his mind, and the almost daily topic of conversation; and knowing that he cannot count on completing it in any fixed period, and desiring to economise time as much as possible, he devotes himself to his preliminary studies with assiduity and care in order that he may as early as possible secure the necessary permission to commence research. The work accomplished may often be very trivial as a contribution to science, but this matters *little*: the spirit it evokes is the main consideration—of chiefest importance is the fact that thoughts are always directed forwards with the desire to solve a problem, and that instead of attention being confined to text-books original literature is freely consulted and studied.

It is not surprising that teachers so trained have evoked in turn the proper spirit in their pupils, and that

with such material at their disposal manufacturers have been successful in maintaining their businesses fully abreast of the times.

The post-graduate career is equally different abroad. A graduate is not worshipped as a young god because he happens to have passed examinations with distinction, nor is he damned for life by being termed a second or third class man because he did indifferently well. Nor is he a prig, for although sufficiently proud of being dubbed "*Herr Doctor*," he knows full well that his future success depends on what he does, not on what he has done in some examination. In fact the examination is forgotten almost as soon as over, and if a professional career at the University be adopted, a man has to work very hard for every step of promotion, and is rewarded only if he manifest originality and activity in research.

And manufacturers have also recognised that they cannot expect to obtain all the material they need ready made from the Universities; the true technical school in Germany is in connection with the works, each of which has its research department, in which men certified by the Universities as likely to do well are set to work under competent leaders and gradually learn to do what is required of them in practice: those who manifest technical skill being gradually drafted off into the works proper. The English manufacturer too often expects the scientific assistant he engages to be already conversant with the industry—to be a practical man; he will rarely be at the pains to educate his staff. He derides college-bred material, and yet will do nothing towards producing a genuine article.

It is clear that if we are to fit ourselves to carry on the work in the world we have undertaken, and to justify our having taken so vast a burden of imperial responsibility on our shoulders, an entire reform of our educational system, starting from the Universities, must be brought about. We have long since reached the point "where toleration sinks into sheer baseness and poltroonery"; and we must no longer allow mediocrity to be our ideal. The attempt must be made to awaken the public generally to a more thorough understanding of the position in which the country is placed. It must be shown that we also have an "aristocracy of talent" capable of advising honestly and well and with understanding; that the methods hitherto adopted have too often been unsound; but that sound methods are now available, and their use must be insisted on. If those who are capable of working in such a cause—and there are very many—will but cooperate, there need be no great delay in formulating and carrying out the changes that are most urgently and imperatively called for: but how are we to effect the necessary organisation of scientific opinion, and secure that its decisions shall be carried into practice? It will be very difficult, and yet it must be done, and without delay. It can only be done if—to use words uttered by Helmholtz—"each of us think of himself, not as a man seeking to gratify his own thirst for knowledge, or to promote his own private advantage, or to shine by his own abilities, but rather as a fellow-labourer in one great common work bearing upon the highest interests of humanity." HENRY E. ARMSTRONG.

(*To be continued.*)

THE GASES OF THE ATMOSPHERE.

The Gases of the Atmosphere: the History of their Discovery. By William Ramsay, F.R.S., Professor of Chemistry in University College, London. Pp. 240. (London: Macmillan and Co., Ltd., 1896.)

THE reading public will be grateful to Prof. Ramsay for this book, for he has explained in a simple and attractive manner the nature of the great discovery about which they have heard much and understood little; and besides telling the story of argon, he has woven it into a history of the great discoveries of the past concerning the chemistry of the atmosphere. We believe that the book will be acceptable also to more scientific people who desire to gain a clear idea of the problems connected with the new gas.

One of the peculiarities of the discovery of argon is the entire absence of anything about it of the "practical" kind, present or prospective. It is so far a mere scientific discovery, and has no telephone or bone-photographing features to arouse a hollow intellectual interest. A book likely to enlist the public sympathy for scientific research, irrespective of its practical application, is to be heartily welcomed, and is probably no less a need of the times than it was a generation since. It is not well that the public esteem for physics and chemistry should depend wholly on a dim appreciation of their commercial value.

The account which Prof. Ramsay gives of the earlier discoveries is very readable, abounding with quotations from the original memoirs, and affording pleasant glimpses of the lives and characteristics of the philosophers concerned. The volume is embellished with a number of portraits, the honour of appearing in the frontispiece being accorded to Stephen Hales. This selection appears surprising, not only because of the slender connection of the work of Hales with the chemistry of the atmosphere, but from the feeling that in a book dealing with the history of the air in special relation to argon the conspicuous figure is that of Henry Cavendish. The merits of Cavendish have indeed been fully recognised by Lord Rayleigh and Prof. Ramsay in their Royal Society memoir, and the statement "that, if there is any part of the phlogisticated part of our atmosphere which differs from the rest and cannot be reduced to nitrous acid, we may safely conclude that it is not more than $\frac{1}{120}$th part of the whole," will remain for ever memorable. It was the same respect for minutiæ and strict loyalty to experiment as are embodied in the foregoing words, that led Lord Rayleigh, rather more than a century later, to raise again the question whether any part of the phlogisticated part of our atmosphere differs from the rest. The habitual attitude of chemists towards the clue contained in the above words of Cavendish is shown very well by the following passage from Dr. G. Wilson's "Life of Cavendish": "He proceeded to test this by trying whether a given volume of the phlogisticated part was entirely converted into nitric acid by explosion with oxygen. *He found that it was*, and thus supplied a demonstration of the homogeneous nature of nitrogen such as none of his contemporaries could have given."

The last hundred pages of the book contain an account of the discovery of argon, and of the physical and