A Working Paper Draft

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EXAMPLE* OF USE OF CHECKING CHART PART I: CHECKING CHART, HISTORICAL PERSPECTIVE AND WORLD POWER PRODUCTION.

* A Reissue of an old seminar Paper: "Preliminary estimate on location of atomic energy piles for generation of electricity and plutonium" May 21, 1947.

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EXAMPLE* OF USE OF CHECKING CHART PART I:

CHECKING CHART, HISTORICAL PERSPECTIVE

AND WORLD POWER PRODUCTION.

Abstract

Part I: First the definition of an "engineer" is reviewed then a method is examined how an engineer might determine the "completeness" of his approach in a particular problem.

"Historical perspective" is introduced to give a background to the consideration of the trends in world power production; Then the electricity production per capita is examined as a base for estimating the potential rate of development and location of primary piles for generation of electricity.

For Part II, see SEP. No. 15-A

The "checking chart" was first drawn up for the Stiles Hall Student YMCA, International Relations (Peace) Discussion Group, April 28, 1946.

It was then used in organizing material for the Elec. Engin. 298 Seminar: History of Electromagnetic Theory; and then was used in the Economics 291 Seminar: International Economic Problems: International Control of Atomic Energy.

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1. Introduction.

The object of this report is to make a preliminary estimate of suitable locations for atomic energy primary piles for the generation of electric energy and plutonium. This analysis is based upon the assumption of a worldwide planned development in cooperation with the proposed Atomic Development Authority of the United Nations.

In this analysis an attempt was made to use an engineering approach consistent with the following statement of the Engineers' Council for Professional Development.

> The engineer may be regarded, therefore, as an interpreter of science in terms of human needs and a manager of men, money, and materials in satisfying these needs.1

This definition is consistent with man's highest ideals, but it is difficult to find a mutual understanding of human needs at the present time where there is so much to be done in the development of adequate understanding between different fields of specialization in modern science and technology, between different social and economic groups, between different nations, and between different social philosophies.

To get around the difficulties due to lack of understanding between various groups, the clarification of the relationship of a specific problem to the general problem may be useful. An elementary checking chart is illustrated in figure 1. Certain

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1. Engineers' Council for Professional Development, Engineering as a career, p. 8, 1942.

basic types of natural phenomena are arranged in horizontal columns intersecting with vertical columns classified by type of activity. The whole problem of international control of atomic energy probably involves work in all compartments of the chart. The regions touched by this particular analysis are filled in on figure 1. The absence of any indication in the biological section implies that biological problems of protection from radiation are not here considered, but the blank space is supposed to act as a reminder that it must be considered in the selection of specific locations within the general areas mentioned in this paper.

Economics, when defined as the science that treats of the production and distribution of wealth, can be considered as one of the sciences which tie together certain aspects of each rectangle on the chart.

The absence of satisfactory consideration of the time rate of change of conditions sometimes results in misunderstanding. To look at the situation in historical perspective, figure 2 is included to indicate the approximate time of occurrence of the more significant events in the history of mankind. Approximate trends are drawn in color to indicate a consistent long-run evolutionary process to which the future course of events must be matched.

TYPES OF PHENOMENA	TYPES OF ACTIVITY			
	BASIC SCIENCE	ENGINEERING SCIENCE	EDUCATION	ACTION
SOCIAL				
PSYCHOLOGICAL				
BIOLOGICAL				
CHEMICAL				
PHYSICAL				
	NATURAL LAWS	TECHNIQUES and RESPONSIBILITY	DISSEMINATION of IDEAS	ORGANIZATION

Darkened regions on chart indicate areas covered by particular analysis.

Certain basic types of natural phenomena are arranged in horizontal rows in order in which each is dependent upon the types of phenomena below it.

The basic types of activities required for the meeting of human needs in an industrial society are arranged in order such that the accomplishment of an objective is dependent upon stages reached in activities to the left.

Figure 1 - Checking Chart to Indicate the Extent to which this Analysis Covers the Possible Phases of the General Problem.

2. World Energy Production.

The trends of world power production as outlined by Dr. Hogbom[1] are shown in figure 3. Power production follows the general increasing trend of the development of man. It is not possible to reduce existing knowledge of the development of man to a precise mathematical formula, but certain aspects of man's development such as energy production can be mathematically analysed. Dr. Hogbom[2] has shown that total world production of most raw materials (minerals) used principally by industrial countries follows an exponentially rising curve, subject to discontinuities at the start of use of a new material or power source and to discontinuities due to wars and depressions.

In figure 4, Dr. Hogbom's curves are extended through World War II. The estimates for 1950 to 1970 were obtained by shifting Dr. Hogbom's 1937 estimates to account for the wartime effect of World War II and by decreasing the rate of increase due to production bottlenecks after the war. The red line in figure 4 is at 1933, the last year for which fairly complete world electric power figures were published.[3]

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1. "Report of the committee for the study of the problem of raw materials, Appendix I: Development of world production of raw materials," League of Nations Official Journal, 1937 II B 7, Off. No. A.27.1937 II B, annex 1682, pp. 1249-1267, Dec. 1937.

2. "Mineral production, a study in trend and geographical displacement," Ingeniors Vetenskaps Akademiens, Handlingar, (The Royal Swedish Institute for Engineering) No. 117, 1932.

3. World Power Conference, Statistical Year-Book of the World Power Conference 1933/1934, London, 1936.

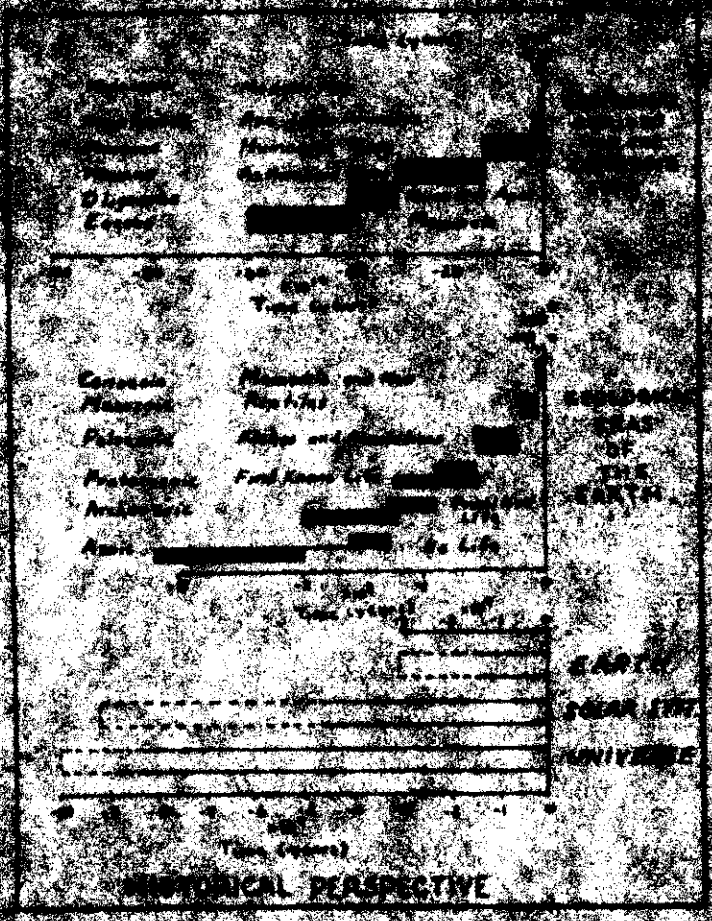


FIGURE 2

TRENDS OF POWER PRODUCTION (IN TERMS OF COAL).

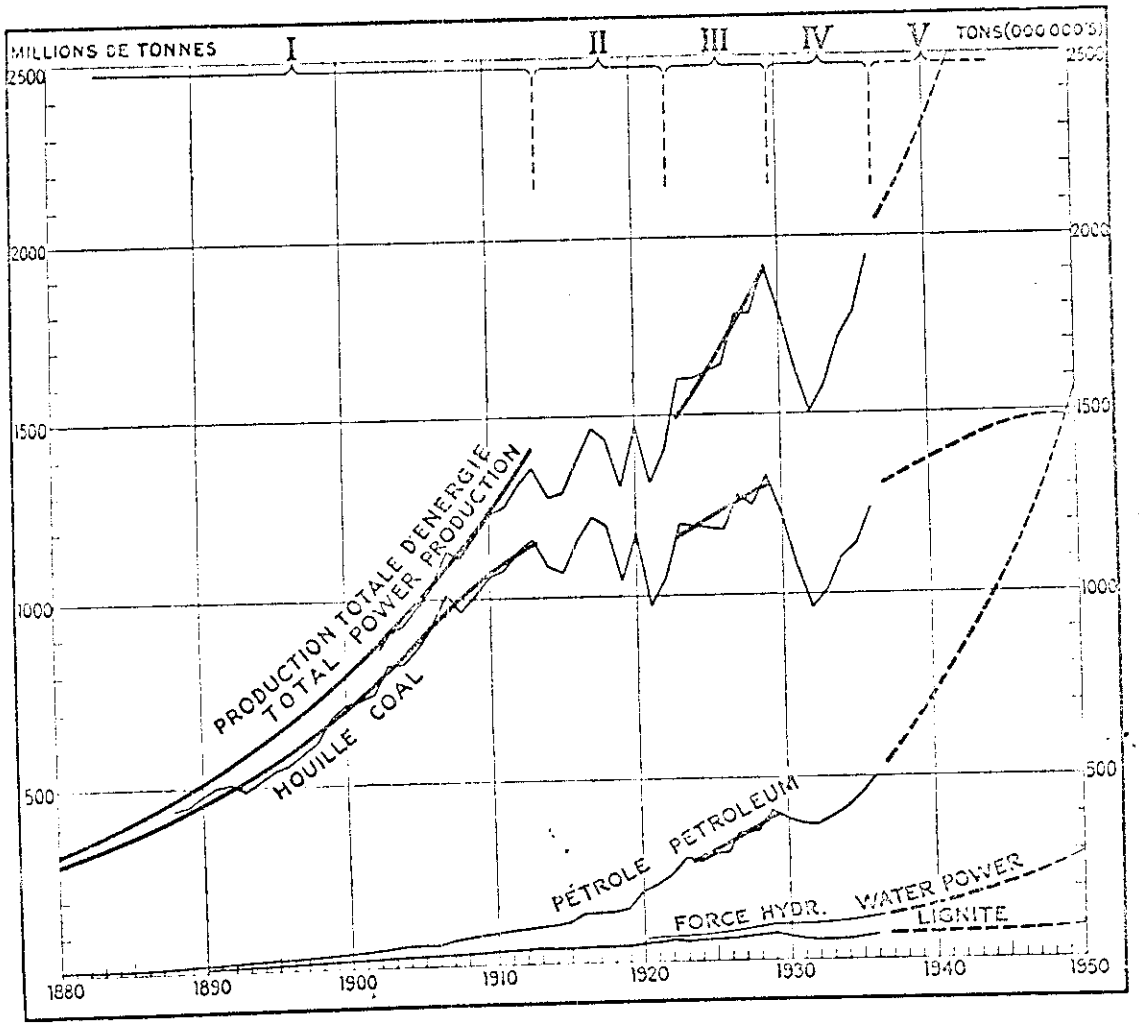


Figure 3

The per capita annual production of electric energy is indicated by countries in figure 5 for 1933. The color in the lower of the circles is the per capita production in the portions of the countries served with electric power. It should be noted that the figures on a consumption basis instead of a production basis would be changed slightly in Europe around the Alps where electrical energy is exported across national boundries.

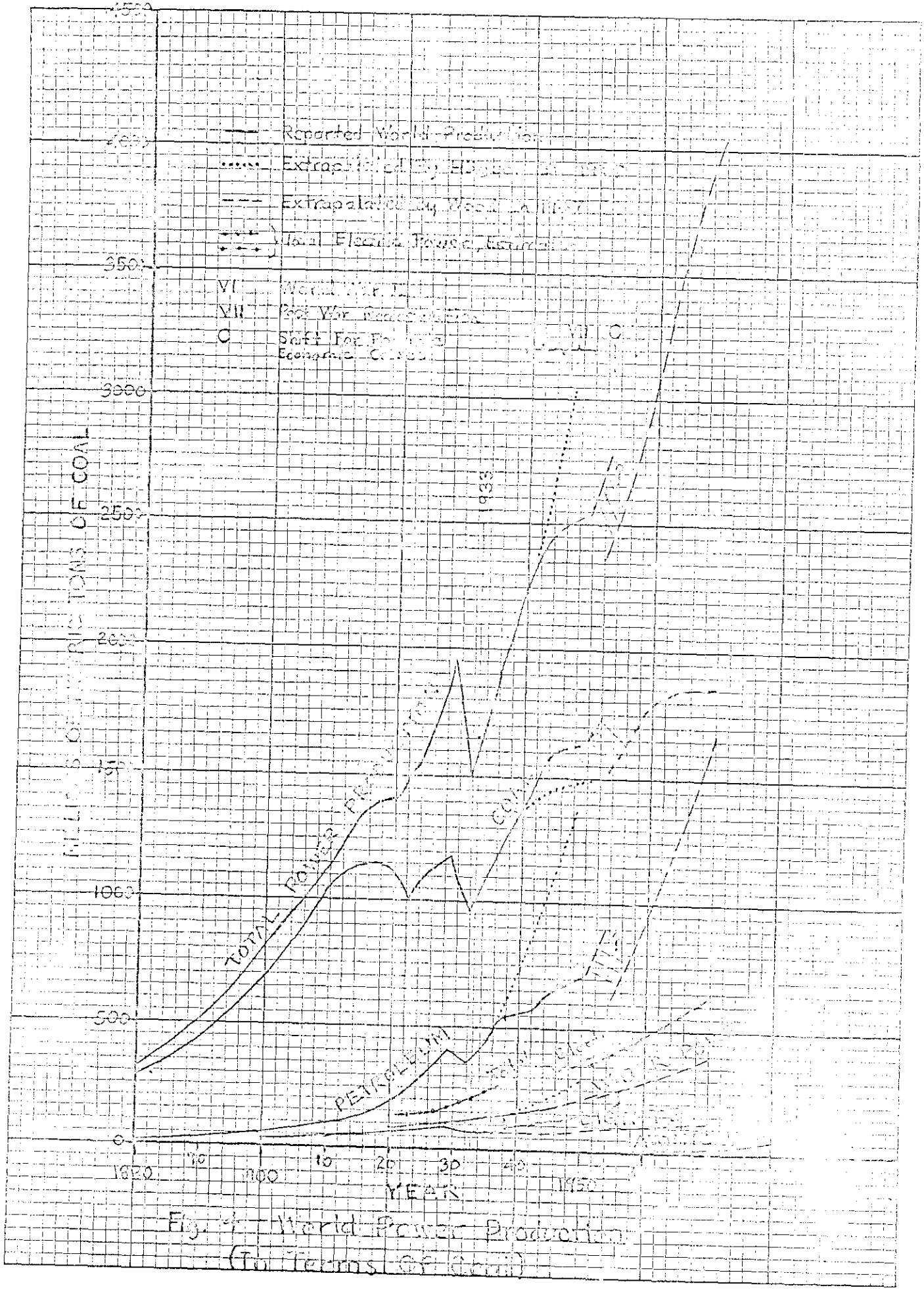
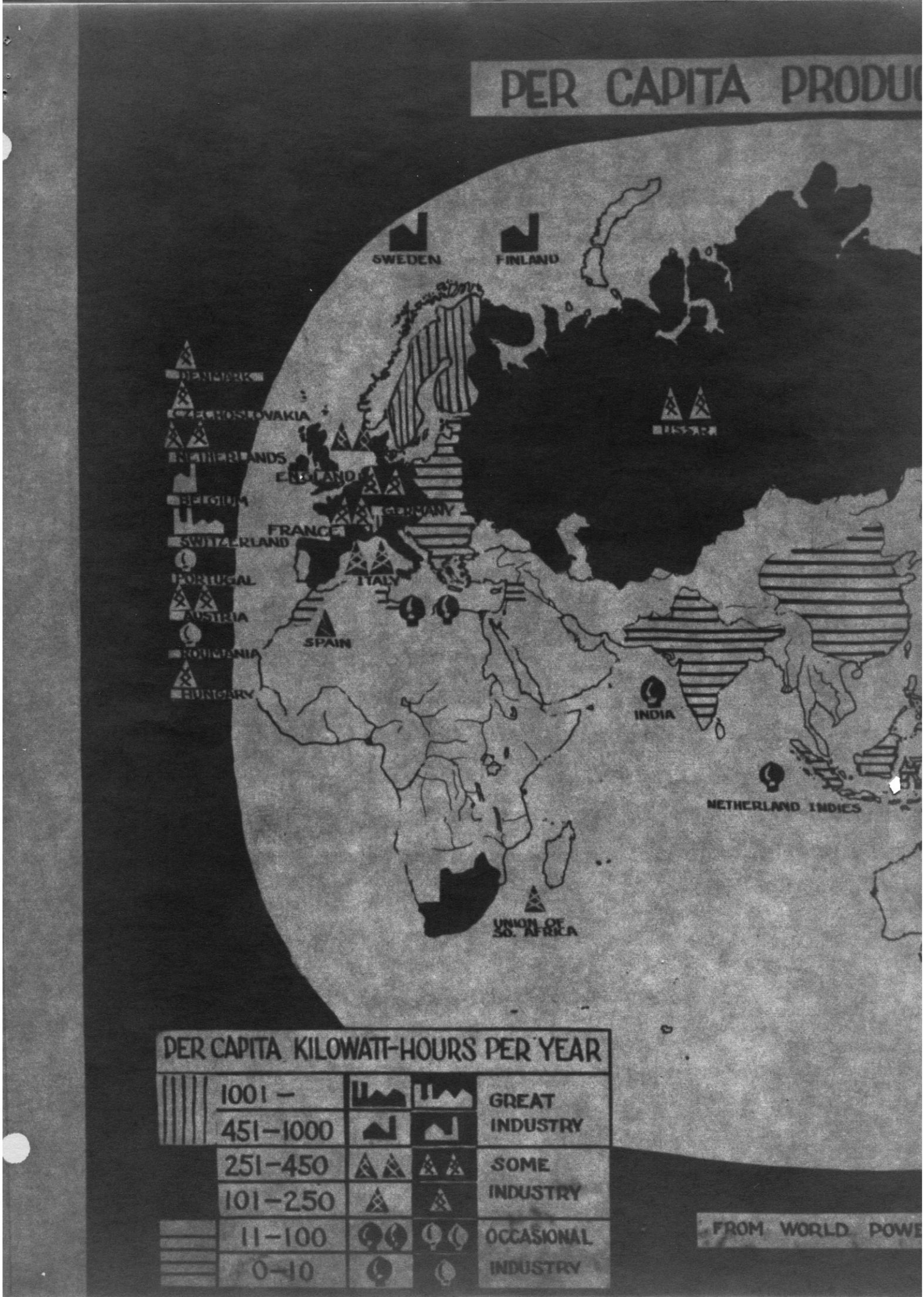
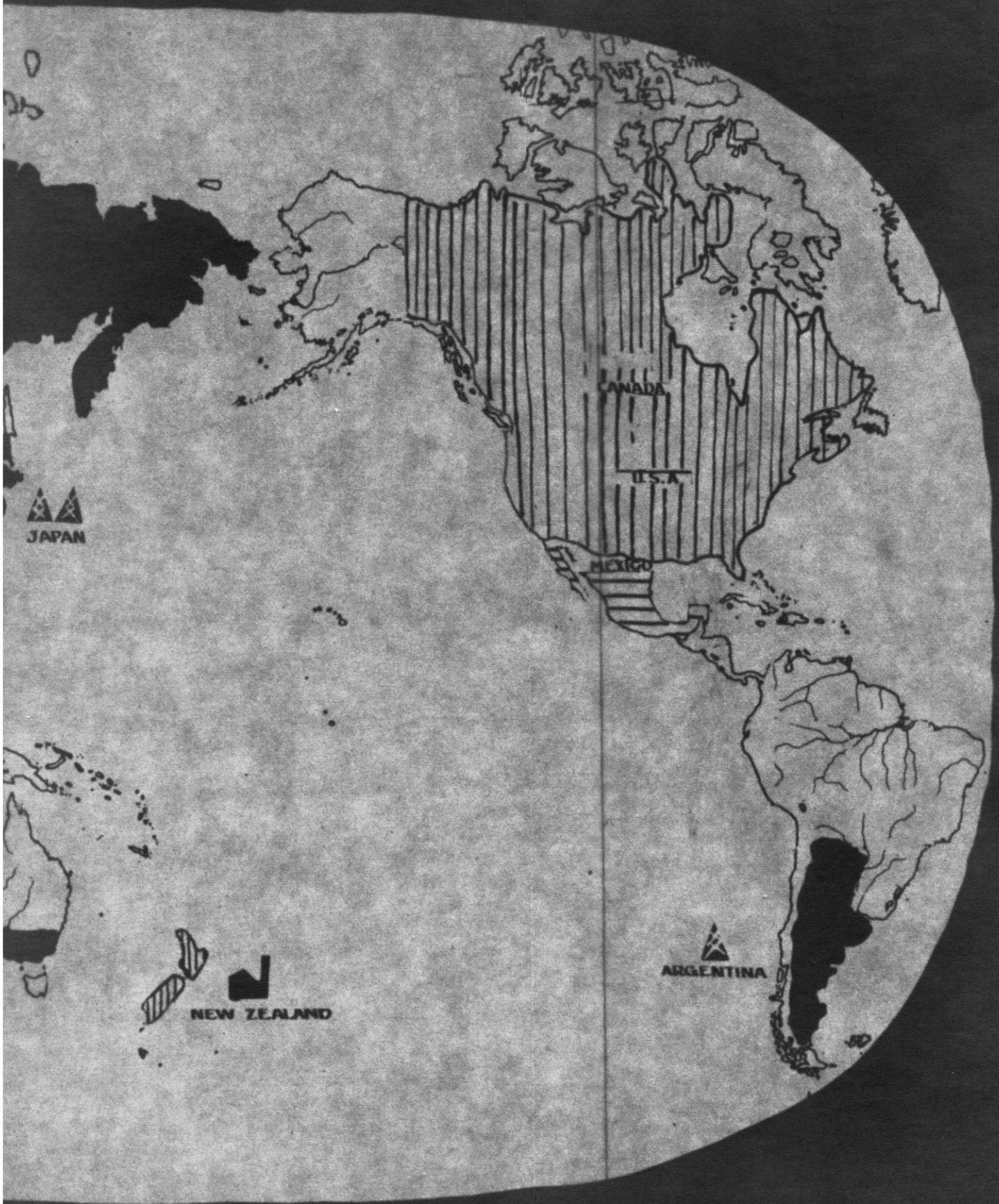


Fig. 4 World Power Production (In Terms Of Coal)


PER CAPITA PRODU
SWEDEN
FINLAND
DENMARK
CZECHOSLOVAKIA
NETHERLANDS
ENGLAND
BELGIUM
GERMANY
FRANCE
SWITZERLAND
PORTUGAL
ITALY
AUSTRIA
SPAIN
RUMANIA
HUNGARY
INDIA
NETHERLAND INDIES
UNION OF SO. AFRICA
PER CAPITA KILOWATT-HOURS PER YEAR
1001 —
451—1000
GREAT INDUSTRY
251—450
SOME INDUSTRY
101—250
11—100
OCCASIONAL INDUSTRY
0—10
FROM WORLD POWE

N OF ELECTRICITY — 1933



FERENCE, "STATISTICAL YEAR BOOK"