when in the plant, or they may be even decomposition products of the cellulose itself. Further investigation on this point is needed. This should be partly chemical, partly microscopical, and made on different stages of growth.

When the true cellulose of the flax fibre has been isolated, it is found to have properties identical with those of the cotton fibre, in fact, so far, no reactions of a chemical nature have been found by means of which cotton and flax cellulose can be distinguished from one another. Their identity is established by their possessing resistance to hydrolysis and oxidation, and containing no active CO or OH groups. Acids, alkalies and solvents react with the two celluloses in precisely the same manner. The only difference between them is a morphological one—the difference in the form of the two fibres. What has been said of the properties of the cotton fibre applies equally well to linen fibre when the impurities which it contains have been separated.

ENGLISH AND GERMAN METHODS OF TECHNICAL EDUCATION.

Professor Ramsay, of the University College, London, has contributed to the *Times* a letter from one of the best known of German leaders in science, Dr. William Ostwald, Professor of Physical Chemistry of the University of Leipsig. The letter, which we here reproduce, shows what a small part the examinational system plays in German methods of instruction; and, second, what a close bond exists between the man of pure science and the man interested in its industrial application:—

"In our frequent discussions on scientific education, we have both often been struck with some points of very great difference between the English and the German way of dealing with it. As it may be asserted without national arrogance that university education is in Germany in a more satisfactory condition than in your country you are, of course, anxious to know which of the German customs I consider most effective in bringing about this better state of things, and I will, therefore, try to point them out. Of course, I shall confine myself to the subject of natural science, and especially chemistry and physics, feeling myself unable to deal with sciences beyond my knowledge

"The main point of our system may be expressed in one word—freedom—freedom of teaching and freedom of learning. The first involves for the teacher the necessity of forming in his mind a clear conception of the scope of his science, for, as he is free to choose any possible method of view, he feels himself answerable for the particular one he has chosen. And in the same way the student feels himself responsible for the method and the subjects of his studies, inasmuch as he is free to choose any teacher and any subject. One who has not seen this system in action may be inclined to think that such a system must lead to arbitrary and irresponsible methods on the side of the teacher, and to confusion on the part of the student. But the former is avoided, because at the beginning of his career the teacher is dependent for his advancement on the results of his scientific views, and is naturally anxious to improve his position in the educational world. And as for the students, they themselves impose certain restrictions on their own freedom. Most of them feel that *they require some advice and guidance, and they therefore* follow the usual and approved order in conducting their studies. As to the inventive man of original ideas, it has often been proved that for him any way is almost as good as any other, for he is sure to do his best anywhere. Moreover, such a man very soon excites the interest of one of his teachers, and is personally led by him, generally to the great advantage of both.

"Let us illustrate these general remarks by considering the course followed by an average chemist. In his first half-year he hears lectures on inorganic chemistry, physics, mineralogy, sometimes botany, and of late often differential calculus. Moreover, the German student is accustomed to take a more or less strong interest in general philosophy or history, and to add to his Belegbuch (list of lectures) to the above-named Fachcollegien (specialized studies) one or two lectures on philosophy, general or German history, or the like. Very often there are in the university one or more popular professors, whose lectures are heard by students of all faculties without reference to their special studies. The student who has heard during his stay at the university only lectures belonging strictly to his Fach, is not well thought of, and is to some extent looked down on as a narrow specialist. But I must add that such views are not prevalent in all faculties, and there are some—*e.g.*, the faculty of law—whose students confine themselves, with few exceptions, to attending exclusively lectures in that faculty.

"In the second half-year the chemical student begins with practical laboratory work. Notwithstanding the perfect freedom of the teachers, the system first introduced by Liebig into his laboratory at Giessen is still universally adopted in German universities and technical high schools—viz., qualitative and quantitative chemical analysis, the former conjoined with simple spectroscopic work, the latter amplified by volumetric analysis. This is followed by a course of chemical preparations, formerly chiefly inorganic, now chiefly organic. Even here a regular system is becoming widely developed, owing to the use of some well-known text-books. Of late years this course is followed in some laboratories by a series of exercises in physical chemistry and electro-chemistry.

"While these practical exercises, which last for three or four half years, are being carried out, the student completes his knowledge of physics, mathematics and the other allied sciences by hearing lectures and working practically in the physical and often also in some other laboratory. The exercises done, he goes to the professor and asks him for a 'theme' to begin his 'work' viz., his dissertation for the degree of Dr. Phil. This is the most important moment in his life as