PHYSICAL PROPERTIES OF THE WOOD-FIBRES.

The principal dimensions of the wood-fibres of the different species are listed in Table 3. The fibres of the New Zealand softwoods are similar in shape to American softwood pulp-fibres, being typically long and slender, with cross-sections approximately uniform throughout their length. Tawa, on the other hand, although yielding a typically shaped hardwood-fibre, thick at the centre and tapering away to sharp points at the ends, has a fibre shorter than American hardwood-fibres, and with a low ratio of length to greatest cross-sectional dimensions. Photomicrographs of typical pulp-fibres of the various woods are shown in Plate 10.

CHEMICAL PROPERTIES OF THE WOODS.

The chemical constants of the several New Zealand woods and comparative data on certain American pulpwood species* are shown in Table 4. The analytical methods employed and the significance of the various determinations are given in Annexure II. Discounting the empirical character of the analytical methods, these data show the similarity of the various New-Zealand-grown pines to the American northern jack-pine (*Pinus Banksiana*), and of rimu, which is not a true pine, to the same species. Insignis pine possesses certain characteristics of both jack-pine and spruce. European larch corresponds closely to the western larch (*Larix occidentalis*) of the United States. Tawa, the hardwood, is similar to sugar-maple (*Acer saccharum*) so far as chemical composition is concerned. The physical and chemical properties of the several woods were important factors in the outlining of methods of pulping, as will develop later in the report.

PULPING TESTS.

OBJECTIVES.

In planning the laboratory or semi-commercial pulping-work three major objectives were set up, their improtance being considered in the order named :—

(1) To produce a pulp or pulps suitable for newsprint from the available species, particularly the major species :
(2) To produce a satisfactory kraft pulp from rimu, the three pines, and larch.
(3) To produce bleached chemical pulps.

In pursuance of the first objective, pulping tests were made by means of the mechanical, sulphite, and semi-chemical processes. The greater part of this work was devoted to insignis pine and tawa, although some attention was given to rimu and European larch. All of the pines and rimu were pulped by the sulphate process, in order to evaluate their possible utility for kraft papers. Pulping tests by the soda process were limited to tawa. Bleached chemical pulps were produced from insignis-pine sulphite pulp and from tawa sulphite and tawa soda pulps. For reasons which will develop later in the report, the pulping tests in the commercial pulp- and paper-mill trials were confined to the grinding of tawa and to the sulphite pulping of tawa and insignis pine.

In reporting the experimental work each process has been considered as a unit and discussed separately. The methods of attack in applying these processes were planned with a view to attaining the objectives mentioned above, and do not purport to cover the field of production of all possible types of pulps. The papermaking experiments constitute a separate part of the report.

PREPARATION OF WOOD.

Preparation of Wood at Laboratory.

Logs for chemical pulping tests were taken from the cord-wood piles as required, barked with a draw-knife, and sawn into sticks 3 in. by 3 in., which is a convenient size for handling by the chipper. This is a two-knife, 24-in.-diameter disk machine, manufactured by J. P. Devine Co., of Buffalo, N.Y., and with a capacity of about one-quarter of a cord of wood per hour, running at 240 r.p.m., and consuming about 20 horse-power. All the woods tested chipped with comparative ease, a chip length of $\frac{5}{8}$ in. being used throughout the tests.

Until required for charging into the digester the chips were stored under cover in grain-sacks holding about 20 lb. of oven-dry wood. Just before charging, sufficient chips for a cook were raked by hand over a horizontal screen, 21 in. by 42 in., made of heavy wire, three meshes to the inch, the sawdust and dirt falling through, and the large pieces of wood, slivers, knots, &c., being picked out by the operator. The screened chips were packed in galvanized-iron cans preparatory to being charged into the digester, oven-dry weight determinations being made from samples of about 2 lb. of the chips as they were raked into each can. All calculations of chemical, yield, bleach, &c., were based on the oven-dry weight of either chips or pulp. Determinations of the loss of wood in sawdust and chips were made at the same time.

Logs for mechanical pulping tests were barked as described above, but not sawn, being used in round form in bolts about 9 in. long. In some instances the blocks were squared.

It is a prerequisite for all pulping-work, whether by mechanical or chemical processes, that the wood be cleaned of all dirt, bark, &c., as otherwise the value of the pulp will be considerably impaired. The chips, too, must be of uniform size to secure uniform cooking-conditions throughout the digester charge, and for this reason good screening equipment is very necessary in commercial operations.

* The analytical data reported here were compiled by Mr. M. W. Bray, Associate Chemist in Forest Products, U.S. Forest Products Laboratory, to whom acknowledgment is made.