viz. the arc method, the cyanamide process, and the Haber process. It is with the working and the results of these processes that Dr. Gilbert's report is particularly concerned. In what follows we purpose to summarise, as briefly as possible, the main conclusions to which his critical examination leads him.

The arc method in its present state of efficiency requires from 2·75 to 3 h.p.-year of electric power per ton of nitric acid yield. Having regard to conditions in the United States, the 2·75 h.p. needed for the fixation of the nitrogen in one ton of nitric acid costs in power-expense alone more than 40 dollars per ton of product. Inasmuch as the fertiliser equivalent in Chile saltpetre is already available at about the same price, the arc method is not commercially feasible under present conditions in America. Notwithstanding this, the U.S. Government is said to be contemplating a twenty million dollar project for atmospheric nitrogen fixation as a military measure. If this sum were put into power-site development it would furnish about 150,000 h.p., capable of yielding about 50,000 tons of nitric acid, or only about a quarter of that needed in military emergency. To satisfy Government requirements a power generation of about 600,000 h.p. would be needed, or some 50,000 h.p. more than the total Niagara power development. As a commercial proposition for peace-time working the arc method offers not a single advantage, and is of very doubtful benefit even as a measure of military preparedness.

The cyanamide process yields three main products, viz. cyanamide, ammonia, and nitric acid, the nitric acid being the end product instead of the first, as in the arc method. Up to the nitric acid stage the power consumption is approximately ½ h.p.-year per ton of nitric acid, or about one-sixth to one-fifth of that of the arc method, and the normal peace-time first product is at once applicable to agricultural purposes. A consideration of all the circumstances makes it abundantly evident that the cyanamide process far outweighs in applicability, convenience, and economy the arc method. When all is reckoned it requires only from three-fifths to two-thirds of the total power involved in the arc method manufacture, in addition to the value of a product normally in demand as against one for which there is relatively very little constant requirement.

The Haber process is exclusively worked in Germany. It is a catalytic process involving many technical difficulties which have hitherto prevented its extension even under present exigencies. Its production of ammonium sulphate is said to amount to 200,000 tons a year. Nothing is known as to comparative costs, but inasmuch as the process would seem not to have greatly extended, its permanent position is still open to doubt.

The general conclusions at which Dr. Gilbert arrives are: (1) That the arc method has not thus far demonstrated its capacity to meet agricultural requirements at all, and defence requirements only very imperfectly. (2) Such knowledge as there is of the Haber process seems to show that its record of achievement is against it, and in any case it is unsuited to American conditions, at least in its present stage of development. (3) The cyanamide process is readily capable of a development which at once meets the requirements for a cheapened nitrogenous fertiliser, of which the nitrogen content can be converted into nitric acid. But whatever may be the relative value of these different synthetic processes, and whatever the future may have in store for them, Dr. Gilbert is evidently disposed to believe that it is by the systematic extension of the coking industry, and by the more rational treatment of our coal, so as to increase the yield of by-products, that the main increase in our supply of nitrogenous fertilisers is to be looked for immediately. He calculates that in America a total of about 700,000 tons of sulphate of ammonia would be possible if all coking were of a by-product nature, and he confidently predicts that not far short of this amount will be reached when the ovens now in course of erection in the States are in full working order. In the meantime are we doing all that we can in this direction? T. E. THORPE.

LITERATURE AND SCIENCE IN EDUCATION.

WHEN Dr. Johnson kept school at Lichfield in 1736 he drew up a "Scheme for the Classes of a Grammar School," which his biographer, Boswell, inserted in the pages of the famous "Life" with the remark that "Johnson well knew the most proper course to be pursued in the instruction of youth." The scheme consisted of Latin accidence, translation, and syntax in the lower classes, with the addition of Greek in the third class. No other subject was mentioned. For a hundred years or more this was broadly the basis of the system adopted throughout English grammar schools, with the addition of a little arithmetic, geography, and history.

Dr. Sleath, High Master of St. Paul's School down to 1847, is reported to have said once to an inquiring parent: "Madam, at St. Paul's we teach only Latin and Greek. We give three half-holidays a week that boys may learn mathematics."

In the early fifties of the nineteenth century a little experimental science crept in almost shamefacedly, introduced by the peripatetic teacher with his box of tricks. But probably the first instance of a systematic teaching of science by resident teachers was at the well-known school at Queenwood, Hants, with Frankland and Tyndall as the masters. This was in 1847, but it was not until twenty years later that this example was followed in other schools. Then Clifton took the lead in 1867, and was followed immediately by the Manchester Grammar School. Since that day matters have improved so substantially that there are few schools of any pretensions which do not possess a good laboratory and competent teachers.

Such facts might seem to justify the question by representatives of the older subjects: "What more do you want, then, and what do you mean by the neglect of science?" The fact is that there

has not been, and in some quarters there is not at the present time, that straightforward dealing with the question to which the advocates of more science think they are entitled. The reluctance of the literary people to yield up a fair proportion of the time-table to the modern studies lies at the root of the matter. It is now a question of curriculum, and even in the schools which boast laboratories and appliances the controversy will never end until this barrier is overcome. It is, therefore, particularly gratifying to observe the attitude of the Headmasters' Conference as represented by the resolutions printed in NATURE of January 4 (p. 359). Among the resolutions passed the following is conspicuous:—

(*a*) That it is essential to a boy's general education that he should have some knowledge of the natural laws underlying the phenomena of daily life, and some training in their experimental investigation. (*b*) That, in the opinion of this Conference, this can best be ensured by giving to all boys adequate courses of generalised science work, which would normally be completed for the ordinary boy at the age of sixteen. (*c*) That, after this stage, boys who require it should take up science work of a more specialised type.

Nothing can be better as a statement of a generalised opinion, and we may hope that headmasters will see that it is put into practical effect. There is some ground for belief that this hope will not be in every case disappointed. The address delivered on Tuesday, January 9, by the Rev. J. R. Wynne-Edwards as president of the Inporated Association of Headmasters (see NATURE, January 11, p. 380) does not appear to be the utterance of a man who is toying with the question, and the distribution of hours at the Leeds Grammar School, of which he is headmaster, would doubtless be found more satisfactory than in some other places. There is not great divergence of opinion in respect to fundamental principles, if we except a comparatively few extreme partisans on both sides. But a satisfactory position is not allotted to the natural sciences in those schools in which an engineering or military side composed of specialists has been established, while the majority of the boys in the school—namely, those to be found on the classical side, which includes many of the best—are put off with two hours a week or less in a time-table which covers thirty hours for other subjects. It is not the function of the schools to provide a body of scientific specialists, but every boy and girl in the kingdom should have time and opportunity for the acquisition of some degree of familiarity with the chief methods and conclusions of the observational and experimental sciences. Concentration on special or technical matters should not be encouraged before the age of sixteen or seventeen, and should not be sought in the curriculum of a general education. The testimony of a business man on this point ought to serve to correct the views of many parents, and it is worthy of notice that Mr. W. L. Hichens (chairman of Messrs. Cammell Laird and Co.), in an important paper contributed to the same meeting, expressed the opinion that "specialised education at school was of no practical value."

On the second day of the meeting (January 10) a paper was read by Mr. A. D. Hall, F.R.S., a Development Commissioner and formerly director of the Rothamsted Experimental Station, on "A General Course of Science for the Secondary School." Mr. Hall made no claim for any kind of training directly applicable to industry. He desired to see a broad and liberal treatment of science, and in the outline he proceeded to sketch he included a larger share than is customary of studies in the domain of biology. In doing this he was not afraid of the charge of smattering. It would be interesting indeed to look into the details of his scheme of work, remembering that this is the outcome of the mature experience of a former schoolmaster. Mr. Hall was at one time chief science master in King Edward's School, Birmingham.

A paper by Mr. A. C. Benson, Master of Magdalene College, Cambridge, read before the Royal Society of Arts on December 20 on the subject of "Literature and Science in Education," will be welcomed by all teachers of science and others interested in progress towards the compromise which must be arrived at if peace is to be secured. Mr. Benson is a well-known literary man with full experience as a teacher, having been for twenty years a master at Eton. It is all the more gratifying, therefore, to find the conciliatory spirit, the liberality of view, and the freedom from prejudice which pervade his paper. It is impossible adequately to summarise it, and it should be read especially by headmasters. One point on which he lays emphasis is the importance of securing good and enthusiastic teachers, and this implies the necessity for rendering the teaching profession more attractive than it has been in the past. With regard to subjects he says: "I do not believe in intellectual progress being possible without intellectual interest"—a view which will be generally acceptable to the present generation, even among those who are not old enough to look back to the time when Latin grammar with plenty of cane was looked upon as the one effectual and economical basis of education.

LORD CROMER, O.M., F.R.S.

NOT only those who have worked in Egypt, but all who are interested in that country, will have learned with deep regret of the death of Lord Cromer on Monday last, January 29.

On returning to Egypt in 1883, six years after his first appointment there as a Commissioner of the Debt, Lord Cromer found the country in a state of administrative chaos after the suppression of Arabi's rebellion, while bankruptcy appeared imminent. In the Sudan, troubles were already assuming a threatening aspect, and the dervish revolt was shortly to take place. Under such conditions the most urgent needs were to reorganise the administration of the country, and to re-establish its financial position by developing the great agricultural resources of the Nile Valley and Delta. The provision at the International