FINAL REPORT

by

Walter G. Kauman

F.A.O. Adviser on
Forest Products Research

Santiago, December 1964.
ACKNOWLEDGMENTS

The work described in the present report could not have been accomplished without the generous and competent help given to the author by his Chilean colleagues. Their number is so great that it would be impracticable to list every name. They include professional engineers, technicians, assistants, secretaries, janitors and workers in the Instituto Forestal, in the universities and in other institutions, and the writer wishes to convey his sincere personal thanks to every one who helped and encouraged him.

However, he considers it an obligation as well as a pleasure to express his gratitude to those persons directly associated with his mission. To his counterpart officers, Messrs. Alejandro Pérez S., and Edgar Blum S., he is indebted for their efficient and capable cooperation and their friendship; to the Director of the Institute, Mr. Manuel Muñoz A., for his support and his patience; to the Staff of the Division of Forest Products Research, for their enthusiastic contribution to the research work and their team spirit; to his secretary, Miss Elizabeth Nagy S., for her dedication and her loyalty; and to the heads and staff of the university laboratories for their friendly and competent collaboration.

He also desires to express his grateful thanks to the Project Managers, Messrs. Lars A. Hartman and Miguel Navarro G., for their continuous interest and guidance, and to the Executive of the Commonwealth Scientific and Industrial Research Organization, Australia, for the permission to accept this mission in Chile.
From February, 1962 to December, 1964, the author acted as senior F.A.O. adviser to the Government of Chile on forest products research, and participated in the establishment of the Instituto Forestal. The terms of reference stipulated that the research should be carried out by cooperation between existing university laboratories and the Institute.

After an initial survey of existing facilities, a coordinated Plan of Work was prepared and presented to a Meeting of Heads of Laboratories in 1962. During the Meeting, the universities accepted the principle of voluntary cooperation with the Instituto Forestal.

To put the Plan into practice, a Division of Forest Products Research was established in the Instituto Forestal as a technically autonomous subdepartment of the Industries and Forest Section. Its task was defined as the coordination of forest products research in Chile, active cooperation in research projects which were considered of national importance, and execution by its own staff of research projects which could not be conveniently handled by the universities.

During the mission, 14 cooperative projects were defined. Of these, 6 were completed or partly completed and reported, 5 are in execution, and 3 had to be suspended. In addition, 4 projects of the Division are being carried out. A number of additional projects are in preparation.

Six university laboratories are participating in the cooperative work, in addition, contact is maintained with numerous other institutions.

Apart from his participation in research, the writer provided informal and formal training to Chilean research staff, acted as adviser to the Library, as visiting professor of wood technology in the Universidad Austral de Chile, Valdivia, and provided practical assistance to other officers and to industry wherever possible.

Research in developing countries is discussed, and the problems of forest products research in Chile are analysed. It is pointed out that one of the most serious bottlenecks of technical aid programmes is the provision of adequate economic and professional conditions of work to Chilean staff, and it is suggested that competent local personnel, if available, should be used in preference to foreign experts.
A number of recommendations are presented with regard to future operation; they include provision of scholarships for Chilean forest products research workers, establishment of a fund for purchasing genuinely required equipment, and provision of carefully selected specialists who would join the research team of the Instituto Forestal to carry out some research work.

The recommendations are based on the premise that the Instituto Forestal is a Chilean institution, and that its successful operation will ultimately depend not on outside aid, but on the competence and dedication of its Chilean personnel.
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In October, 1961, the writer accepted a fixed-term appointment for 2½ years, subsequently extended to 3 years, as Adviser on Wood Technology Research to the Instituto Forestal in Santiago, Chile. His tour of duty lasted from 29th December, 1961 to 31st December, 1964. From 6th February, 1962 to 13th February, 1965, were spent in Chile.

The terms of reference for his work were defined in his Job Description as follows (final revised version):

"To participate as member of the team of foreign experts which will assist the Government of Chile in establishing the Institute for the Development of Forest Resources and Industries; in particular the expert will serve as a senior adviser to Government on forest products research activities and will

1) provide advice and guidance to Government on the development of research organizations and facilities in both mechanical and chemical wood technology,

2) assist cooperating agencies and institutions in the development of their research programmes and facilities,

3) organize and coordinate cooperative research among the several agencies and institutions participating in the work of the Institute,

4) train Institute staff and research personnel from other agencies and institutions in the use of modern research techniques and equipment, including the statistical design of experiments."

More specific instructions by the Project Manager (letter AG/61/640 of Oct. 18, 1961) stated that:

"The Institute does not plan to operate its own Forest Products Research Laboratory, but will assist the existing Universities, which already conduct their research, to intensify and improve their work on this field of applied research. Our intention is that you should first find out what is really being done and then you should prepare a plan of cooperative and coordinated Forest Products Research."

...
The Plan of Operations of the Project (CHI/2 SF 4/1 dated 26.6.61) stated

"... research will be carried out on both the mechanical and chemical properties of the wood of present and potential commercial species of trees. The experts working in this field will be responsible for establishing the necessary research facilities. ... Existing laboratories of participating Universities and new ones, if required, will be used."

The Draft of the Chilean Statutes of the Institute provides that one of its objectives will be

"To promote, coordinate, foment and carry out forestry and forest products research resorting preferably to the existing institutions."

In the letter of appointment (dated January 9, 1962) received during briefing in Rome, it was emphasized that "... an important aspect of your work is the training of the national counterpart personnel who will be assigned to the project by the Government. Wherever possible, you should endeavour to impart an understanding of your technical specialty in such detail as circumstances will permit. Special Fund assistance has a limited duration and nationals of the country must be in a position to carry on similar work when the project is completed."

In addition, verbal instructions were given from time to time by the Project Manager.
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1. INTRODUCTION.

This writer concurs entirely with the philosophy expressed in the instructions of his letter of appointment, in which it is stated that nationals of the host country must be able to continue his work when he leaves. He agrees that assistance by Special Fund or other international or bilateral agencies should have a limited duration, especially as regards the provision of foreign specialists.

His work and actions during his tour of duty have therefore been governed by the overriding consideration that the Instituto Forestal is a Chilean institution and should be run by Chileans at the shortest possible notice. He believes that the original period of operation of the Project - 4 years - was judiciously selected. In his opinion, the quality of the available technical and scientific manpower is sufficiently high to allow carefully selected Chilean personnel to carry on by themselves at the end of the 4-year period.

It would be a lamentable failure if the considerable expense and effort which has gone into this Project would produce nothing more than a new project of assistance; or a request for extension of the present one, instead of an independent, vigorous, young Chilean institution.

The establishment of an institution of lasting value requires long-range planning, especially as regards the creation of a research tradition. It would be relatively easy for the experienced specialist to produce spectacular results during his stay: his main concern must be what happens after he leaves.

This writer believes that he has cultivated and developed a research attitude in the forest products field among Chilean technicians and scientists; he does not claim, however, to have established more than an embryonic research team in the Institute. It would be an easy matter to blame the problems pertaining to new institutions and to developing countries for possible shortcomings in the results. These problems have been discussed exhaustively in the periodical Personal Reports submitted to the Project Manager. While they have undoubtedly caused serious difficulties, this adviser would not allege that his performance has been faultless.

However, he hopes to show in the present report that provided certain basic recommendations are adopted, the Institute's forest products research team, together with those of the universities, has every chance of developing into a unit which in 5 or 10 years' time may take its rightful place among the world's Forest Products Research Laboratories.
It is not proposed to repeat in detail the information presented in the various half-yearly Personal Reports. In accordance with the wishes of the present Project Manager, in this final report emphasis will be given to comments and recommendations for future operation.

2. INITIAL SURVEY AND PREPARATION OF PROGRAMME OF WORK.

During his appointment travel, the writer visited 13 forest products research laboratories in Israel, Germany, Norway, England, Belgium and France. In addition, he briefly met senior officers of the Philippines and Spanish laboratories during stopovers at the respective airports.

On arrival in Chile, in accordance with the instructions to propose a research programme in cooperation with the universities, the first job consisted in a detailed survey of existing facilities, and of earlier work (Kuwaan, 1962). After an exhaustive study lasting five months, and involving extensive travel, the writer felt that he had acquired the necessary knowledge of local conditions to make his first recommendations and formulate a coordinated working plan.

To present this plan, representatives of the five universities which were then maintaining forest products laboratories were invited to a meeting held in the Instituto Forestal in August, 1962, in order to present details of their Programmes of Work and achievements, and to discuss the proposed Coordinated Plan. Agreement was reached to establish and maintain close cooperation and collaboration between the universities and the Instituto Forestal in the execution of the Plan (Proceedings, 1962; Anon. 1963). In this Plan, some 20 experimental projects were proposed as urgent necessities to be initiated as soon as possible, and some 20 more as being of interest but of a less urgent nature.

In addition, the writer formulated a number of conclusions and recommendations which are contained in the two reports cited (Kuwaan, 1962, Proceedings, 1962), and in a Memorandum to the Project Manager dated 21.8.62. The most important of these were:

(i) In view of the terms of reference which call for research by voluntary cooperation of existing universities, the research unit of the Institute could not be built up along the lines followed in other countries where central national laboratories were established, but should take the form of a Secretariat which carries out the coordination.

(ii) As the main task of the Industries and Forest Products Section was to consist of industrial development projects, the research unit should be technically autonomous, with its officer-in-charge directly responsible to the Executive Director.
The first of these recommendations was approved by the Management during the abovementioned meeting. The technical autonomy of the "Division of Forest Products Research" was formally established by the Project Manager in a communication to Headquarters dated 11.10.62. (PoI-CH/617).

In addition, the writer recommended the establishment of a small laboratory in the Institute, and pointed out (Memo, 21.8.62) that the alternatives to the proposed plan were either abandonment of research and exclusive dedication to industrial development, or the establishment of a fully equipped research laboratory in the Institute which would require considerably more funds and personnel than were available.

3. ORGANIZATION OF RESEARCH WORK AND COUNTERPART PERSONNEL.

3.1 Organization:

As a result of the above recommendations, the Division of Forest Products Research commenced operating in September, 1962, as a technically autonomous sub-department of the Industries Section. The initial staff consisted of one Chilean engineer-in-charge and a secretary. A technical officer was employed late in 1963, and another technical officer and two assistants early in 1964.

By May, 1964, the Division had been built into a close-knit team and was operating as an efficient Secretariat coordinating the work in the various universities, as a consulting centre whose officers were actively cooperating in selected projects in university laboratories, and last but not least, as the nucleus of a future forest products research laboratory in the Institute.

On 11th May, 1964, the Project Manager, revoked the technical autonomy of the Division which had been officially approved in 1962, and placed its officer-in-charge under the authority of the Chief of the Industries and Forest Products Section, whose qualifications and interests are related to industrial development and extension.

This reversal of policy was contrary to strong recommendations made by the writer. As a member of the Project team of advisers, he has endeavoured to carry out the instructions implied by the new policy, while at the same time seeking approval of some modifications which mitigated their deleterious effect on his work. The most important of these modifications was the designation of his counterpart, the Division's officer-in-charge, as the officer responsible for all research projects in the Industries and Forest Products Section, as from July, 1964.

However, this adviser continues to be in strong disagreement with the new policy. Its adoption is obliging him to repeat, in the present report, recommendations which had already been made in 1962 and which had, as he thought, been definitely approved.
3.2 Counterpart Personnel:

The writer has been very fortunate in having assigned to him as counterpart officers capable, experienced and hardworking Chilean engineers with whom it has been a pleasure to collaborate.

Mr. Alejandro Pérez Seranl, Ing. Quim., was appointed on 1st May, 1962 and continued until March, 1963, when he felt constrained to resign. Mr. Pérez was subsequently appointed Professor of Wood Technology in the Technical University Federico Santa María, Valparaíso. Since taking up his new duties in August, 1963, he has been most successful, in the judgement of the academic authorities of that University, in building up the recently created Department of Timber and Plastics Engineering. He has continued to give excellent and wholehearted collaboration to this adviser.

Mr. Edgar Bluhm Spannuth, Ing. Quim., was appointed on 1st Sept., 1963, having collaborated with the writer before that date in his former capacity of Professor of Forest Products in Concepción University. Mr. Bluhm has been working in forest products research and technology for more than 6 years, including 9 months at the U.S. Forest Products Laboratory in Madison. He is the only engineer with significant experience in wood technology at present employed by the Institute, apart from the Executive Director. The writer has had frequent opportunity to ascertain that Mr. Bluhm is held in high esteem by Chilean professional forest products personnel both in the universities and in industry.

In accordance with parts 2, 3 and 4 of his Job Description, the writer collaborated with research personnel in the universities almost as closely as with his counterpart officers. He wishes to record the names of the officers in charge of the various laboratories who have given him efficient cooperation and support:

Universidad Austral de Chile, Valdivia
Facultad de Ingeniería Forestal
Instituto de Utilización de Bosques y Tecnología de la Madera
Ronald Brun, Ing. For., May 1964 - Dec. 1964
Guillermo Mittak, Ing. For., Feb. 1962 - May 1964

Universidad Católica de Chile
Facultad de Ciencias Físicas y Matemáticas
Departamento de Investigaciones Científicas y Tecnológicas
David Fuller, Ing. Quim., Sep. 1964 - Dec. 1964

Universidad de Chile
Facultad de Ciencias Físicas y Matemáticas
Instituto de Investigaciones y Ensayos de Materiales
Universidad de Chile
Facultad de Agronomía
Escuela de Ingeniería Forestal
Departamento de Tecnología de la Madera
Emilio Cuevas, Ing. For.  Feb. 1962 - July 1963

Universidad de Concepción, Concepción
Facultad de Ingeniería
Instituto de Investigaciones Tecnológicas
Departamento de Productos Forestales

Universidad Técnica Federico Sta. María
Facultad de Química
Departamento de Maderas y Plásticos

In addition to the above, an average of some 10 professional engineers and at least 10 technical officers or assistants in the various universities took part in the research work.

3.3 Operational Responsibility:

Although the writer's mission was of an advisory nature, he was requested by the Project Manager to assume responsibility for the operation of the Division of Forest Products Research from March to August, 1963, inclusive, when no counterpart officer was available. He was also responsible during the initial planning period from February to April, 1962, until the appointment of Mr. Pérez.

3.4 Relations with the Universities:

In accordance with the instructions received (see Preface), the Division of Forest Products Research was organized as a Central Secretariat (Kawen 1962, Proceedings, 1962) to undertake coordination of research work and cooperation in selected projects which were considered by the Institute to be of national importance, and which would be initiated by common agreement. The Division's contribution to this cooperative work consisted in technical advice and loan of some equipment, as outlined in Section 3.6.

3.5 Laboratory Facilities in the Institute:

Although the initial term of reference (see Preface) did not contemplate the installation of a laboratory in the Institute, this adviser pointed out at an early stage that the provision of some facilities and equipment was essential if it was desired to retain a good research worker as officer-in-charge of the Division. On May 26, 1962, he recommended pur-
chase of apparatus worth about US$ 2,000 for the Industries Section (See Equipment Lists 101 and 117 dated 29.7.62 and 24.7.62).

As a result of his representations, in November, 1962, the Management provided a small room to serve as a laboratory. The Personal Report for 1962 (dated 8.1.63), states (Section 3) that a small laboratory will be installed in the Institute: "(its) purpose is to enable the Divisional staff to carry out small tests and experiments which cannot be conveniently assigned to a university."

Due to shortage of local personnel, the laboratory did not start functioning until November, 1963.

3.6 Equipment:-

In the Plan of Operations of the Project, US$ 35,000.- were provided for the importation of equipment for forest products research. It was stipulated by the Project Manager that most of this equipment should be assigned to the cooperative work with the universities, and should, in each case, be made available on loan to the university laboratory where the work would be carried out.

The sum provided has been spent as follows:

- Equipment for loan to the universities: US$ 14,700.-
- Equipment for the Institute's laboratory: US$ 11,900.-

Total: US$ 26,600.-

Of the balance, some US$ 7,000.- was transferred by the Project Manager in March, 1964, to items requested by the Adviser on Industrial Development. The remaining US$ 1,500.- were used to pay the impression of a card-sorting key (see Section 4.2, Project III-2/EST-1).

Some £1,000.- Chilean funds were spent on local purchases of apparatus for the Institute.

4. WORK ACCOMPLISHED.-

4.1 General:-

The proposal of a Coordinated Working Plan by this adviser (see Section 2) took into account the generally accepted view that research activities may be subdivided into: academic research, exploratory research, and developmental projects, as will be discussed in more detail in Section 6.2.
In accordance with these principles, it was proposed (Kuunan, 1962) that under the conditions currently prevailing in Chile, academic research should be left to the universities but should be encouraged by the Institute, whereas exploratory research should be considered as the main task of the Division of Forest Products Research, in cooperation with the universities. Commercialization and developmental work should be undertaken by the Extension Service of the Institute's Industries and Forest Products Section.

With the approval of the Project Manager and Executive Director, the Division's work has been planned and carried out along these lines.

Full details of the work accomplished have been given in the Quarterly and Annual Reports (in Spanish) prepared by the writer in collaboration with his counterpart officers, and somewhat shorter versions (in English) in his Personal Half-Yearly Reports.

The present Final Report will therefore be limited to a brief summary of the various projects.

Early in 1962, prior to any recommendation by this adviser, the Management decided to include all research projects in a special series designated "ITM" (Investigaciones de Tecnología de la Fadera), whereas developmental projects were included in separate series designated according to subject matter (IS - Industrias de Secado, IF - Industrias de Preservación, etc) (Com. No. 23, 27.12.62). (This decision was in agreement with verbal instructions that research and developmental work, respectively, were to be regarded as complementary but separate activities).

4.2 Cooperative work with the Universities:

Project ITM-1: "Reconocimiento de las facilidades existentes para investigación de productos forestales en Chile" (Survey of existing facilities for forest products research in Chile)

A complete survey of existing facilities and requirements was carried out, and a report prepared to record the results of this survey (Kuunan 1962).

The report included the coordinated plan of work which was proposed to the Meeting held in August, 1962 (cf. Section 2).

Project ITM-2: "Planificación e iniciación de trabajos cooperativos del Instituto Forestal con las diferentes Universidades" (Planning and initiation of the cooperative work of the Instituto Forestal with the various universities)

This was designed to cover all cooperative work with the universities. It was accordingly subdivided into sub-projects according to subject matter. Altogether, 14 projects were defined during the writer's mission.
FIS-1 ("Estructura") - (Universidad Austral de Chile)

"Clave para la identificación macroscópica de especies de maderas que crecen en Chile"
(Key for macroscopic identification of timbers growing in Chile)

A card-sorting key for the identification of the 30 most common timbers in Chile according to macroscopic characteristics was designed and printed, and the work reported (Hittak and Kauman, 1964). A pamphlet is in preparation.

FIS-2 ("Física") - (Escuela de Ing. Forestal, Universidad de Chile)

"Determinación de las correcciones según especies para medidores eléctricos de la humedad de la madera del tipo resistencia"
(Determination of corrections according to species for electrical moisture meters of the resistance type)

Corrections were determined to obtain the true moisture content of wood samples from readings of electrical moisture meters of the resistance type. Data for six species have been reported (Náta, 1964). It is hoped to examine four or five additional species during 1965.

MEC-1 ("Mecánica") - (IDHEM, Universidad de Chile)

"Determinación de las propiedades mecánicas del pino insigne (Pinus radiata D.Don), según normas ASTM"
(Determination of the mechanical strength properties of radiata pine based on ASTM standards)

Mechanical strength properties based on 20 trees from 2 regions have been measured and reported (Albala, 1964). Material from 20 more trees from two other regions has been collected.

QUI-1 ("Química") - (Universidad de Concepción)

"Determinación de la composición química orgánica del pino insigne (Pinus radiata D.Don)"
(Determination of the chemical and organic composition of Monterey pine)

Using material from the trees sampled for MEC-1, and some 40 additional trees, the chemical composition of Pinus radiata (hSto- and alpha-cellulose, lignin, extractives) was determined and reported. (Váz and Ceballos, 1964).
The Division's contribution was limited to the experimental design and general advice. A UNESCO (Special Fund) adviser, Dr. Werner Schweers, participated in the work.

PRE-1 ("Preservación") - (Escuela de Ing. Forestal, Universidad de Chile)

"Determinación de la durabilidad natural de especies autóctonas y exóticas"  
(Determination of the natural durability of native and exotic species)

A preliminary series of experiments with Pinus radiata and Nothofagus dombeyi was completed and reported (Ortiz and Cuevas, 1964).

PRE-2 ("Preservación") - (Escuela de Quím. y Farmacia, U. de Chile)

"Investigaciones de los componentes químicos responsables de la durabilidad natural de las especies durables"  
(Research on the chemical components responsible for the natural durability of durable species)

PRE-3 ("Preservación") - (Universidad Austral de Chile, and a commercial company)

"Investigaciones sobre la impregnación de durmientes de coigüe (Nothofagus dombeyi)"  
(Investigation of the impregnation of coigüe sleepers)

This is the only work of a somewhat academic nature undertaken during the writer's mission. Various extracts have been obtained from the heartwood of Fitzroya cupressoides. Biological tests and chemical analyses are in progress.

SEC-1 ("Secado") - (Universidad de Concepción)

"Aplicación del proceso de "recondicionamiento" para la recuperación de colapso en maderas autóctonas y exóticas"  
(Application of the reconditioning process for recovery of collapse in native and exotic species)

SEC-2 ("Secado") - (Universidad Austral de Chile)

"Investigación del secado de coigüe (Nothofagus dombeyi) y determinación de programas secado"  
(Investigations on drying Chilean coigüe and determination of drying programmes)

216 sample boards from 3 trees were dried by 9 programmes, and reconditioned. The results were reported (Kahman and Hättak, 1964, c, d).
SEC-3 ("Secado") - (IDEM, Universidad de Chile)

"Diseño de una cámara de climatización"
(Design of a conditioning room)

After obtaining some relevant information from Australia, the project was suspended pending the availability of a suitable room in the University.

SEC-4 ("Secado") - (Universidad Austral de Chile)

"La economía del secado de la madera"
(Wood-seasoning economics)

Data on the economics of seasoning in Chile were collected and correlated. A report is in preparation.

SEC-5 ("Secado") - (Universidad de Concepción)

"Investigación sobre influencia de las variables del secado a la edad sobre colapso y recuperación en Eucalyptus globulus chileno"
(Investigation on the influence of process variables and age of tree on the seasoning behaviour, collapse and reconditioning in Chilean Eucalyptus globulus)

Continuing the work started under SEC-1, sample boards from 12 trees were dried according to schedule. The data are being analyzed.

ELI-1 ("Elaboración") - (Universidad Católica de Chile)

"Resistencia mecánica de uniones encoladas de pino insigne"
(Strength of glued joints of radiata pine)

A preliminary working plan was discussed. The project had to be suspended pending presentation of a detailed plan by the University.

New sub-projects under consideration include work on growth stresses in coigue, and on creep, in the Universidad Austral, on predrying of posts prior to preservation in the Universidad de Concepción, and on natural durability in the Escuela de Ingeniería Forestal, Universidad de Chile.

Six of the 14 sub-projects listed above, and 4 of the 5 under consideration, form the subjects of these prescribed for the degree of "ingenero". According to accepted practice in such cases, the experimental work is carried out by the student under close supervision by his professor.

4.3 Research carried out by the Division:

A number of research projects are being undertaken by the staff of the Division of Forest Products Research in accordance with the principles outlined in Section 3.5 and 4.1 above.
"Determination of the equilibrium moisture content of wood in all climatic zones of Chile"

A total of some 1,500 specimens measuring 21 x 9 x 2 cm was obtained from 24 trees including 6 of each of the species Fitzroya cupressoides, Nothofagus dombeyi, Aextoxicon punctatum, and Pinus radiata, according to random methods. 48 specimens were allotted to each of 19 field stations, including 12 from each species and two from each tree. The remaining specimens are being kept in reserve.

The field stations are distributed from 18° to 53° S throughout the territory of Chile, and each consists of a standard shelter in which the specimens are kept exposed to outdoor conditions, but protected from rain. Cooperating institutions include 5 universities, 6 technical schools, the Chilean Air Force, the State Electricity Corporation, and a mining company. Each has appointed a technician in charge of the station who is taking weekly readings of specimen weights, and forwarding reports to the Division (Anon., 1964).

The project is working satisfactorily and a first progress report has been presented (Bluhm et al., 1964). It is scheduled to terminate at the end of 1965, or possibly 1966.

"Bibliografía de investigaciones científicas y tecnológicas de productos forestales chilenos"

(Bibliography of scientific and technological investigations on Chilean forest products)

The aim is to prepare a bibliography of all published work on Chilean forest products. Owing to the various administrative problems which have affected the Division, progress has not been as fast as had been anticipated. However, with the cooperation of the universities, a number of references have been collected, and it is hoped that the project will be completed during the coming year.

"Resistencia a la intemperie de recubrimientos superficiales en madera y en productos derivados"

(Resistance of surface treatments of wood and wood products when exposed to the weather)

To test the behaviour of various paints and surface treatments when exposed to the weather, 216 panels measuring 30 x 15 x 2 cm were painted with 12 types of coverings and placed in three test racks located in Santiago, Valparaíso and Valdivia. The project is expected to last one or two years.
ITM - 6  "Estudio crítico del comportamiento de maderas chilenas durante su secado"
(Tests on the drying behaviour of Chilean timbers)

The drying behaviour of Nothofagus dombeyi in boards of commercial length (3 metres) was examined in two air-drying and two kiln-drying runs. The results are ready for analysis.

In addition, the following projects are in preparation:

ITM - 7  "Estudio crítico del empleo de sulfato de cobre como preservador de postes por métodos sencillos"
(Critical study of the use of copper sulphate as preservative of poles using very simple methods of impregnation)

ITM - 8  "Comportamiento de maderas chilenas frente a cargas sostenidas"
(Behaviour of Chilean timbers under sustained loads)

ITM - 9  "Estudio sistemático de programas de secado para diferentes especies"
(Systematic study of drying programmes for various species)

ITM - 10 "Estudio sistemático de la impregnación a presión de diferentes especies"
(Systematic study of pressure impregnation of various species)

ITM - 11 "Preparación de un manual de las propiedades de maderas chilenas"
(The preparation of a manual on the properties of Chilean timbers)

The initiation of this work will depend on the provision of personnel and administrative facilities for the Division. However, barring unforeseen contingencies, substantial progress with ITM - 7, 8 and 11 is anticipated during 1965.

Minor Projects:

Late in 1963, a series of Minor Projects was commenced to accommodate tests, calculations and small experiments carried out mainly at the request of the Extension Service of the Industries and Forest Products Section. Up to date, 10 minor projects have been completed including tests of glue joints, calibrations, preparation of thermocouples and participation in kiln testing, etc.

4.4 Forest Products Research Conference:

In pursuance of a resolution adopted during the August, 1962, Meeting (Section 2), a Conference on Forest Products Research was held in Concepción University on October 1 to 3, 1964, under the joint sponsorship of that institution and the Instituto Forestal. The meeting was presided over by Mr. Gustavo Pizarro, Dean of Engineering in the University of Concepción, with the assistance of a committee composed of Mr. Roberto H. Melo (Rapporteur), Mr. Edgar Bluhm (Secretary), and the writer (Adviser).
Some 50 scientific and technical personnel from the Instituto Forestal, universities and technical colleges attended, as well as some 10 students, 20 representatives of industry, and 5 officers of international organizations. 32 papers were presented, among them 26 carried out in Chilean Laboratories, 3 carried out by Chilean engineers while on fellowships overseas, and 1 by a member of ECLA.

The Conference was most successful in demonstrating both the quantity and the quality of the work accomplished by the small number of Chilean engineers and scientists at present engaged in forest products research. The participants considered it especially significant that nearly all contributions represented personal work carried out by Chilean workers in Chilean Laboratories.

A policy session of the Heads of Laboratories recommended the formation of an Advisory Committee on Forest Products Research, with the participation of the universities, the Instituto Forestal, and a representative of private industry. It was agreed to request the Instituto Forestal to act as convening institution, and to authorize the officer-in-charge of the Division of Forest Products Research to act as secretary to the Committee. The recommendation is at present under consideration by the Management of the Institute.

4.5 Activities as adviser to the Library:

From the beginning, the writer took a special interest in the Institute's Library. In view of its importance to the Research Division, he advocated the appointment of a qualified librarian. In September, 1962, Mrs. Lyrna Soto B. was appointed to this position. A qualified assistant librarian was employed in August, 1963.

At the request of the Project Manager and senior Chilean officers the writer agreed in October, 1962, to act as Adviser to the Library. In this capacity he has been responsible, in collaboration with Mrs. Soto, for the classification of the material according to the Oxford/UDC system, for organization of internal loans and journal circulation, exchange with kindred institutions, and all other dispositions pertaining to the efficient operation of a specialized library. Nearly all material has been classified, and some 3,000 catalogue cards prepared. The author catalogue is 75% completed, and a comprehensive subject catalogue has been started. Accession lists are prepared and circulated periodically.

In January, 1963, Statutes and Rules for the Library were prepared and submitted to the Project Manager. Up to date, this document has not been finally approved.

The library staff take particular pride in a little periodical publication entitled "Library News" which is issued in Minco, form about every two months. In a colloquial way, this periodical provides information to Institute staff on library matters of current interest. It also includes brief educational articles on subjects such as the system of classification used, "How to use the Library", how to prepare bibliographies, etc. ...
4.6 Training of local personnel:

Training was provided mainly through informal conversations, and above all by personal participation in all aspects of the work together with Chilean personnel.

However, with the increase in the Division's staff during the last eight months, it was deemed advisable to arrange talks and lectures on various aspects of wood technology and related physics and chemistry. Altogether some 15 lectures were given in the Institute, including 8 on statistical design and analysis of experiments. In addition, 4 lectures were contributed by Mr. Bluhm.

Some 12 public talks and lectures were given in connection with the extension programmes of various Chilean universities.

In accordance with Point 4 of the Job Description (see Preface) special stress was laid upon training in statistical design of experiments. Apart from the lectures on this subject given in the Institute and in the U. Austral, 4 field trips were made to inculcate the correct methods for sampling trees and material in the forest and sawmill according to statistical principles. Altogether, some 15 Chilean personnel from the Institute and the universities participated in one or more of these journeys.

4.7 Visiting Professorship in the Universidad Austral, Valdivia:

At the request of the authorities of the Universidad Austral de Chile, the Project Manager commissioned the adviser early in 1964 to accept an honorary position as visiting professor in wood technology in the Forest Engineering Faculty. The main purpose of the request was to alleviate the loss caused to the University by the departure of Prof. G. Mittak who accepted a mission with FAO in Guatemala.

Throughout the academic year, the duties pertaining to the professorship were performed during frequent visits to the U. Austral in connection with the cooperative research projects carried out by the Division. In particular, lecture courses were given on Elementary Statistics and on special topics of wood technology, and the corresponding examinations were conducted. The adviser also acted as supervising professor for four students' theses, and took charge of the Institute of Forest Utilization and Wood Technology.

To avoid encroaching on the time spent on Project duties, much of this work was carried out during weekends and evenings.

4.8 Travel:

The work described in the preceding paragraph made it necessary to travel frequently and extensively to carry out the cooperative projects in the universities, to initiate and supervise the equilibrium moisture content project, and generally maintain contact with scientific and technical institutions. Altogether, some 55 extended journeys and 3 short trips were undertaken in Chile, mainly by air to economize time.
As far as possible, outlying experimental stations of the equilibrium moisture content project in the far North and South of the country were visited during private holiday travel. In addition, numerous visits to forest services, FAO Projects, universities and industrial undertakings in Argentina, Uruguay, Bolivia and Peru were made during private trips to these countries. (In Argentina and Uruguay, FAO provided per diem for 5 of the 10 days spent on professional visits). During travel on home leave in November, 1963, forest products laboratories in Madison and Melbourne were visited, as well as the "Division of Wood Technology" in Sydney.

4.9 Miscellaneous Activities:

Throughout his term of duty, the adviser provided information and guidance on his specialty to officers of other departments of the Institute, and to personnel of the universities, technical schools, industrial undertakings, etc. In particular, he made it a special point to provide practical and theoretical help to Chilean and foreign personnel of the Extension Service of the Industries and Forest Products Section, whenever such help was accepted.

Although his instructions did not envisage a significant participation in developmental projects, he provided technical assistance whenever circumstances permitted. In particular, practical advice was given to management, employees and workers of various industrial firms on air-drying procedures, simple preservation methods, and on the reconditioning process. In connection with the visit of Mr. J. V. Gottstein of the Australian Division of Forest Products (CSIRO) as a consultant on the peeling of Pinus radiata and eucalypt veneer, the writer spent three days at a plywood plant in July, 1963, to carry out exploratory practical peeling. During Mr. Gottstein's mission, in February 1964, he acted as coordinator and as an assistant to this consultant.

In addition, suggestions were made in writing on a number of miscellaneous matters, including arrangements for preparing, checking and issuing publications, safety procedures, administration of research departments and so on.

Whenever possible, close contact was maintained with officers of CORFO and other Chilean government instrumentalities and with officers of other international agencies interested in the forest products field.

Other academic and scientific institutions were visited from time to time to ensure liaison of forest products research with other disciplines: they included the Advisory Committee to the Council of Rectors of Chilean Universities, the Chilean Academy of Science, the Chilean Standards Association, the Museum of Natural History, university faculties other than those collaborating with the Institute, and so on.
Early in 1962, assistance was given the Technical University Federico Santa María, Valparaiso, with the elaboration of the syllabus of their newly created course of Timber and Plastics Engineering.

Following a suggestion made during the August, 1962, meeting, draft regulations were prepared, in collaboration with Mr. E. Bluhm, for a Prize to be awarded annually to a Chilean student who submits the best paper on personal, original experimental research on wood technology carried out in connection with his graduate thesis.

4.10 Extracurricular activities:

Apart from his official duties, the writer undertook to promote scientific and technical relations between Chile and Australia.

In this endeavour, he was given valuable and sustained support by the Advisory Committee to the Council of Rectors, the Scientific Attache of the Australian Embassy in Washington and the Australian Trade Commissioner in Lima; and the Head Office of C.S.I.R.O., Australia. Interchange of publications, abstracts, information on scholarships, etc., was arranged, and assistance given to Chilean scientists with the planning of visits to Australia, and to Australians visiting Chile.

The Australian convener of a Corresponding Committee on Plant Ecology of the Pacific Science Congress was assisted in his search for a Chilean delegate, an article on the Chilean research effort was published in Australia (Kauhn, 1963a), and a paper on "The Role of Research in the Development of Australia" in the Bulletin of the Advisory Committee to the Council of Rectors in Chile (Kauhn, 1964).

In 1962, following the writer's departure from Australia, his home laboratory (The Division of Forest Products, C.S.I.R.O.) decided to allocate the money saved on his salary to a fellowship for a South American forest products research worker. He collaborated by circulating information, interviewing candidates and by assisting the successful applicant, Mr. Emilio Cuebas, Ing. For. of the U. of Chile.

In 1963, the writer joined the newly formed Chilean Staff Association of the Institute as an associate member. It is a source of particular pride and pleasure to him that he was elected by the Chilean staff to serve as an advisor on the Council of the Association during 1963 and 1964.
In this capacity, he participated in the drafting of the Association’s Constitution and other documents, in discussions affecting welfare and amenities, and in the organization of social activities. He also took an active interest in the Association’s magazine, “El Leñador”, both as a member of the editorial committee and as a contributor.

5. RESUME AND APPRAISAL OF THE WORK ACCOMPLISHED.

In accordance with his instructions as summarized in the Preface to this Report, the writer acted during three years as adviser on forest products research, and provided guidance on the necessary research organization and facilities.

As his principal contribution towards the realization of the Institute’s objectives in the field of forest products research, and in fulfillment of Point (1) of his Job Description, he recommended the creation of a technically autonomous Research Division, and assisted in its establishment.

To comply with the other specific points of the Job Description, assistance was given cooperating agencies, cooperative research was organized, and training provided, as outlined in section 4 above. The laboratories of the various universities and of the Instituto Forestal are now working in unison and their staff are maintaining friendly personal and professional relations. Personnel are conversant with the most important research techniques, including the statistical design of experiments.

Chilean research workers are in charge of all laboratories, and the recent Forest Products Research Conference in Concepción (Section 4.4) demonstrated their ability to carry on research by themselves. The actual standard of the work is comparable to that of similar institutions a few years after their creation, such as the Australian Division of Forest Products, CSIRO, in the early ‘thirties, or the Philippines Forest Products Research Institute in the late ‘fifties.

Provided Chilean research workers are accorded the administrative facilities which govern successful research institutions throughout the world, there is no reason why forest products research in this country should not, in time, attain a level of excellence equal to that found at present in more highly developed countries.

As the writer’s mission was of an advisory nature, it may be considered that his instructions have been fulfilled by the provision of guidance, and that he is not responsible for the implementation, or lack of implementation, of the advice provided by him. However, it is his duty to point out to his superior officers that his most important and basic recommendations have not been officially approved by the Management (see Section 3.1). Although the Division of Forest Products Research is at present functioning as
if it were a technically autonomous department, it does not, in fact, possess this necessary autonomy. This adviser is seriously concerned that after his departure, his counterpart officer, Dr. Bluhm may not have the independence required to continue the work initiated and carried out during the last three years. On the other hand, he notes with particular pleasure that his detailed technical recommendations have been very largely put into practice by the qualified Chilean research workers with whom he has been in contact.

Unfortunately, the staff of the industrial extension service of the Institute's Industries and Forest Products Section was not given the opportunity to take full advantage of the training offered by this adviser.

6. DISCUSSION AND CONTENT.

6.1 General Observations:

After the first three years of operation, the Instituto Forestal is now a going concern, and many of the objectives proposed in the Plan of Operations have been met. However, although the Project may be counted a success, it is inevitable that there should be certain shortcomings, and possibilities for improvement.

In the present Section, it is proposed to discuss critically those aspects of the Institute's operation which are of importance in relation to its activities in forest products research, and to propose conclusions and comment as a basis for a series of concrete recommendations to be presented in Section 8. In Section 7, special problems of forest products research are discussed.

6.2 Research in developing countries:

In the present discussion "Research" will be understood in the sense defined by Gillespie (1964), i.e., "the use of systematic study and of creative, intuitive, or original thought and experiment to extend the available store of knowledge and understanding".

Most modern writers reject the primitive subdivision of research into "basic" and "applied" fields which is considered obsolete. Instead, the activity of research laboratories is usually understood to comprise three broad fields, although the terms employed to designate them vary according to each author's preference (Heritage 1962, Gillespie 1964, Sant 1964, and literature cited by these writers). The three fields may be described as:

1. Academic or uncommitted research which establishes new principles and pursues knowledge for its own sake.

2. Exploratory or committed research which applies known principles to discover new facts and data, and which usually has a definite but not necessarily an immediate economic objective.
3. Commercialization or developmental projects, in which existing knowledge is applied to solve current industrial problems or to develop new industrial processes. This activity is generally not "research" in the accepted sense of this term (Gillespie, 1964).

There are two main schools of thought with regard to research in developing countries. According to one, research is an unjustified luxury and the available resources should be devoted entirely to developmental projects. The necessary knowledge should be imported from abroad in the form of "experts". The other school maintains that to promote a genuine industrial development it is imperative for the country to build up its own research traditions and facilities, and to rely, as far as possible, on training its own nationals rather than on importing "experts".

The present writer agrees emphatically with the second school of thought. He believes that in the long run, the first alternative can only result in converting the country into a technological colony of some more advanced nation or group of nations, with the well-known undesirable social, economic and political consequences.

6.3. The role of the "expert" in foreign aid programmes:

In agreement with the foregoing discussion, foreign specialists, or "experts", should be brought into a country only after a careful appraisal of the necessity for them, and only after making sure that no suitable national personnel are available.

"Experts" may be useful as short-term consultants to do a specific circumscribed technical job (e.g., demonstrating peeling of veneer), or as long-term advisers to organize the running of a department or activity. It should be obvious that the "expert" must be technically more experienced than the local personnel he is supposed to train.

While the above principles are generally acknowledged in theory, evidence shows that they are not consistently applied in practice.

There have been cases where an "expert" was appointed because he happened to be the only candidate available in his field. Often an "expert" arrives in the country with preconceived ideas which he proceeds to apply without a prior exhaustive study of local conditions and requirements, "exercising domination with the authority of his expertise, rather than through his superior knowledge" (Calder, 1963). This tendency which Calder has called "the tyranny of the experts", results in costly failures and brings into disrepute both the expert's country and the organization which sponsored him.

Apart from outstanding technical ability and experience, the expert, to be of value, must be able to adapt himself to the way of life and idiosyncrasies of the people among whom he is working. This means, especially, a working knowledge of the local language, without which real personal contact is limited to a small group of persons who happen to speak the expert's language with sufficient fluency.
Some experts tend to live in a "golden ghetto", and the local professional counterpart officer is relegated to the role of an assistant, interpreter and travel agent. This tendency is often accentuated by the very substantial difference in salary between expert and local man, and by the former's right to import luxury goods under diplomatic franchise.

It is not intended to convey the idea that technical assistance by foreign experts should be unreservedly deprecated. On the contrary, the experience of the Instituto Forestal shows that "experts" can make significant and valuable contributions to the development of institutions. However, the writer believes that it would have been of greater benefit to the Institute to bring out fewer specialists and employ the money thus saved in training schemes and scholarships for Chilean personnel at all levels.

A comparison of Australia and Chile shows that the policy of giving preference to the training of local personnel pays more dividends than that of relying on experts. The development of the Australian paper industry is a particularly outstanding illustration of this principle (Boas, 1947).

6.4 The contribution to developmental projects by local authorities and counterpart officers:

If the reasoning of the preceding Sections is accepted, the principal contribution by the local authorities consists in the establishment of facilities which permit the appointment of qualified local personnel in sufficient number and of adequate standard.

This implies in the first place the selection of an existing institution, or the creation of a new one, through which the Project can operate. This institution should have full legal existence before the Project is initiated.

On the other hand, its internal administrative structure should be left sufficiently flexible to enable it to be given its final form on the basis of the studies carried out during the initial phases of the Project. The experience of the Instituto Forestal has provided ample evidence of the delays and inconveniences caused by having to operate an institution before its legal creation is completed, and of the difficulties created by the imposition of a rigid hierarchical structure and subdivision into Sections before the functional requirements have been properly assessed.

In the second place, it is necessary to ensure that finance is available to pay adequate salaries to local personnel. This aspect constitutes, in fact, one of the principal bottlenecks of assistance programmes. While it is relatively easy to obtain ample funds for the provision of foreign experts or for the importation of expensive equipment, it is much more difficult to find money for paying Chilean personnel who can make use of these facilities. Although the Instituto Forestal has been relatively fortunate in this respect, the position regarding salaries of Chilean staff is far from satisfactory.
Finally, it should be obvious that competent professional officers will only serve an institution which allows them to develop their skills and augment their professional stature, and to carry out their technical work without unmerited interference. The conditions required to achieve these aims have been discussed in detail by Hunt (1961). They include provision for appointment and promotion on the basis of achievement and not purely on seniority, provision of competent leadership, and proper recognition of the individual's contribution. These considerations apply with particular emphasis to research which is essentially a creative activity and requires considerable freedom of intellectual expression and action (Gillespie, 1964).

The writer is, of course, aware that the contributions by local authorities proposed in the present Section are dependent upon the organizational and hierarchical structures of the country concerned, and that their implementation may not be an easy matter. However, there is a growing awareness among Chilean authorities that failure to provide these conditions is resulting in the loss of many of the country's best brains to foreign institutions.

6.5 The problem of scientific manpower:

From time to time, deprecating remarks about Chilean scientists and technicians are still being voiced, often to justify the failure to provide the conditions proposed in the preceding Section. In fact, on the average, Chilean scientists are as capable as their colleagues in any country. The lack of adequate conditions at home has driven hundreds of Chilean professional men and women abroad, where they are making a success of their career in foreign universities and public or private enterprise, or in international organizations, while Chilean graduate students are successfully obtaining higher degrees, even though they have to do their work in a foreign language.

The problems raised by this exodus have received ample attention in Chile during the last few years. In fact, a Chilean scientist or engineer employed by a foreign agency usually has to be replaced by a foreign specialist brought to Chile at great expense from abroad. The Rector of the Technical University Federico Santa Marín, Valparaíso, Dr. Carlos Ceruti (1963) has drawn attention to the "really tragic paradox for a country like ours", which consists in the importation of knowledge from abroad at high cost, while simultaneously the country is investing money in the education of its own talented young people who often emigrate just as they are on the point of becoming productive. He points out that just as foreign financial aid should be used for investment and not for consumption, thus technical aid should be used only to prepare competent local personnel.

The exodus of scientists from less developed to more highly developed countries is, of course, a world-wide phenomenon, and cannot be prevented altogether. However, the magnitude of the movement may be reduced by improving the conditions offered in the home country.
It is not suggested that there are Chilean scientists and engineers available to replace all foreign specialists working in this country. However, it is surely sound financial policy for any organization to make sure that no suitable Chilean candidate is available before bringing in a foreign expert to fill a position.

6.6 Equipment:

There is no doubt that modern research often requires complicated and costly apparatus. However, this must not be taken to imply that equipment constitutes the first priority in the planning of research.

Hunt (1961) points out that "even more important than buildings and equipment for facilitating research is the personnel available to plan and conduct the investigation. Some research can be done without buildings or equipment but no research can be done by buildings and equipment alone".

A first-rate research worker will often achieve far more with improvised or simple equipment than a less talented person with expensive apparatus. The real standard of a laboratory is often more eloquently demonstrated by the apparatus or "gadgets" constructed by its personnel, rather than by the machines bought from manufacturers.

Good research workers should be given all the equipment necessary for their work without obstruction or delay, but no equipment should be bought unless a research worker is available to make use of it.

Equipment is sometimes bought "on spec," under the pretext that available funds must be expended, or under the mistaken assumption that the success of a project may be measured in terms of money spent rather than work accomplished. This practice should be deprecated. It results in the creation of "museums" of equipment which cannot be used, because no qualified staff is available. By the time somebody becomes available, the equipment is probably obsolete or deteriorated.

In certain cases it is necessary to equip a laboratory in anticipation of the initiation of actual research work. On such occasions, the equipment should be as versatile as possible, applicable to a wide variety of investigations, and the purchase of specialized items should be left in abeyance until appropriate research personnel is appointed.

Equipment should be of a type and make for which accessories and spare parts are easily obtained through national channels, and which can be repaired locally. It is generally preferable to select manufacturers represented in Chile by serious local agents who maintain a technical service and repair workshop. Valuable time is lost if spare parts have to be requested from overseas, or if apparatus has to be returned to the manufacturer for repairs.
The importance of good local workshops and maintenance services cannot be overemphasized. In the writer's opinion, the installation of such workshops would make a greater contribution to the Chilean research effort than many individual pieces of apparatus, and might well be considered by organizations responsible for technical assistance. In particular, there is a pressing need for well-equipped shops to handle glassblowing, precision mechanics and electronics. These shops should be staffed by competent tradesmen and should undertake manufacture and repair of laboratory apparatus for any research institution on a cost basis. Existing facilities in some universities could be used as a basis for building up this service.

Although the above considerations have been formulated with regard to laboratory apparatus for research work, they apply equally to equipment for developmental projects. Some additional points regarding equipment for industry will be presented in Section 6.8.

6.7 Training of Research Personnel:

The training of research officers for forest products work in a developing country has been discussed in considerable detail by Hunt (1961) in his report on the Philippines laboratory. He laid especial stress on the importance of post-graduate academic training, preferably abroad, emphasizing that "ordinary empirical testing and survey work can be done by those who have only the customary 4-year college training, but leadership in scientific research requires academic training to a much higher degree".

It is interesting to note that in the period 1954 to 1961, the Philippines laboratory authorized 34 of its total research staff of 92 college graduates to accept scholarships provided by various organizations in different forms (Hunt, loc. cit.) In 1961, 23 of these had returned to duty, 8 had received master of science degrees, one a doctorate, while 3 more were working for their Ph.D.'s. During the same period, the laboratory imported 5 FAO specialists.

This adviser agrees entirely with the conclusions presented by Hunt and believes that most of his recommendations are applicable to Chile. For further details, the reader is referred to the report cited.

6.8 Developmental and extension projects:

Developmental projects constitute a very important activity which is usually included among the objectives of research laboratories, even though it is not research as understood in the present report (cf. Section 6.2). Although developmental projects should preferably be carried out by industry or trade associations, they have to be accepted by a research institution if there is no other way of getting the work done. (Hunt, 1961). This is at present the position in Chile, and the Institute will have to accept res...
ponsibility for this type of work until competent commercial consultant
services are available.* This point will be further discussed in Section 7.5.

Extension work includes direct technical assistance to industry
and solution of specific problems in particular plants. Although this is
one of the main tasks of personnel working on developmental projects, re-
search staff should endeavour to participate whenever possible.

Under the conditions at present prevailing in Chile, this writer
strongly believes that technical assistance, to be of value, must be eminently
practical. He wishes to quote from his Personal Report for 1962, in which he
stated that

"The Division of Industrial Extension should actively assist
industry to improve the quality of their products. Although in many cases
this will mean the application of known facts, the personnel of this Divi-
sion cannot maintain the high level of proficiency required of them unless
they constantly increase their skill and knowledge by doing practical jobs.
To this end, apart from working as much as possible in industrial undertak-
ings, they should have access to the laboratory facilities of the Institute
of the Universities to carry out experiments, and research staff should
give them all possible assistance. The engineers of the Extension Division
should obviously be thoroughly familiar with all types of machinery and pro-
cesses used by the timber industry. Their primary task should be to do and

* In his discussion of research management in C.E.C.R.C. (Australia),
Gillespie (1964) states that

"In contrast with scientific research ... activities such as
engineering and medicine are largely concerned with the application of the
available accumulation of knowledge ... to human affairs. ... These activi-
ties do not require the organizational structure needed for research, and
although frequently referred to as research, would not so be regarded in
C.E.C.R.C.

Development is often coupled with research. In broad terms develop-
ment bridges the gap between research and application and is the process of
taking an original discovery through the stages of scientific study to the
point where it can be put to practical use. It is a very important activity,
and although essentially different from the research which precedes it, it
frequently contains elements of research and it may uncover previously unrec-
ognized problems which can be resolved only by further scientific research.
These problems must be tackled either within the development group, or re-
ferred back to the research organization. Both the characteristics of the staff
and the organizational structures required for development differ from those
required for research. It is the policy of the Organization to encourage in-
dustry and other appropriate organizations to undertake their own develop-
ment work ... Nevertheless, when it is necessary to undertake this important phase
of scientific work, research and development are integrated in C.E.C.R.C.
under the control of research staff." (Emphasis by W.C. Kaufman)
demonstrate jobs (operate kilns, sharpen a saw, adjust a veneer lathe, etc.), using measuring instruments, spanners, screwdrivers and drawing boards. In my opinion, written or spoken advice can only benefit industrial personnel who have previously received practical technical instruction."

At the present stage, little actual help is given by a foreign specialist or Chilean engineer who visits a plant for one or two days, pointing out the shortcomings in the operations and offering advice without showing himself how to put this advice into practice.

On the other hand, certain experts of the Instituto Forestal have provided outstanding examples of what can be achieved by a specialist who puts on overalls and goes to work on the machines himself for a sufficient number of days to demonstrate how the job should be done.

Extension work frequently involves recommendation of equipment for purchase by industry from foreign suppliers. Such recommendations should only be made after an exhaustive study of local conditions. If this study is omitted, the recommendation may result in the importation of machinery which, although perfectly suitable in some other country, is not appropriate under the circumstances prevailing in Chile. A typical example is the importation of gang saws and high temperature drying kilns to handle native hardwoods which are subject to rotten heart and to severe collapse.

Generally speaking more simple machines should be preferred to more elaborate ones, and of course, technical service and spare parts should be available locally.

Similar considerations apply to recommendations for timber engineering designs, standards, and generally any large-scale application of timber. For instance, timber structures in Chile must be designed to resist seismic shocks, and designs prepared in earthquake-free countries cannot be adopted without appropriate modifications.

7. THE SPECIAL PROBLEMS OF FOREST PRODUCTS RESEARCH.

7.1 Present Situation:--

In Sections 2 to 5 of the present Report, the scope, facilities and achievements of forest products research in Chile were outlined. Some general topics related to research in developing countries were discussed in Section 6. It is now proposed to analyse the present situation of forest products research in this country and to discuss its future possibilities.

At the present time, four university laboratories are engaged in fairly extensive research programmes (cf. Section 3). Each of these has to some extent specialized in one or more fields, viz
University of Chile, IDIEM - timber physics and mechanics
University of Chile, Forest Eng. School - timber physics, anatomy, preservation
University of Concepción - wood chemistry, pulp and paper, preservation, collapse recovery
University Austral - timber physics, anatomy, seasoning

In addition, the Catholic University of Santiago is doing a limited amount of work on timber mechanics and engineering. The Technical University Federico Santa María in Valparaiso has been working on wood chemistry and minor forest products in the past, and is now planning the installation of a substantial laboratory in connection with its course of Timber and Plastics Engineering.

The Division of Forest Products Research of the Instituto Forestal has succeeded in coordinating the work of all laboratories, and is cooperating with the universities in projects which are of national importance. In addition, it has initiated some research work in its own laboratory to complement the effort of the universities.

The extension and development staff of the Industries Section of the Instituto Forestal is still undergoing training, but it is intended that they will also carry out research, besides their work on technical assistance to industry.

7.2 Organizational aspects:

The present situation as outlined in the previous Section arose from the historical fact that in Chile, forest products research has been initiated and carried on by the universities for 20 or 30 years (Fasman, 1962), whereas the Instituto Forestal was formed only recently.

The original recommendation (Igler et al., 1960) proposed that the Institute should coordinate and direct all research and training in forestry and forest products in Chile. However, the actual terms of reference (Plan of Operations CH1/2 SF 4/1, dated 26 June, 1961, and Chilean Draft Statutes) do not give the Institute authority to direct the research effort of other Chilean agencies, so that the coordination has to rely on their goodwill and voluntary cooperation. The Institute's own laboratory was conceived as complementary to existing ones (Igler et al., loc cit., France and Section 3.5 of present report).

Finally, technical assistance to industry was visualized largely as application of existing knowledge, in parallel with the Institute's research effort, (Igler et al., loc cit., Plan of Operations, Chilean Draft Statutes, François 1962), in contrast to most similar institutions which consider developmental work as an outcome of, and subsidiary to the research work.
Under these circumstances, this adviser believes that the organization developed by his counterpart officers and himself, as outlined in Sections 2 and 3, is the most realistic and efficient one for achieving the objectives of the Project in forest products research. To ensure that the very urgent and necessary task of improving industrial processes does not impede the realization of high-quality research in the Institute and collaborating laboratories, the technical autonomy and integrity of the Division of Forest Products Research must be maintained. Its officer-in-charge must have authority to plan and carry out his research programme, and must have full control over his personnel.

The alternative to this organization would be to assign responsibility for research to the personnel of the industrial extension service of the Industries and Forest Products Section. Apart from the fact that this personnel is still largely untrained (cf. Section 5), this adviser is convinced that the combination of research and development as the responsibility of the same person would at present be detrimental to both activities. Research work would most probably be reduced to empirical testing and problem solving, subject to the immediate needs of industry, and the Institute would forego the possibility of building up a sound research tradition and establishing a reputation as a research laboratory.

This does not mean that extension personnel should not carry out some research work. On the contrary, participation in research is essential as part of their training, and as a means of keeping abreast with developments in their respective specialities. However, such research work should be undertaken under the direction of the officer-in-charge of the Division of Forest Products Research, and should be coordinated with research in the country in general, according to the Institute's terms of reference.

This arrangement should be retained as long as the Industries and Forest Products Section is operating with the present establishment, and under the present terms of reference. However, at some future date, it may become desirable to transform and expand the Section into a forest products research laboratory. This would imply a reorganization by which trained and qualified research officers would be put in charge of the various specialties such as seasoning, timber mechanics, etc. Each research officer-in-charge would have under him one or more engineers responsible for extension and development, with the necessary supporting staff. The Chief of the Laboratory should be a highly qualified man with significant personal experience in research. The present Division would, in this case, probably be given the responsibility for the more basic disciplines of wood physics and chemistry. Alternatively, positions of "subject matter specialists" might be created (Hunt 1961) to provide advancement for outstanding research men without burdening them with administrative duties.

In the opinion of this adviser, it is unlikely that the Institute will be ready for such a development for another four or five years, quite apart from the budgetary requirements implied by it. ...
As far as the universities are concerned, the principal organizational problem is the achievement of a proper balance between teaching, attention to thesis work by undergraduate students, and personal research by professors. The problem is really one of shortage of funds (Kaman, 1963a). Chilean universities are obliged to work with such limited resources that their teaching staff is often forced to take on a heavy load of lecturing, to the detriment of research.

The writer believes that a university professor should devote some 40 or 50 per cent of his time to research, roughly half of it as personal work, and the other half in connection with students' thesis. Most university workers at present engaged on forest products research are producing significant results in spite of the limitations noted, and should be given full support and encouragement. However, it would probably not be wise to permit the installation of new laboratories, in addition to the existing ones: if funds become available, they should be spent on improving the latter.

7.3 Shortcomings:—

The principal shortcomings which affect Chilean forest products research are those common to most research institutions in this country, that is, administrative and budgetary instability, inadequate funds for paying Chilean personnel, and in many cases lack of continuity of research policy and programmes. The solution of these problems obviously exceeds the scope of the mission of this adviser. It would require an improved organization of the country's research effort in general, with assured stability of establishments and a guaranteed annual budget. Possible ways for achieving such an improvement will be briefly discussed in Section 7.7.

Unfortunately, these shortcomings often result in a tendency on the part of both Chilean and foreign officers when taking over a new position, to disregard all that was done before and start building up from scratch. This is wasteful and tends to repeat the same projects, and the same mistakes, over and over again. The remedy is obvious: forest products research in the various Chilean institutions should be integrated so that each new officer can take advantage of the experience of those who came before him, and avoid duplicating other people's effort. The best way to achieve this at present is through the proposed Advisory Committee on Forest Products Research (see Section 4.4).

More specific individual requirements concern certain items of equipment, training, planning of experiments and administrative facilities. These problems could in most cases be solved on the basis of the general recommendations which will be presented in the next Section.

7.4 Research Programmes and Equipment:—

Although every effort should be made to remedy the shortcomings noted above, this is likely to take a number of years. In the meantime, research must be carried on under the prevailing limitations.
A coordinated programme for forest products research adapted to the present Chilean conditions was proposed by the writer six months after the start of his mission (Kounr 1962). In general terms, this programme is still applicable and may serve as a guide for the next five years or so. This does not mean that Chilean research workers should not take the initiative of introducing additional projects, or eliminating existing ones, if circumstances warrant it.

The principal objective of the Instituto Forestal is to promote the economic and industrial development of the country. The universities likewise consider national development as an important part of their mission. Most research must therefore be "committed" in the sense used by Gillespie (1964), that is, it should have a definite economic objective in mind.

Committed research should not be confused with empirical testing (Section 6.2). The experience of the Australian C.S.I.R.O. has shown that a research organization will make the most effective and useful contribution to the welfare of the community by tackling its research problems on as fundamental a basis as necessary for their solution, and not by limiting itself to seeking only immediate and limited answers (Gillespie loc cit. Section 6.). Modern industrial development shows that the greatest opportunities have arisen from "frontier" research (White 1964).

Apart from its direct benefit to industry, research should also contribute to the development of the country by raising the standard of its scientific and educational institutions, and by increasing its international stature in science and technology. The strategy of tackling research problems on a general and fundamental basis will go a long way towards achieving this aim, provided, of course, that the work is done by competent scientists under the necessary conditions of intellectual and administrative freedom.

Research projects should be designed in such a way that significant and self-contained results can be obtained within a reasonable period, say one or two years, with the personnel available. A series of small projects each providing an answer to a limited problem is better than an ambitious large-scale project to provide many answers at once. Such large-scale projects are in many cases abandoned without results because the work involved has been underestimated.

The objectives of research noted above cannot be considered as fulfilled until the results are published; this should be done as rapidly as possible after the conclusion of each experiment. In many cases, it may be convenient to prepare a publication of the practical results in simple language for the benefit of industry, and to prepare a separate paper with the scientific conclusions, if any. Results of general interest, if significant, should be submitted to an overseas journal for publication in English, French or German. Care should be taken to check whether the work is of sufficient standard for the journal selected. During the first few years, it may be more appropriate to limit overseas publications to brief technical notes, rather than submit full-length articles.
There may be cases where an important research project requires a major piece of apparatus which is not available in Chile and cannot be improvised. A project should never be designed with the object of justifying importation of equipment, but if special equipment is genuinely required, no effort should be spared to obtain it. It has been the writer's experience in Chile, that funds for the importation of equipment can usually be obtained without undue difficulty through some international or bilateral assistance programme: the problem is rather how to pay the staff who will use the equipment (Section 6.4). As far as possible, duplications of equipment should be avoided by making arrangements which permit research personnel to use the installations of any Chilean forest products laboratory, irrespective of the institution to which the worker belongs. Equipment should not be bought just for one particular project of limited duration unless this is of overriding importance. In general, the most versatile and most widely applicable equipment should be preferred.

While the continued existence of several forest products laboratories in Chile is advocated because of the incentive and mutual stimulation provided by the existence of several research groups, the resources should be pooled not only as regards equipment, but also by interchanging staff members for limited periods and by carrying out as many cooperative projects as possible.

To achieve this, it is of paramount importance to constitute the proposed Advisory Committee on Forest Products Research (Section 4.4) with the least possible delay. The proposal made by the universities is giving the Instituto Forestal a unique opportunity to establish itself on a firm and permanent basis as the central coordinating authority of Chilean forest products research, as proposed originally by Igler et al. (1960). If the Institute does not take advantage of this opportunity within a reasonable delay, the universities would be justified in constituting the Committee by themselves, since they are under no legal obligation to accept the Institute's co-ordination (Section 7.2). In this case, the Institute could be relegated to the role of a marginal testing laboratory, and much of the work accomplished during the last three years would be lost.

7.5 Extension work by the Instituto Forestal:

The objectives of extension and development have been discussed in general terms in Section 6.8.

In the Instituto Forestal, the staff responsible for extension are still in the early stages of training. This adviser has many times suggested that this training should be given a more practical orientation. While a Chilean trainee engineer must study the theoretical background of the specialty assigned to him, and while he can pick up useful information and techniques by accompanying an expert on visits to industrial plants, there is no better way of training oneself than by doing the job. This should start at the most elementary level.
Before any engineer can act as a technical adviser to a branch of industry, he must have worked in this industry with his own hands. Before he can suggest improvements, he must be familiar with the methods used at present. The writer would therefore suggest that as part of their training, engineers should spend extended periods of 2 to 4 weeks in several undertakings of the industry in which they intend to specialize. During these stages, they should not attempt to offer any advice, but should simply work in the plant to become thoroughly familiar with the different phases of the processes and operations.

For instance, an engineer specializing in seasoning might start by stacking timber in company with the workers of the plant. After a few days of this activity, he should go on to operate the kilns for a couple of weeks, prepare moisture content control sections, make himself familiar with the system of record-keeping used, and so on.

Finally, he might spend some time on maintenance, in the administrative office, and with the firm's salesmen. On completing his programme in one firm, he should return to the Institute to continue his theoretical studies and possibly assist with a research project, and after a while proceed to make a similar extended visit to another plant; until he is thoroughly familiar with the industry.

After a year or two of such training, the engineer should be sufficiently versed in his field to start offering some useful technical advice. After another four or five years of conscientious training and practice in his subject, he might justifiably be called a specialist.

In resume, the practical knowledge required to help the Chilean forest products industry cannot be acquired purely from books or by watching somebody else, but only by learning to do the job with one's own hands.

The writer is certain that industry would cooperate in a training scheme as outlined above by receiving trainees in their plants.

7.6 The role of administration:

The role of administrative services in technical and research institutions has been exhaustively discussed by many authors. The consensus of the most qualified opinion may be stated by saying that administration should facilitate the work of the technical departments, and not dominate them (Hunt 1961).

Administrative services should not be given authority over technical personnel, and all responsibility for both the technical and administrative running of the institution should be vested in the technical director. Although it may be convenient and indeed necessary for the director to delegate responsibility and power of approval for non-technical matters to an administrative officer, this officer should be regarded as an "approving instrument", not an "approving authority", and his delegation should not allow him to refuse approval without reference to the director (Gillespie 1964).
This applies especially to the distribution of the annual budget and other financial aspects, since the correct allocation of funds to the different departments requires full understanding of the technical matters with which they are dealing.

Although administration in Latin countries is customarily based on written regulations to a greater extent than in Anglo-Saxon nations who rely on precedent, such regulations should be kept to a minimum to preserve flexibility. Sooner or later, a fixed rule will probably clash with some technical requirement. In such cases, senior scientific officers should have a certain amount of discretion to decide on a course of action.

Administration of research personnel requires particular qualities of tact and diplomacy. The research worker's education lays especial stress on the importance of critical questioning and scepticism, he is taught that he should never accept anything on authority, and there is no way of enforcing effective work on him if he does not identify his own wishes and ambitions with his job (Hiscocks 1956).

According to Gillespie (loc. cit.) Sir Lawrence Bragg has been quoted as saying that the worst enemy of research is pre-occupation. The surest way to kill the creative impulse and reduce a research institution to mediocrity is to burden it with a bureaucratic and top-heavy administration.

Up to date, the Instituto Forestal has been fortunate in avoiding most of the dangers referred to above. Constant vigilance needs to be exercised on the part of both technical and administrative personnel, to make sure that this remains so.

7.7 The integration of forest products research with the general Chilean research effort:

While the maintenance of technical autonomy and freedom of action is of the utmost importance in a research institution, it is equally true that close contact must be maintained with similar institutions of the same and other disciplines to enable research workers to keep abreast of their speciality and of their science. In addition, the shortcomings noted in Section 7.3 are often better surmounted by concerted action on a national level than by the separate endeavours of individual institutions.

In the early tradition of pure science, such contact and cooperation was provided by the various national Academies of Science and learned societies. More recently, it became necessary to put science at the service of national development. Many countries have found it convenient to create government-sponsored central councils to coordinate, direct and often carry out scientific and industrial research. Examples are the Australian C.S.I.R.O.*

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* The Australian Science and Industry Research Act, 1949 - 59, states the principal function of C.S.I.R.O. as "the initiation and carrying out of scientific researches and investigations in connection with, or for the promotion of, primary and secondary industries".
the British and New Zealand Departments of Scientific and Industrial Research, the French CNRS, the Dutch TNO, the Indian and Thai CSIR, the Ceylon CSIR, and so on. The essential feature of most of these organizations is that they are directed up to the highest level by scientists and engineers and are relatively free from bureaucratic or political interference.

In Chile, the only legally constituted central organization in the field of science is the Council of Rectors of the universities and its Advisory Committee. The writer believes that the attributions of this Council and this Committee could with profit be amplified to include the effective coordination of research throughout Chile. This coordination could at first function on a basis of voluntary cooperation through sub-committees of the Advisory Committee to the Council of Rectors, each dealing with a particular branch of science or engineering and composed of the heads of the major laboratories in the field concerned.

At a later stage, a necessity might arise for forming new laboratories in some fields to take care of those areas of committed research which cannot be conveniently undertaken by the universities, and which are the responsibility of the CSIR's etc. in other countries. The initiative for installing such laboratories could be taken by the appropriate sub-committee.

If the measures outlined above are successful, a final phase could be the combination of the sub-committees in a Council of Scientific and Industrial Research, modelled on the most successful organizations of other countries, having due regard to special conditions in Chile.

It is obvious that the funds for such an organization would have to be provided by the State through a guaranteed budget, and would have to be additional to those allotted to the universities. The purpose of the proposal is to increase the total research effort, not to switch some research from one institution to another.

The eventual Council for Scientific and Industrial Research should be closely associated with the Council of Rectors, as well as with primary and secondary industry. Its organization would require a detailed study, but it would be necessary, at all stages, to tailor the operations according to the funds available. A small, effective organization would be preferable to a large, inefficient one.

The various Chilean forest products research laboratories should endeavour to associate themselves with any serious initiative of the kind outlined above. The proposed Advisory Committee on Forest Products Research (sections 4.4, 7.4) could well become a pioneer of the sub-committees proposed. As suggested during the Concepción (1964) meeting, the Council of Rectors should be requested to designate a representative to this Committee. By accepting to act as the secretariat to the Committee, the Instituto Forestal would fulfill its mission to coordinate forest products research in Chile, and at the same time contribute to the integration of the Chilean research effort without which, in the opinion of this adviser, no real progress can be made.

...
Similarly, the Institute's laboratory might act as a pioneer of other technological and scientific laboratories which might one day be set up to handle the tasks undertaken elsewhere by the CSIR-type organizations. By striving for excellence in accordance with the principles outlined in Section 7.4 the Institute's laboratory could act as a peacemaker and thus contribute significantly to the progress of science and industry in Chile.

7.6 The future contribution by FAO and other non-Chilean agencies:

As stated in the Introduction (Section 1) and in Section 6.1 of the present report, the writer believes that the Project has largely succeeded in its objective to assist the Chilean Government in setting up the Instituto Forestal. The continued operation of the Institute should now be left to the appropriate Chilean authorities.

However, FAO as well as other organizations can make further contributions. Any such contribution should be subject to the prior legal creation of the Institute.

In keeping with the tenor of the suggestions and opinions formulated in this report, contributions by outside bodies should be directed towards the advancement of Chilean technical staff. In particular, fellowships should be provided to enable qualified personnel to travel overseas for extended periods. A condition of such fellowships should be the performance of some serious work in a laboratory, industrial undertaking or university, and evidence in the form of a higher degree, or a certificate of the receiving institution, should be required as proof that the work has been successfully completed. In addition, the recipient's return to Chile must be guaranteed.

In the second place, selected items of equipment should be provided if a genuine need for it can be proved. To avoid a repetition of earlier mistakes (cf. Section 6.6) every request should be investigated to ensure

(i) that existing equipment in some other Chilean institution cannot be used,

(ii) that the equipment is really suitable under Chilean conditions,

(iii) that the equipment is recognized as fully proven by senior laboratories in its country of origin.

A most valuable contribution can be made by the regular provision of new technical books and payment of subscriptions to technical journals. Chilean institutions often have difficulty in obtaining foreign currency for these items. It is unnecessary to insist on the importance of maintaining a well-stocked technical library, and the books and journals provided by an international organization would be a contribution of a value many times that of the actual cost.

Finally, the Institute as well as university forest products departments could benefit from extended visits by foreign specialists. Such
specialists should come to work as members, professors or officers of the institution, not as outsiders. They should, however, be guaranteed the necessary independence in their technical work. It is desirable that the receiving institution pay at least a token part of their remuneration.

Visiting specialists on forest products research should be carefully selected. Chilean research workers are by now well versed in their subject and the expense of bringing out a specialist can only be justified if he is of a high scientific standing. He should carry out one or more advanced research projects in collaboration with Chilean colleagues, and should contribute to undergraduate teaching and supervision of theses. A working knowledge of the Spanish language is considered essential.

The specialist should be responsible for his technical work to the Chilean director of the institution, although he will probably be administratively a member of the sponsoring organization.

As far as extension work is concerned, experience has shown that most valuable contributions can be made by outstanding consultants brought out for a limited time (a few months) to do and demonstrate a particular well-defined, technical job. There is little point in bringing out a man to write pamphlets or manuals which have to be translated into Spanish * since the information thus provided is usually contained in textbooks or in leaflets etc., published by overseas laboratories. However, if an experienced practical man can be found who is prepared to spend most of his time in seasoning yards, sawmills or preservation plants to improve the actual operations, rather than in the office, no effort should be spared to obtain him.

The theoretical knowledge required by the Institute's extension staff can be taught to them to a fairly advanced level by the officer-in-charge of the Division of Forest Products Research, Mr. E. Bluhm, and University research personnel. However, there is a great and urgent need for practical instruction in the workshop and on the various machines used in the timber industry.

The writer would suggest that after the end of the Project, the Institute wait for about six months before deciding on requests for further assistance, to give the Chilean staff a chance to settle down and assume full responsibility for the running of the institution.

8. CONCLUSIONS AND RECOMMENDATIONS.

8.1 Scope and Principles:

In the present Section, it is proposed to condense the results and observations presented in this report into a series of concrete recom-

* In many cases, such translations are prepared by secretarial or technical personnel who are not qualified translators, and the standard is rather below that produced by official or editorial translation services.

If this service is required, qualified technical translators should be employed.)
recommendations. In accordance with the instructions listed in the Preface, recommendations will be presented with regard to the Instituto Forestal as well as cooperating agencies. In addition, a few suggestions of a more general scope are included.

The recommendations are based on the writer's conviction that an institution is no better than the people who compose it. He believes that the utmost care should be taken in selecting an officer for a research position. Once he is appointed, he should be expected to assume full responsibility for both the planning and execution of his work. It should not be necessary to provide him with a detailed list of rules and recommendations to guide his work. If he is unable to live up to this responsibility, the answer is not to give him a list of instructions, but to replace him.

If an officer of the requisite standing is not available, the initiation of research must be deferred until a suitable person can be trained, or an outside specialist must be brought in.

The guiding principles of recommendations for research laboratories should be feasibility and flexibility.

Feasibility means that each recommendation should be a realistic one which has a reasonable chance of being put into practice with the facilities available or likely to be available.

Flexibility means that recommendations should refer to a general line of action and to principles, and should not be in the form of fixed rules and instructions.

Apart from the fact already noted that a good research officer should be able to plan his own work, the future operation of the Instituto Forestal is subject to so many unknowns that it would be quite impossible to lay down detailed directions even for the near future.

The main conclusions with regard to personnel, equipment and research policy will be briefly discussed in Sections 8.2 to 8.4, and a list of explicit recommendations presented in 8.5.

8.2 Research Personnel:

The writer desires to state explicitly that he is fully satisfied that Mr. E. Bluhm has the capacity and experience to operate a research department at the level at present required in Chile. He believes that the Institute is fortunate in having secured Mr. Bluhm's services, and wishes to warn that an outstanding person cannot be retained unless he is given the recognition and authority commensurate with his status. There is now no other person in the Institute with a personal research experience superior to that of Mr. Bluhm, and he should immediately be given full responsibility for the running of the Division of Forest Products Research, and for all research projects in this field.
The writer has consistently recommended in his Personal Reports and Memoranda that Mr. Bluhm be assigned an assistant research engineer. This has not been done up to date, and the matter is now of the greatest urgency.

Apart from Mr. Bluhm, between five and ten engineers in Chile could be entrusted with the running of a forest products research department. Some of them are working in the universities, and some in industry. In addition, there are some 10 to 15 engineers and professors, and some 10 technicians, who have had significant research experience in forest products.

8.3 Research Equipment:

The Division of Forest Products Research has been provided with sufficient equipment to do significant work in wood chemistry, wood physics, laboratory aspects of preservation, seasoning, and application of adhesives, and chemical analysis. Most other fields of wood science can be covered by resorting to equipment held by the universities, in accordance with the Plan of Operations and the Chilean Draft Statutes.

It is recommended that no further equipment should be purchased until a proper laboratory is available to house it.

The equipment at present on loan to the universities (Section 3.6) should remain under their care.

8.4 Research Policy and Organization:

The Institute's terms of reference stipulate that the coordination and realization of research should be one of its objectives.

This objective can at present be realized only through a technically autonomous research department, working in collaboration with, but not subordinate to, the Extension and Development Service of the Industries and Forest Products Section.

It has been suggested that the engineers who are now being appointed to this Service should each become a specialist in his field and be responsible for both research and extension work. It is to be hoped that these officers will indeed one day be specialists. This will take several years. To assert that they can take charge of research projects now, or in the near future, is simply begging the question.

If it is intended in the future to integrate research and the extension service without diminishing the quality of research work, the Section must be reorganized as a forest products research department, and research staff must be in full control.

The Management will have to decide whether it is desired to continue forest products research in the sense in which this term is understood in comparable institutions throughout the world, or whether the Institute should limit itself to empirical testing and problem solving.
8.5 Summary of Recommendations:

8.51 The Institute in general:

8.511 The Project has produced satisfactory results and should not be extended or renewed.

8.512 Every effort should be made to hasten the legal creation, and the provision of adequate buildings.

8.513 The Executive Director should be given greater responsibility and should not have to refer to the Council except on matters of basic policy.

8.514 Section Chiefs and officers-in-charge of groups and divisions should lead and participate in the technical work of their staff. They should be freed from administrative encumbrances as much as possible.

8.515 It should be obligatory to advertise all vacant positions in the press, in the universities, and by other appropriate means, to ensure staff is selected on the widest possible basis, and not merely by recommendation.

8.516 Administration should be an instrument of the Executive Director, and should facilitate the work of the technical Sections.

8.52 The Industries and Forest Products Section:

8.521 The Industries and Forest Products Section should be subdivided into an Extension and Development Service with various working groups (Seasoning, Preservation, etc.), and a Division of Forest Products Research.

8.522 The Officer-in-Charge of the Division of Forest Products Research should occupy a position similar to that of a "Subject Matter Specialist" in the U.S. Forest Products Laboratory.

This means, he should be technically in charge of the Division and be responsible directly to the Executive Director. He should have full control of his personnel, and should have the status of a Section Chief. However, he should not have the administrative duties of a Section Chief, and the Division should be administratively attached to the Industries and Forest Products Section.

8.523 The closest possible cooperation should be maintained between the Division and the Extension Service, on a basis of equality.

   Research staff should take an active interest in extension work, and extension staff should be trained in research under the authority of the officer-in-charge of the Division.
3.524 The training of the personnel engaged on extension work should be given a more practical orientation.

3.525 If the above recommendations cannot be implemented, it is useless to pretend that the Institute can continue carrying out significant forest products research. Although it is easy to designate projects as "research", they do not thereby become research projects unless the work undertaken corresponds to the definition of this term.

The management will have to decide whether the Institute should continue doing research, or limit itself to commercialization projects and "trouble-shooting" in industry.

3.53 The Division of Forest Products Research:

3.531 The integrity of the Division should be maintained.

3.532 The staff should comprise the officer-in-charge, an assistant engineer, two technicians, two laboratory assistants and one secretary.

Appointment of the assistant engineer is a matter of the greatest urgency.

3.533 The present Division may be regarded as a nucleus of a future forest products research department.

The staff listed in 3.532 could profitably be doubled during the next two years, but there is little point in doing so until better laboratory accommodation becomes available.

The eventual size of the research department should be a matter for recommendation by the officer-in-charge, in the light of circumstances prevailing when the Institute occupies its definite quarters.

3.54 The Research Programme and Equipment:

3.541 The Coordinated Plan of Forest Products Research prepared in 1962 (Kuwan 1962) should be used as a general guide for the next few years.

3.542 The Research Programme should be considered under the three headings:

(i) academic or uncommitted research
(ii) survey-type or committed research
(iii) commercialization and developmental projects.

3.543 Academic research should be left to qualified personnel in the universities, but should be actively encouraged by the Institute. It should in no case occupy more than 25% of the time of any one worker.

...
It would be desirable for the officer-in-charge of the Division to start at least a small project of pure scientific research within a year, to ensure his personal progress, and to help increasing the Institute's international stature.

8.544 Survey-type research should be the principal subject of the Division and of the university laboratories. As many projects as possible should be cooperative.

8.545 Commercialization projects and problem-solving should be the responsibility of the Extension Service of the Industries and Forest Products Section.

At present industry is turning for much of this service to the universities where trained personnel is available. The Extension Service should make every effort to accelerate the training of its staff, especially in the practical aspects of their specialties, to enable it to make a real contribution to industrial development.

8.546 The future planning of research should be the responsibility of the officers-in-charge of the various laboratories, in consultation with the Chief of the Industries and Forest Products Section and a representative of industry.

8.547 Equipment for research is a vital necessity, but even more vital is the need to employ qualified personnel, under adequate economic and administrative conditions, who can make use of this equipment.

8.548 The Division of Forest Products Research has sufficient equipment to do significant research with its present personnel.

Future purchases should form the subject of recommendations by its officer-in-charge, but should not be considered (except small items) until improved laboratory accommodation is available.

Equipment on loan from the Division to the universities should remain in the university laboratories.

8.549 Equipment of all Chilean forest products laboratories should be pooled to enable any apparatus to be used by any worker, irrespective of his institution.

8.55 The Universities:

8.551 At this stage, and in view of the present difficulties and the many unknown quantities regarding future developments in Chile, a multiplicity of forest products research laboratories is to be encouraged.

However, the present number of laboratories is sufficient, and no new ones should be created.
8.552 The Timber Investigation Section of the Materials Testing Institute (IDTEM) of the University of Chile should be given responsibility for all standard-testing work of mechanical properties, in collaboration with the Chilean Standards Institute and the Instituto Forestal.

Installation of conditioning rooms, and of an air-conditioned testing laboratory, is urgent and essential.

8.553 The Forest Engineering School (Escuela de Ingeniería Forestal) of the Faculty of Agriculture, University of Chile should formally create a Department of Wood Technology with a competent officer-in-charge. Apart from the supervision of theses, each professor should have one personal research project, preferably on topics related to biological aspects or timber physics.

The staff should endeavor to obtain greater industrial experience than they have at present.

8.554 The Department of Scientific and Technological Investigations (DICTUC) of the Catholic University should detail at least one officer of its Strength of Materials Section to specialize in mechanical timber testing.

In close collaboration with IDTEM and the Institute, this officer should complement the mechanical testing programme, especially with regard to joints and connections.

8.555 The University of Concepción should augment the staff of its Forest Products Laboratory to include a professor-in-charge, three engineers and at least three permanent technicians. The professional staff should be given an opportunity to devote 40 to 50% of their time to research on wood chemistry (incl. pulp and paper), preservation and collapse. The laboratory should also be responsible for extension work to chemical industry in the Concepción region. It would be desirable to install a well-equipped and competently staffed adhesives laboratory.

The officers-in-charge of the UNESCO/FF Project for the Faculty of Engineering of Concepción University should be requested to allocate some of the resources of that project to the realization of the above objectives.

8.556 The Wood Technology Institute of the Forestry Faculty, (Instituto de Utilización de Bosques y Tecnología de la Madera), Austral University is at present passing through serious difficulties due to the departure of Professor W. Mittak who accepted a FAO mission in Guatemala.
The Institute has made a good start and has a well-equipped laboratory and enthusiastic, though inexperienced personnel. Other laboratories, as well as FAO, should give all possible assistance during the next two years to enable the Institute to be maintained.

8.557 The Technical University Federico Santa María should accelerate the installation of the laboratory for the course of Timber and Forests Engineering. This laboratory has been well planned by the professor-in-charge to be oriented towards practical engineering aspects. Special attention should be given to research on sawmilling, to production of veneer, plywood, and composite panels, and to applied aspects of adhesives.

At least two assistant professors should be appointed.

8.558 Other universities or faculties, industrial schools, and agricultural colleges, etc., should be given assistance and support whenever their work includes research or thesis work on wood technology, but should not be encouraged to install their own laboratory facilities except where the necessary apparatus is not available elsewhere in Chile.

8.559 The Division, in cooperation with the Institute's Training Section, should assist with teaching programmes in universities and technical schools as much as possible.

In general, considerably more emphasis than at present should be given to training at an intermediate technical level (specialized workers, tradesmen, foremen, production managers).

8.56 The Integration of Research:

8.561 Personnel and resources of all Chilean forest products laboratories should be pooled by voluntary cooperation, to make maximum use of facilities.

8.562 The Instituto Forestal should convene, as a matter of urgency, an Advisory Committee on Forest Products Research. This Committee should be composed of the heads of the various Chilean forest products laboratories. The Director of the Instituto Forestal, or a person designated by him, should preside, and the Officer-in-charge of the Division of Forest Products Research should act as permanent Secretary.

The Committee's terms of reference should be:

(i) the coordination of all forest products research in Chile
(ii) the discussion and active exploration of ways and means for increasing available funds.

The Advisory Committee of the Council of Rectors, and the Chilean Timber Association (CONAF) should be requested to designate representatives on the Committee.
8.563 If the Instituto Forestal is unable to convene the Committee proposed in 8.562 within a reasonable lapse of time, the universities should jointly take the initiative of forming it, and should then invite the Institute to participate.

8.564 It is respectfully suggested to Government and to senior academic authorities that scientific and industrial research in Chile would benefit from the formation of sub-committees to the Advisory Committee of the Council of Rectors.

Each sub-committee should take care of the coordination of research in a particular branch of science or technology, and possibly initiate the realization of some research.

Eventually, these sub-committees might be combined in a Council for Scientific and Industrial Research. The example of many developing countries shows that such a Council is one of the best ways of promoting industrial development.

Funds for these bodies should be provided by the State, and should be additional to funds at present available to the universities.

8.57 The Library:

8.571 The Library is working satisfactorily, but its facilities are inadequate.

8.572 As a matter of urgency, the Library should be provided with adequate quarters. It appears unlikely that the Institute can occupy its permanent building before 1967.

The library cannot possibly continue to function in its present quarters until that time.

8.573 Also as a matter of urgency, the Library requires a full-time secretary to allow its qualified staff to concentrate on professional work. They are at present obliged to waste considerable time on necessary clerical and secretarial duties, to the detriment of the technical operation of the Library.

8.58 The contribution by FAO:

8.581 No further contribution should be made by FAO, after the end of the Project, until the Institute is legally created.

8.582 Any further contribution should be made in the form of assistance to an existing Chilean institution, not in the form of a Project comparable to the present one.
8.583 Studentships should be provided for intermediate and advanced training of Chilean forest products research workers.

These terms are understood as follows:

Intermediate training: work for about one year in a recognized overseas forest products laboratory. This is applicable to relatively new graduates in "Ingeniería", of one or two years' standing. In deserving cases, "Técnicos" should also be considered.

Advanced training: work for one or two years in a university, such as Yale, Syracuse, München, etc., during which period the officer should obtain a higher degree. This is applicable to "Ingenieros" of several years' professional standing, and with proven research ability.

The reasons for this recommendation are those stated by Hunt (1961).

FAO should make available funds for one intermediate and one advanced studentship per annum over the next 5 years, to be awarded in open competition to any qualified Chilean national. A categorical obligation to return to Chile for at least 3 years on completion of training should be a condition of award. After 5 years, the programme should be revised.

8.584 A fund of US$ 10,000 per annum for the next five years, should be provided for the purchase of genuinely required items of research equipment, subject to the controls suggested in Section 8.3.

The fund should be cumulative, and there should be no requirement to spend US$ 10,000 in any one year. However, moneys in excess of the funds accumulated at any one moment should only be advanced in very special cases.

The fund should be available for the Division of Forest Products Research, and authority should be given to loan some of the equipment purchased to the universities, if necessary.

After five years, the position should be reviewed.

8.585 FAO should consider assisting the Library with purchase of technical books and payment of subscriptions to technical journals, whenever necessary.

8.586 Requests by the Executive Director for extended visits by forest products research workers should be considered sympathetically.
The appointment and mission of such workers should be governed by the following main considerations:

(i) Recruitment should be by means of a world-wide advertising campaign, similar to the procedure used by CERBO (Australia) in appointing its research staff.

Recruitment by recommendation, in the opinion of the writer, is highly unsatisfactory.

(ii) The successful candidate must be of high scientific standing and show evidence of substantial personal, published contributions to wood science. Some teaching experience is desirable.

(iii) A working knowledge of the Spanish language is essential, including speaking, reading and writing.

(iv) The specialist should be prepared to join the Institute's research group as a senior member. He should not consider himself as an outside "expert" or "adviser" who is imparting his superior knowledge to the untrained staff of a foreign institution in an underdeveloped country, but as a research worker who joins a team to carry out some interesting piece of work in company with less experienced colleagues.

In the opinion of this writer, these subtle differences in attitude often determine success or failure.

8.587 The assistance proposed under 8.583 to 8.585 should become operative as from June 1st, 1966, with the restriction noted in 8.581.

Provision of specialists (8.586) should not become operative before July 1st, 1966.

8.59 The position of experts in developing countries:

The writer respectfully suggests to the Organization that general observance of the principles outlined in 8.586 would improve both the technical usefulness and the social acceptance of experts, which in turn would increase the repute of the organization which sponsors them.

Every effort should be made to integrate the expert with the local community. The writer would recommend, in particular, the abolition of the privilege of duty-free imports during an expert's mission, except in special, qualified circumstances. A genuine case can be made out for the duty-free importation of bone fide household goods and of a motor car on arrival, and for administrative facilities and exemptions. However, the continued right to import luxury goods, and the realization of a large personal profit when selling the imported car, do not contribute in generating goodwill towards the individual and the organization on the part of the local population.
When considering the appointment of experts to countries which have already attained a certain level of development, such as Chile, local national scientists and engineers with the necessary qualifications should be included among the possible candidates.
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Reports and/or publications on IMT-2/EST-1, */SEC-1 and */SEC-2 are in preparation.

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