

with the repeal of the duty upon paper; and so the whole trade has been kept in a state of uncertainty to the present moment.

With respect to the discovery of new materials of a fibrous character, fit for paper making, a great deal has been written and said, and a vast amount of time spent, we may say wasted, in investigations, which would never have been the case had the authors, and speakers, and experimenters possessed any real knowledge of the requirements of the paper maker. And so slight has been the advancement made by virtue of all these exertions that the question remains practically very much where it was at the beginning; indeed, none but the experienced manufacturer knows how very difficult this problem is, and how very little progress has been made towards its solution. It is a popular idea that any fibrous material from which a sheet of paper can be made may be applied to the uses of the paper maker; there can be no greater fallacy; almost any vegetable material can in fact be converted into paper, there are scores of substances which can be readily bleached, beaten into pulp, and converted into good, some into excellent, paper. But there are many things to be thought of besides this, and it is really going but a very little way into the actual question of the substitution of other materials for rags in a commercial sense. The real gist of this question lies in the implication that any material to substitute rags must produce paper equal to that from rags at less, or at least not greater cost. The new material must yield paper equally good with rag paper, and costing no more. This being the question, is there any material which can be said to, in any wise, take the place of rags in paper making? At present there is none. Although almost every conceivable fibrous substance has been the subject of experiment, and most of them of patent, in relation to paper, and although numberless ingenious and active minds are ever at work upon this object, there is not, at the present time, any new raw material employed in paper making, with the exception of straw, and perhaps a comparatively small quantity of the Esparto, or Spanish grass; and with respect to straw the use is almost wholly exceptional, as the paper can scarcely be ranked with rag paper. In applying any of these prepared fibrous materials to the manufacture of paper in competition with rags, there are many important points for consideration. In the first place (and this forms a sort of standard to which the question must constantly be referred), rags are a refuse material; throughout the civilized world rags are produced spontaneously, as it were, with as much certainty as time passes away; it requires neither capital nor industry; neither sowing nor reaping; neither sunshine nor rain, to produce rags; changes of season, commercial crises do not interfere with their production; within narrow limits, therefore, the supply is certain and invariable. Add to this that rags are a material already prepared to the hand of the paper maker, they have already undergone treatment which must be applied in a greater or less degree to all fibrous substances before they can be fitted for his use, and that, above all, rags are perfectly suited to the object in question, so that, irrespective of cost and trouble of manufacture, no substance has been discovered capable of producing paper equal in all respects to that made

from rags. The fact that rags are refuse material places a difficulty, *in limine*, with respect to the introduction of raw material, properly so called, to take their place. Raw material must be raised by cultivation, which requires labour and capital; it must be dependent upon the character of the seasons, and upon a hundred circumstances which will affect the certainty of the supply, and enhance the cost—that is, the first cost. Coming then to the paper maker, it requires to be treated by peculiar methods irrespective of paper making but necessary to reduce the crude material to a manageable form; and then comes lastly the comparison between the new substance and rags, in facility of working, and in the quality of paper produced.

It is generally believed that linen enters much more largely into the composition of fine paper than is really the case. Cotton is by far the more staple commodity, and constitutes probably at least four-fifths of the best papers. The fibre of cotton is remarkably adapted to the production of a fabric like paper, in which the strength is wholly due to a natural interlacing of the fibres similar to what exists in felt. Examined under the microscope, it will be seen that the fibres in paper run in every possible direction, intertwining and winding about each other so as to give firm consistency and considerable strength. It is not every kind of vegetable fibre which possesses the property of interlacing together in this manner, and paper made from fibre deficient in this property can never be equal to paper made from linen and cotton, which do possess it pre-eminently. The fibre from many vegetable substances is almost straight, the fibres laying together naturally in fasciculi or bundles, and devoid of the curling property by which the fibres are enabled to twist themselves together when the natural structure is broken down—such matters will never make a good tenacious paper. Other fibrous materials are naturally endowed with, that is cemented together by, or encased in, substances which must be wholly removed before the paper maker can avail himself of their otherwise valuable qualities; in flax, for instance, the fibre is encased in a coating of siliceous matter, which, when the structure of the plant is broken down, develops itself in what is technically called shive. In preparing flax for textile purposes the shive is removed by various processes, the value of the material being sufficient to justify the outlay; but if the same outlay were incurred upon raw flax for the uses of the paper maker, the value of flax thus prepared would exceed that of the best linen rags; and this brings us back to the starting point, that all new materials have to contend with a refuse material in paper making.

It would be a vain and humiliating thing to say that as knowledge advances no substitute can be found to take the place of rags in the paper mill. In all probability the reverse will be the case, and the time will come when cheap and appropriate substances will be produced, affording to the paper maker a regular and economical supply of raw material, as suitable to his use as rags now are; but there are many things to be considered before it can be assumed that any substance, simply because it is found by experiment capable of being converted into paper, will become a competitor with rags on the commercial scale.

It will be remembered by most of our readers,