Wood-pulp and the Future

IT is safe to state that during no similar period since the first commercial production of wood-pulp in the middle of the last century has our knowledge of the subject advanced so rapidly as during the past three years. A number of entirely different influences have contributed to this activity. In the first place, one of the benefits associated with slump conditions is the time (and in the case of far-seeing concerns, the stimulation) it provides for research work; and secondly, there has been an increasing demand for rags for paper-making, which has resulted in a shortage, and consequently, rising prices in this market. To this may be added the growing use of certain classes of wood-pulp for rayon manufacture, the present position being that this industry now absorbs ten per cent of the world production of wood-pulp; in some quarters there is even a scare of a shortage of pulp for paper-making in the future.

These various influences are all apparent in the advances referred to. Prolonged research has for example resulted in the production of 'alpha-pulps', so named because they contain a high proportion (90–98 per cent) of α-cellulose; this is the name given to the constituent which is insoluble in a 17·5 per cent solution of sodium hydroxide at 20° C. under specified conditions. The method of production is usually a modified sulphite 'cook', followed by chlorination, extraction with alkali and careful washing.

In comparison with ordinary wood-pulps, alpha-pulps have some interesting properties. In the first place, highly absorbent papers may be made from them, and they are therefore very suitable for the manufacture of paper towels and handkerchiefs for facial tissues, etc., the use of which is far more common in the United States than in Great Britain. Papers made from such pulps also lend themselves readily to impregnation with rubber latex and similar materials, and as a result of subsequent processing they can then be converted into leather substitute[1]. There is already a wide market for products of this kind in the manufacture of handbags, fancy goods, bookbindings, shoe linings, etc. where effect is more important than durability. Furthermore, since alpha-cellulose represents the nearest approach to true cellulose obtainable on the manufacturing scale, it is not surprising that advantage has been taken of the inherent strength of the fibre to use it in the production of certain classes of strong papers. Special mention may be made of papers the tearing-strength of which is important, because in such cases fibre length is of special significance. The use of alpha-pulps in this connexion, however, calls for special care, because alpha-pulps do not respond in the same way as other wood-pulps to the development of strength characteristics by 'beating'. Moreover, as resistance to tear is obtained only by sacrificing other forms of strength, for example, bursting-strength, it is usual to add only a relatively small proportion of the alpha-pulp, and, so far as possible, to beat it separately.

Recent work has shown[2] that the permanence of paper, that is, its resistance to the effects of normal ageing, depends as much on the purity of the cellulose present as on the origin of the fibre, and although the traditional preference for rag is still strong, it is now recognized that a paper made from a carefully prepared wood-pulp can last longer than an inferior rag paper. The difficulty of devising a really reliable accelerated-ageing test is probably the biggest obstacle to the demonstration of the relative merits of these fibres. Apart from these questions, however, the fact that the alpha and similar pulps contain such a high proportion of α-cellulose is an obvious argument in favour of their use in 'permanent' papers. This course has so far been justified by such accelerated-ageing tests as exist; provision, however, has also been made for natural ageing tests, the conclusion of which must be left in the hands of the next generation.

Since the method of preparing alpha-pulps is similar to that employed for the determination of α-cellulose (cf. *supra*), namely, removal of other substances by selective solution in various reagents such as sodium hydroxide, it follows that the yields of pure material are necessarily low. This and the manufacturing costs arising from the use of several treatment processes have made these pulps rather expensive, and would seem to be the factor which at present places a limit to their more extended use.

The advances in the technique of bleaching wood-pulps which have been a feature of recent years have also resulted in the production of some interesting types of pulp. These are based on the treatment of the pulp with the bleaching agents in several stages instead of in one only. Chlorine, either as gas or in the form of an emulsion in water, is used in the first stage. This procedure serves to chlorinate the lignins and other undesirable substances in the raw wood, the resulting compounds being soluble in alkali; removal of these in this way is therefore the second stage. Up to this point, there is no real improvement in the colour of the pulp, but the bleaching proper may now be carried out, hypochlorite being the reagent used. This again may be operated in one, two, or even three stages. It is interesting to note that the use of chlorination for the isolation of cellulose was proposed by Cross and Bevan[3] so long ago as 1903, but it is only within recent years that advances in chemical engineering have enabled the process to be realized in practice.

The principal advantage of this method of bleaching is that the colour may be improved without undue detriment to strength, but the elimination of a good deal of the dirt and troublesome resinous matters in wood and an economy in bleaching costs are further benefits which are not to be ignored. Pulps made by the sulphite process provide some of the best-known examples of the advantage of multi-stage bleaching, but of great interest also are bleached kraft pulps of high strength and good colour, as these have become available only relatively recently. The general principles of the preparation process are similar to those used for sulphite pulps and indicated above, but the results obtained almost justify the descriptions of a modern bleached kraft as a new raw material for paper. This is because, although the colour and cleanliness bring these pulps into favourable comparison with many grades of bleached sulphite pulp, the corresponding strength is very much greater, and the cost is not excessive. It is believed that the advent of this new type of pulp may create a demand for a paper which combines the strength of the familiar brown kraft wrapping with the æsthetic and advertizing value which result directly (and indirectly, through the printer's art) from a good colour; foodstuff wrappings suggest themselves immediately in this connexion; and substitution of certain grades of rag is another possibility.

The use of American southern pine as a source of paper-making wood-pulps other than kraft has already been referred to in NATURE[4], and the requirements of the rayon industry are now also being studied. In view of this work, there seems little doubt that it is only a matter of time before it is possible to deal with the vast supplies of southern pine by the groundwood process, and possibly even by a sulphite process. There are many who are sceptical about even the former of these possibilities; but it is less than seventy years ago that similar doubts were expressed as to the practicability of making paper from wood at all. When it is remembered that there are a hundred million acres of longleaf and loblolly pine available from the southern States of the Union alone, there is ample justification for the statement that this region may well be as important in the future as a source of newsprint as at present it is of kraft-pulp.

The exploitation of new sources of wood at once raises the general question of the conservation of timber supplies and, in particular, the matter of re-afforestation. One respect in which certain of the Scandinavian countries have set an example which might well be followed more closely elsewhere is the organization of the pulp-mill in close relationship to the saw-mill, with the object of eliminating waste. In this connexion, it was stated a few years back by the U. S. Forest Service that every year about six million cords of sound wood suitable in size for pulping processes were wasted in the course of logging operations. This statement refers to one of the richest timber regions in the world, namely, the strip of Pacific coastline between Oregon and Alaska. Here the western hemlock, which is very suitable for the production of sulphite wood-pulp, occurs in close association with an important timber tree, namely Douglas fir, and there are now possibilities that the latter might be amenable to treatment by the sulphate process.

In the case of southern pine, a relatively short time of growth—at the most eighteen years—is required in order to obtain a tree of suitable size for pulping, so that in this instance the problem of re-afforestation should be simplified, at any rate from the economic point of view.

A final word seems desirable on the subject of possible rivals to wood pulp. These are not lacking, and many indeed (such as straw) precede it historically. Each year brings a host of suggestions which the paper-maker assiduously tests, and frequently finds to be satisfactory from a purely technical point of view. The objection is nearly always the cost of transport, because the fibres usually grow in remote parts of the earth where the cost of harvesting and bringing to the nearest port is prohibitive. The rapidly advancing price of wood-pulp is, however, focusing attention on the results of trials which have been 'filed' for many years. Esparto is of course an old-established rival to wood-pulp and one which enjoys the advantage of being a printing fibre *par excellence*, although it is too soft to be used alone where strength is at all important. At the same time, any decrease in the difference in price between wood and esparto must tend to increase the demand for the latter.

Another fibre which may assume more importance in the future is bamboo. It may be safely stated that the main technical difficulties associated with this fibre have now been overcome, and it is firmly established in India; Sabai grass, which produces a paper having similar characteristics, is also increasingly in evidence in papers from this source. Both types of paper are similar to those made from esparto, and give good printing results. To come nearer home, straw is a source of pulp which is encountered frequently in Continental papers, and particularly in those from agricultural countries such as Holland. Its use in recent years has been on the decline, but as this has been due mainly to the cheapness of wood-pulp, the removal of this competition should mark the revival of straw. Unlike esparto and bamboo, straw imparts a hardness and rattle to paper and has a good colour; it is therefore more suitable for writings than for printings. Although there is, and presumably always will be, plentiful supplies for pulping, the processing of it for use in fine papers will, however, be controlled to a great extent by the demands on the raw material made by the straw-board industry. Danubian reed (*Phragmites communis*) is also available in large quantities in the Danube valley, and a similar reed grows in the marshy districts of Norfolk. Many investigations into their paper-making properties have already been carried out both privately and in conjunction with the Ministry of Agriculture[5], and it was concluded that if it were not for the low yield the reeds might prove competitive with certain classes of wood-pulp; here again, therefore, rising prices may reverse the situation. Similar considerations apply to New Zealand flax[6] (*Phormium tenax*) and hemp stalks. The former is perhaps in a different strength category from wood-pulp, as its strength makes it more comparable with rags, but the latter is of considerable importance to countries such as Italy where some 400,000 tons of stalk are available per annum; this is sufficient to render this particular country self-supporting from the pulp point of view[7]. Here again, however, the rayon industry may claim a share of the new material.

Finally, the possibility of a paper pulp famine in the distant future is extremely remote, as even if wood-pulp supplies fail—an unlikely probability—human ingenuity will soon provide a substitute. On the other hand, the immediate future may be a period of difficulty which will last until the gap between past and future conditions is bridged, so that there is every prospect that the rapid advances in the technology of the subject will continue.

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[1] Grant, J., NATURE, **134**, 921 (1934).
[2] Grant, J., NATURE, **130**, 320 (1932); **132**, 414 (1933). Grant, J., *Discovery*, **17**, 156 (1936). Grant, J., "Books and Documents. Dating, Permanence and Preservation" (1937).
[3] NATURE, **138**, 175 (1936).
[4] Grant, J., NATURE, **136**, 1014 (1935).
[5] *Bull. Imperial Institute*, **33**, 421 (1935).
[6] Yeates, J. S., *Paper Trade J.*, Technical Section, **103**, 66 (1936).
[7] *Woch. Papierfabr.*, **67**, 75 (1936).

International Council of Scientific Unions

NINETY-EIGHT representatives of seven International Unions and twenty countries attended the third General Assembly of the International Council, held in the rooms of the Royal Society, London, under the presidency of Prof. N. E. Nörlund. At the opening meeting on April 27, the Council was first welcomed by Sir William Bragg, president of the Royal Society, and then Prof. Nörlund gave his presidential address on "The Figure of the Earth".

After the report of the Executive Committee had been read, Prof. B. Cabrera presented the report of a special committee which was appointed to consider the relations of the Council with the Committee of Intellectual Co-operation of the League of Nations. Among the recommendations of the committee, which were adopted in full, was one that the International Council should act as a consulting body on problems of a scientific nature which the Committee of Intellectual Co-operation might be called upon to solve. Questions of an international character concerning the organization of scientific work would be referred by the Council to the Committee. Prof. S. Chapman presented the report of the Committee on Solar and Terrestrial Phenomena, and the Committee was continued with an increased grant. The Committee on Instruments and Methods was discontinued.

The second session of the Council was largely devoted to the resolution from the Royal Academy of Sciences at Amsterdam asking for the appointment of a committee "which should attempt to arrive at a co-ordination of what has been proposed in respect of the social responsibilities of science and of scientific workers" (see NATURE, 139, 697, April 24, 1937). Prof. J. M. Burgers presented the motion, which led to a lively discussion in which eighteen speakers took part. It was clear that a number of the representatives of national academies adhering to the Council were not in a position to vote for the motion as it stood without reference back to their academies. A restricted field of activity was the most that could secure general support for a committee of the type indicated. The matter was referred to a small committee representative of the different views that had been expressed.