TONNAGE AND FREIGHT*

1. INTRODUCTION

On several occasions attention has already been given in "De Nederlandsche Conjunctuur" to the factors which exercize their influence on freight rates. A first article[1] drew attention to the significance which total tonnage seems to have on freight rates, whilst a second article[2] estimated the relationship between demand and supply factors for the post-war years. The "Centraal Bureau voor de Statistiek" is now able to publish the result of similar calculations pertaining to the pre-war period.

2. ELIMINATING TREND MOVEMENT AND INCIDENTAL FLUCTUATIONS

As has been done previously, the trend movement was eliminated for the greater part by subtracting the average percentage increase in all the series (freight rates, supply of tonnage and demand for tonnage). In order to eliminate at the same time the shorter fluctuations of a partly incidental nature,the annual increase was calculated for three successive years, and the average of these annual increases was then taken. This somewhat cumbersome method leads to five-year averages of the increase concerned, whereby greater weight is attached to the middle figure than to the extremes. This is also true, although the coefficients are more complicated, if we use the theoretically more exact methods of elimination of ANDERSON.[3] Since the influence of the weights is not very great, the method indicated was considered to be sufficiently accurate.

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* With the cooperation of Mr. B. G. F. BUYS in: *De Nederlandsche Conjunctuur* (1934) March, page 23–35.

[1] *De Nederlandsche Conjunctuur*, March 1931, page 14 *sq.*

[2] *De Nederlandsche Conjunctuur*, March 1933, page 12 *sq.*

[3] *Die Korrelationsrechnung in der Konjunkturforschung*, Bonn, 1929, page 120 *sq.*

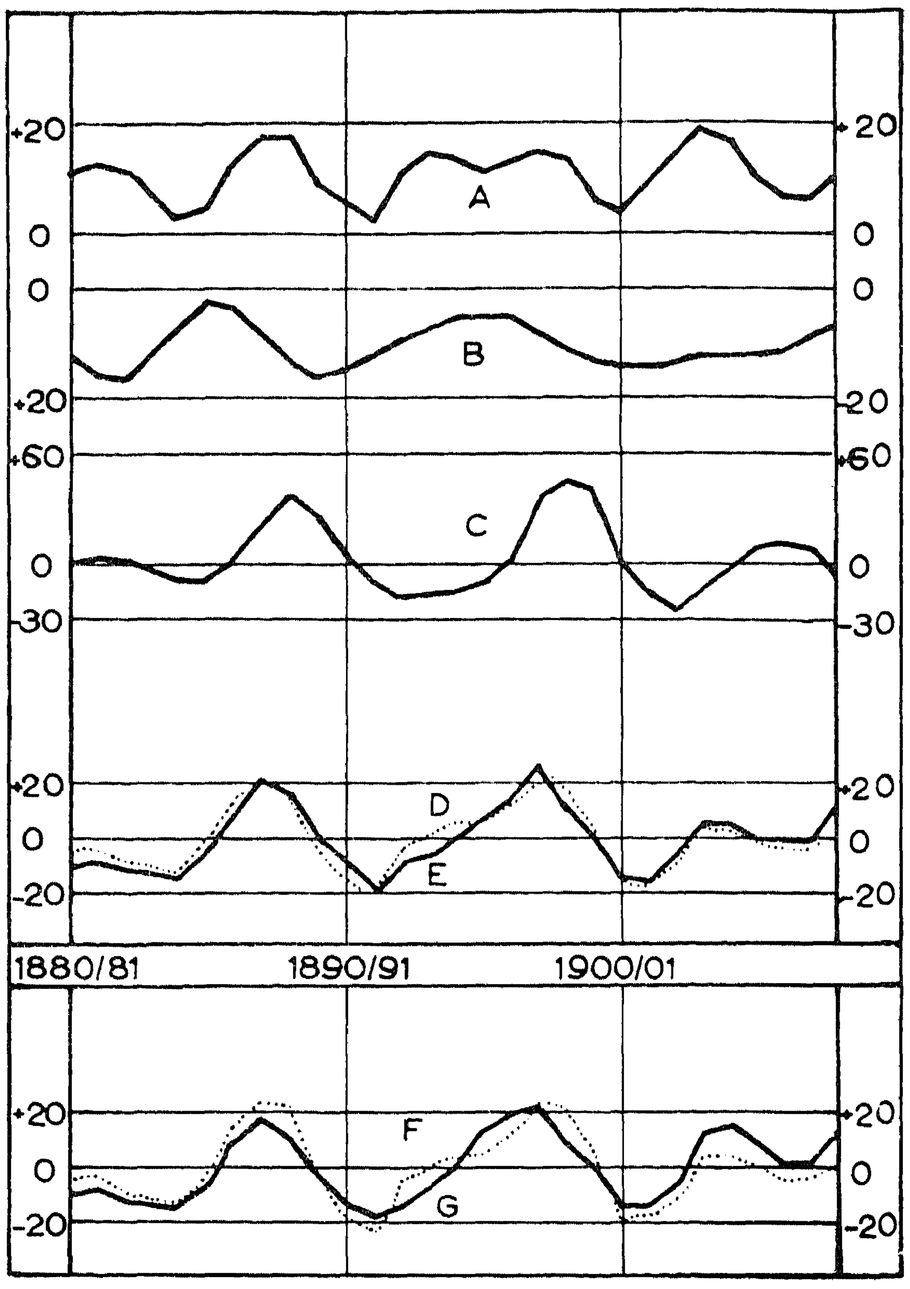

Fig. 1

Percentage increase (5 yearly moving averages) of:
A. demand for tonnage (transport index).
B. total tonnage of the largest countries.
C. coal prices.
D. the calculated
E. the actual } freight index according to Fairplay (homeward freights).
F. the calculated
G. the actual } freight index according to Hobson.

3. FREIGHT RATES

The data used in the correlation calculations are the homeward freights as given in the periodical Fairplay (Year 1916, annex). For comparison, the figures given by HOBSON[4] are reviewed and plotted in Fig. 1. For the period previous to 1885, the figures of Hobson, adapted to the Fairplay figures, were used. For the period 1884–1895 these correspond entirely to the average Fairplay figures.

[4] HOBSON, *The Export of Capital.*

4. DEMAND FOR TONNAGE

As we remarked earlier,[5] when the purpose of our analysis is to explain the course followed by prices (in this case freight rates), we should define "demand" as the result of the independent demand factors which together with the freight rate determine the demand which actually occurred. These are the price differences which exist with regard to the main goods transported between the country of origin and the country of destination. Price differences, in their turn, are governed by relative scarcity and are accordingly influenced by variations in harvest or cyclical fluctuations. In this investigation, the quantities actually transported (taking into account the transport distance), although they are also to a certain extent dependent on the freight rate, have been taken as an index of demand. The theoretical consequence of this method is that the regression coefficient of the freight price with respect to actual demand will not be entirely accurate. However, the relation between this coefficient and the supply coefficient is not altered by this. As it can be assumed, as far as the fluctuations of actual demand are concerned, that the fluctuations in the independent demand factors are of much greater significance than the fluctuations in price, it is to be expected that the error in the above-mentioned regression coefficient will prove small. Accordingly a demand index was calculated on the basis of the quantities actually transported and the distance over which transport took place.

Because no figures are available regarding the total weight of all goods shipped and the distance over which these goods have been transported, a demand index had to be set up on the basis of overseas exports of a number of mass products.

Exports of grain from several countries, exports of coal from Great Britain and the United States, exports of oil from the latter country, exports of nitrate of soda from Chile and imports of timber into Great Britain were selected. The export quantities were multiplied by the average distance over which these goods were transported. These distances could be estimated fairly accurately by taking the North Sea ports as the average ultimate destination. The average transport distance of coal from Great Britain could be calculated on the basis of a

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[5] *De Nederlandsche Conjunctuur*, March 1933, page 25.

statistical survey broken down by country of destination.[6] The average distance for the years 1850, 1860, 1870, 1880, 1890 and 1900 respectively was 2.1, 2.2, 2.2, 2.2, 2.3 and 2.0 thousand nautical miles.

The quantity of product multiplied by distance was expressed in thousands of ton-miles units.

The separate components of the demand index were calculated as follows:

A. GRAIN

a. Exports of grain from the United States of North-America and Canada.

A difficulty occasioned by the fact that the statistical year of American statistics does not coincide with the calendar year. However, since the chief shipments take place in the autumn, the statistical year (July 1st–June 30th) can be compared to the calendar year which precedes it by six months. Although the influence of this shift can be disregarded in the method of the average three-yearly increases, in the case of yearly increases it may have a disturbing influence.

United States' exports of wheat, maize, barley and oats and Canada's exports of all grain were studied. The frontier traffic between Canada and the United States has been taken into account. In studying grain exports from the United States the major ports of export were classified by location into two groups: the Atlantic coast ports (New York, New Orleans) and the Pacific coast ports (San Francisco). This breakdown was significant due to the great difference in transport distance. Such a breakdown, however, could not be applied to Canadian ports. Furthermore, the grain index figures were supplemented with data pertaining to flour transport between the United States and Canada on the one hand, and Great Britain on the other.

b. Grain exports from Argentina did not become sizeable until 1900, which explains the difficulty of obtaining figures for the years previous to 1900. Data regarding wheat exports from 1883 and figures of maize exports from 1901 were included in the index.

c. The extremely important grain exports from Russia are assumed

[6] *Journal of the Royal Stat. Soc.*, 1903, page 508.

to originate from the Black Sea ports, an assumption which can be made without the danger of significant error. Up to 1892 exports of wheat, barley, oats and rye were included, after this year exports of all kinds of grain were included.

d. Exports of all grain from Rumania since 1880 were also included in the index.

e. Australia, like Argentina, became important as a grain producer only in later years. Wheat exports from this continent were included in the index.

f. The statistics for India are based on a statistical year other than the calendar year, just as in the North-American countries. Overseas exports of rice (including paddy) and wheat were included. The rice (incl. paddy) exported to Ceylon was deducted.

B. Coal

a. The important series in this case are the exports from Great Britain. Coal bunkered in British ports was deducted. With regard to the calculation of the average transport distance we refer to the introduction given above.

b. Similarly to grain, when reviewing exports of coal from the United States of North America, land traffic (imports into Canada) was taken into consideration.

Because, in general, coal exports from Germany do not go overseas, they are not included.

C. Oil

a. The only way to convert oil exports from the United States from statistical years to calendar years was to apply the method of two-year averages. Here again exports of oil from the United States to Canada were deducted from the total exports from the United States.

D. Nitrate of Soda

a. Although they are not of decisive influence on price formation, exports of large quantities of nitrate of soda over relatively large distances on tramp steamers could not be left out of consideration.

E. Timber

a. This series was obtained by selecting as starting point the timber

imports into Great-Britain. Although accordingly the series is not at all complete, it still gives an rough idea of the volume of timber transport.

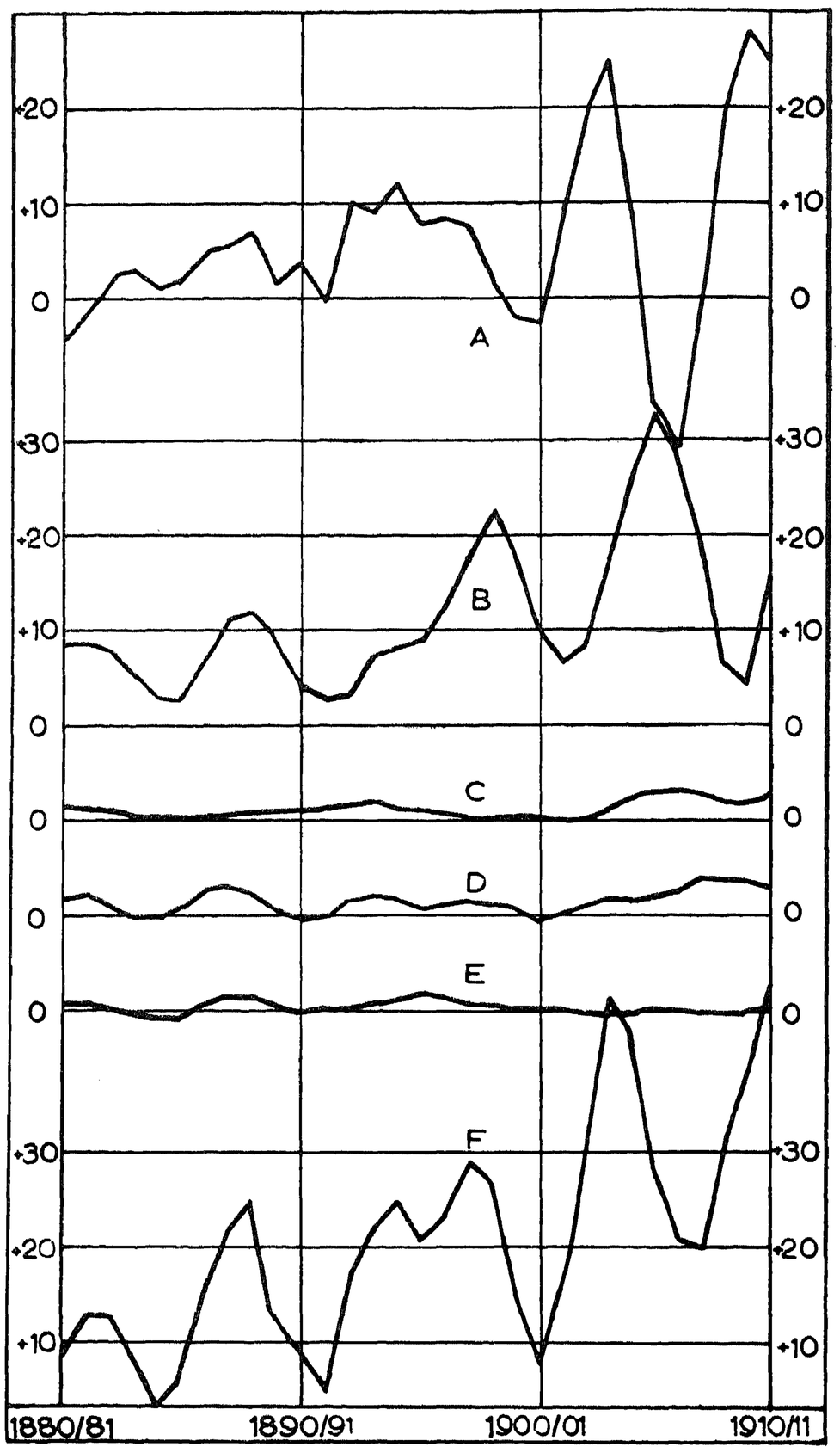

Fig. 2 Absolute increase in thousand million ton-miles of the transport, as far as reviewed, of:

A. grain
B. coal
C. oil
D. nitrate of soda
E. timber
F. all 5 goods jointly

By summing up the separate series, the total demand index was obtained. Graph 2 illustrates this point. Furthermore it clearly demonstrates the relative unimportance of the series C, D and E. The series B and E are clearly subject to trade cycles; this is not certain with regard to series C and D; but they have been considered subject to cyclical influences in the following.

5. THE SUPPLY ASPECT

The supply picture is determined by two kinds of quantities: in the first place, by the total transport capacity and in the second place by the operating costs. For example when the latter become higher, it is possible that some ships cannot be operated profitably any longer, which might lead to laying them up. Even without reaching this stage the (variable) operating costs influence the freight price because they partly determine the level to which competition is capable of pushing down freight rates. Coal prices (export prices from Great Britain), being the most variable part of operating costs, were included as an independent factor in the calculations.

Just as for demand, when statistically determining transport capacity, the data were restricted to a few important countries *i.e.* Great Britain, the United States of North-America, Germany and Norway. The appropriateness of this method was shown by the fact that adding Norway to the three countries firstmentioned made no significant difference in the percentage rate of increase. The simple addition of the tonnages is not possible because there is an important difference between the transport capacity of one ton on a steamship and one ton on a sailing ship. The relation between one "steam ton" and one "sail ton" generally being taken in English statistics to be 3:1, this ratio was used in calculating the supply index. Other calculations take the ratio 4:1 as basis. All tonnages were converted into sail tons and subsequently totaled. Apart from the difficulty thus overcome there have also been other factors on the supply side which have brought about a change in the significance of the figures, such as the tremendous improvement of the power plant which has reduced coal consumption to less than half; the improved speed of the vessels; the rise in their tonnage which has contributed to the great reduction in crew per

Crew per ton tonnage on Sl: Sailing ships. St: Steamships on the British fleet

	Sl	St		Sl	St		Sl	St
1870	0.28	0.43	1885	0.21	0.25	1900	0.16	0.23
1871	0.27	0.43	1886	0.20	0.28	1901	0.16	0.22
1872	0.27	0.41	1887	0.19	0.27	1902	0.16	0.22
1873	0.27	0.39	1888	0.20	0.28	1903	0.16	0.22
1874	0.27	0.38	1889	0.20	0.27	1904	0.15	0.21
1875	0.26	0.37	1890	0.19	0.27	1905	0.15	0.21
1876	0.25	0.36	1891	0.19	0.27	1906	0.15	0.20
1877	0.25	0.34	1892	0.18	0.26	1907	0.15	0.20
1878	0.24	0.31	1893	0.18	0.25	1908	0.14	0.20
1879	0.24	0.30	1894	0.17	0.25	1909	0.15	0.20
1880	0.23	0.30	1895	0.17	0.24	1910	0.15	0.20
1881	0.23	0.28	1896	0.17	0.24	1911	0.15	0.20
1882	0.22	0.27	1897	0.17	0.24	1912	0.15	0.20
1883	0.22	0.26	1898	0.16	0.23	1913	0.14	0.20
1884	0.21	0.26	1899	0.16	0.23	1914	0.15	0.20

vessel ton both on steamships and sailing vessels. The figures shown above illustrate this development:

The cost of ship construction declined steadily from £ 18 per ton in 1872 to £ 13 per ton in 1877. In 1885 it was only £ 9 to 10 per ton.

All the latter factors, however, have not been considered in the calculations because their influence has been so gradual that in studying the year-to-year fluctuations they can be ignored for all practical purposes. In an analysis of longer periods these factors would be of decisive importance.

It should also be mentioned that, in the tonnage figures used, the fishing vessels and the American lake vessels have not been included.

6. DISTURBING INFLUENCES

Besides the already mentioned, more normal, economic factors which have their influence on the level of freight prices, we can mention a number of a more abnormal nature. For example, troup transport during war time makes considerable demands on tonnage and in this way influences freight rates. This is shown very clearly in 1900 as a result of the Boer War. An impression of the size of this type of demand for tonnage is given by a note in a report of the Norddeutsche Lloyd

(50 Jahre Norddeutsche Lloyd) from which we see that in order to ship troups to China to put down the Boxer Rebellion, eighteen vessels were required to transport 20.000 men plus ammunition and armament over a distance of 13.000 miles. In 1898 the Spanish Government also called on tonnage to transport troups and supplies to Cuba.

Furthermore it can be surmised that price formation may also be disturbed by partial monopolies. Little historical material can be supplied in this respect. However, this monopoly formation, as known, is limited to the liner trade whilst in the tramp trade it generally has repeatedly failed.[7]

Strikes, also, were often the cause for smaller or larger disturbances of the freight market (*e.g.* the 1898 strike in the coal mines of South-Wales). Speculations in grain (1898 Wheat corner in the United States) also exercised their influence on the grain prices and on the freight rates.

Although all these influences are levelled off for the greater part by the average five-yearly increases used for the correlation calculation, wherever the yearly differences have been used (graph 6) the particularly high peaks in the years 1898 and 1900 immediately hit the eye.

As a reasonable estimation of the deviations occasioned by all these influences is not feasible, a short explanation with a few notes on the figures in those years where great divergences appear will have to suffice.

7. RESULT OF THE CALCULATIONS

On the basis of the above analysis, an attempt was made, using multiple correlation technique, to estimate as well as possible the fluctuations of the percentage increase in freight rates (based on five-year moving averages). A linear combination of the percentage rise of the following series was made:

a. demand index;
b. total tonnage;
c. coal prices.

The calculations are made for the period 1880–1911; the ten years 1870–1880 show such a rapid structural growth that their inclusion did not seem recommendable. The year 1912 also shows an exceptional

[7] *Cf.* K. GIESE, *Das Seefrachttarifwesen*, Berlin 1919.

boom in freights for which no reasonable explanation seems to be available; the "Fairplay" records suggest that the cause is psychological; although the tonnage is low (as compared to increased demand) it is far from exceptionally so, while insiders do not give any explanation except the one of low tonnage.

The results of these calculations are shown graphically in Figs.

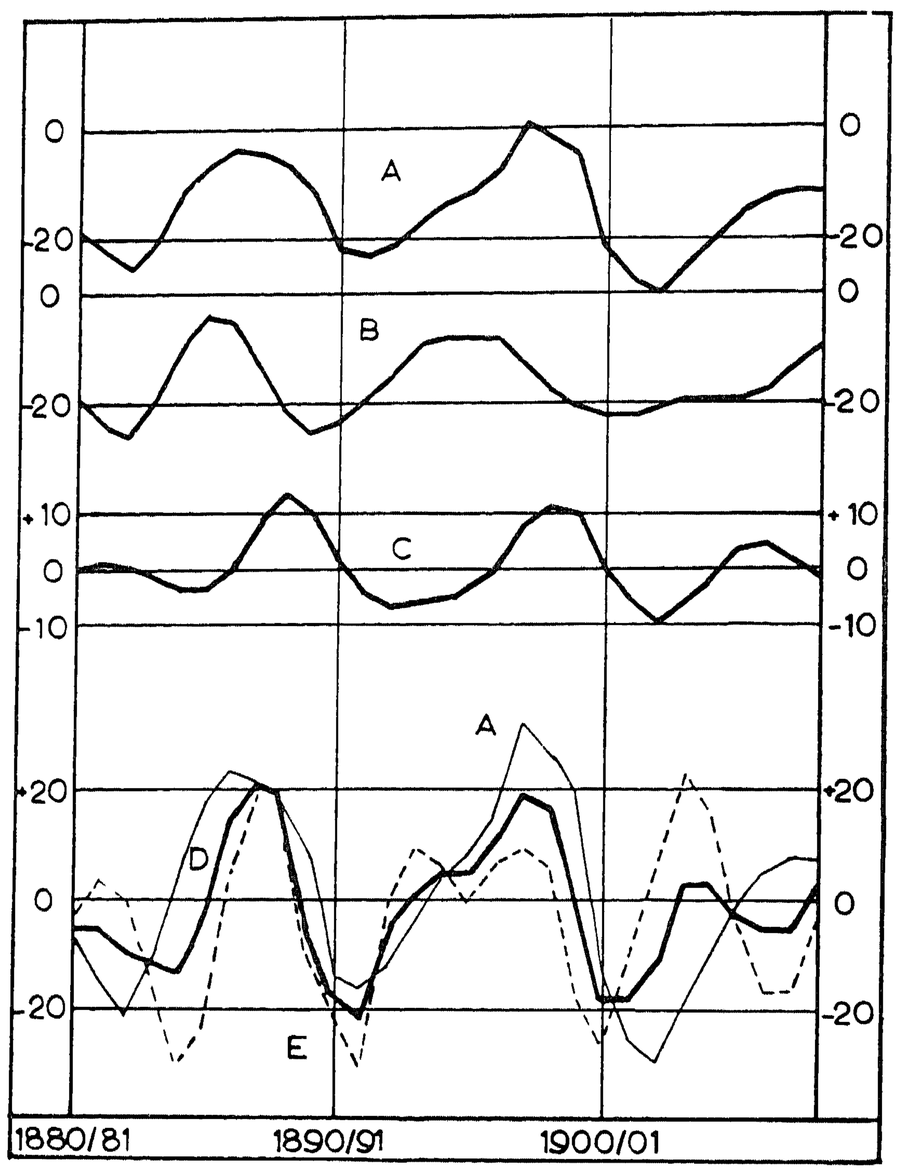

Fig. 3

A. Joint influence on the supply side (tonnage and coal price combined) on the freight change of D.
B. Influence of tonnage.
C. Influence of coal price.
D. Percentage rise (5 year moving average) of the calculated freight index (Fairplay).
E. Influence on D exerted by the demand side.
N.B. The lowest scale applies only to the D line; for A and E the figures of the scale would have to be twice as small.

1 and 3. As can be seen, there is a reasonable correlation with the freight figures of Hobson, and even a good correlation with those of the homeward freights of Fairplay. The formula

$$D = 1.7\,A - 1.6\,B + 0.4\,C$$

demonstrates the relative importance of the three factors: A, the demand index; B, the supply index; and C, the coal price (expressed in 5 year moving averages of the annual percentage increase) on D, the calculated freight rate.

8. COMPARISON WITH THE POST-WAR PERIOD

In the calculations regarding the post-war period, the influence of fuel prices was not yet taken into account. The coefficients found for the influence of the other factors, when the changes in these factors are also measured in percentages, proved to be: for the demand index 0.5 (as compared to 1.7 pre-war) and for the supply index 3.3 (as against 1.6). The significance of these differences will be further elaborated upon in a later article.

9. SIGNIFICANCE WITH REGARD TO TRADE CYCLE RESEARCH

The significance of the results obtained for business cycle research is made clear by determining the relative influence of each of the causes mentioned. For this purpose the breakdown into demand and supply factors is less important than the breakdown (basic to Fig. 4) into:

(*i*) the influence of the harvests and of the tonnage;

(*ii*) the cyclical influences.

The influence of harvests can be called exogenous from a general economic viewpoint. As is generally known, several authors attach considerable importance to harvest fluctuations in explaining cyclical movements. Some (JEVONS Sr. and Jr. and MOORE) even consider the possibility that cycles can be mainly attributed to harvest changes. This opinion is now shared only by a few. Probably the best way of expressing the inter-relation between harvest and trade cycles is to say (as for example is said by FRISCH) that the harvest changes are the *irregular* shocks which continuously disturb the economic mechanism which has its own period, creating thereby not a pure wave but an irregular wave. In this connection it should be noted in passing that the internal mechanism of the cyclical movement can

TABLE II A few figures concerning the supply of ships' tonnage, coal prices, the demand for of the "calculated" freight into: 1. supply and demand I

DESCRIPTION		Units	1870	1871	1872	1873	1874	18
Supply aspect.								
Total tonnage of the fleets of Great Britain, the United States of North-America, Germany and Norway on July 1st		sail-tons × million		**11.92**	**12.51**	**13.18**	**13.85**	**14**
Coal price (Aver. export price: Great-Britain)		sh./ton	**9.6**	**9.8**	**15.8**	**20.9**	**17.2**	**13**
Demand aspect.	Quantities transported × distance from:							
1. Grain	United States of North-America and Canada (incl. flour to Great Britain	ton/miles × milliard	4.2	5.8	5.8	9.6	8.7	10
	Argentina	,,						
	Russia	,,	8.4	9.7	6.8	8.5	11.4	9
	Roumania	,,						
	India	,,	4.1	4.6	6.1	5.6	4.5	5
	Australia	,,						
	Total	,,	16.7	20.1	18.7	23.7	24.6	26
2. Coal	Great Britain	,,	24.6	26.8	27.9	26.6	29.5	30
	United-States of North-America	,,						
	Total	,,	24.6	26.8	27.9	26.6	29.5	30
3. Oil	United States of North-America	,,	1.5	1.7	1.6	2.6	2.6	2
4. Nitrate of soda		,,	1.5	1.3	1.6	2.3	2.1	2
5. Timber	Imports into Great-Britain	,,	5.2	5.4	5.8	6.6	7.5	6
	Total demand subject to trade cycles (2 to 5 incl.)	,,	32.8	35.2	36.9	38.1	41.7	42
	Total all demand . . .	,,	**49.5**	**55.3**	**55.6**	**61.8**	**66.3**	**68.**
Freight rate.								
1. Index figure Hobson		1900=100	**185**	**227**	**222**	**248**	**224**	**196**
2. ,, ,, Fairplay, homeward . . .		,,						
3. ,, ,, ,, , outward		,,						
4. Aver. freight rate grain Montreal, New York to Liverpool		cents/60 liv.	12.8	17.2	15.7	22.0	18.2	16.
Fairplay homeward, Procentual increases; weighted five-yearly progr. aver.; deviations from the aver.								
Fairplay homeward, calculated, same . .								
Influence on the calculated freight rate of:								
1. supply (incl. coal price), same								
demand, same								
2. factors not subject to cyclical factors, same								
factors subject to cyclical factors, same .								

* points to a discontinuity in the series; the figures in brackets have been calculated on

transport of several goods, are broken down by areas, and the freight rates, besides a breakdown
2. part not subject to trade cycles and part subject to trade cycles.

1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891
15.00	**15.38**	**15.94**	**16.26**	**16.59**	**17.25**	**18.16**	**19.39**	**20.39**	**20.80**	**20.59**	**20.55**	**20.91**	**22.15**	**23.47**	**24.78**
10.9	**10.2**	**9.5**	**8.8**	**8.9**	**9.0**	**9.1**	**9.3**	**9.3**	**8.9**	**8.4**	**8.3**	**8.4**	**10.2**	**12.6**	**12.2**
							(12.8)	(15.2)	(14.4)						
10.2	14.6	19.9	24,4	22.9	15.0	15,8	*12.9	15.8	1.50	16.2	11.3	12.9	17.5	10.8	26.3
							0.3	0.6	0.5	0.1	1.3	1.0	0.1	1.8	2.4
10.8	12.8	17.8	16,5	9.5	9.7	14'1	16.5	15.0	15.8	12.1	17.6	24.5	20.5	18.6	16.8
				2.8	3.4	4,0	3.4	2.7	3.8	3.7	4.1	4.5	5.2	5.1	4.7
6.7	6.3	5.6	6,2	9.3	13.6	12,7	13.4	10.5	13.8	13.8	11.5	11,0	11.1	13.6	17.8
				4.4	1.1	1,1	1.1	5.5	3.3	2.2	4.4	4,4	2.2	3.3	1.1
				(41,7)			(47.2)								
27.7	33.7	43.3	47,1	*48,9	42,8	47,7	*47.6	50.1	52.3	48.1	50.2	58,3	56.6	53.2	69.1
34.5	32.8	33.0	34,5	39.4	41.4	43,8	47.7	49.3	49,9	48.6	51.3	56,3	60.5	63.1	64.9
								1.2	0.9	0.3	0.0	1,2	1.8	1.8	2.4
								(49.3)							
34.5	32.8	33.0	34,5	39.4	41.4	43,8	47.7	*50.5	50.8	48.9	51.3	57,5	62.2	64.9	67.3
2.9	4.0	3.8	4,6	3.8	5.7	5,5	5.8	6.0	6.1	6.5	6.6	6,2	7.4	7.6	7.5
2.7	1.8	2.6	1,2	1.8	2.9	4,0	4.7	4.5	3.5	3.6	5.7	6,2	7.7	8.6	6.9
7.5	8.0	6.4	5,6	7.5	6.6	7,5	7.8	7.2	7.4	6.4	6.6	7,6	9.3	8.5	8.0
								(67.0)							
47.6	46.6	45.8	45,9	52.5	56.6	80,8	66.0	*68.2	67.8	65.4	70.2	77,5	86.6	89.6	89.7
				(94.2)			(114)	(117)							
75.3	**80.3**	**89.1**	**93.0**	***101.4**	**100**	**109**	***114**	***118**	**120**	**114**	**120**	**136**	**143**	**142**	**150**
193	**181**	**176**	**158**	**154**	**138**	**135**	**133**	**116**	**104**	**101**	**100**	**111**	**122**	**107**	**100**
								120	**106**	**97**	**95**	**106**	**125**	**103**	**104**
								110	101	105	105	116	118	111	96
16.0	14.1	15,2	12.6	11.8	8.3	7,8	9.9	7.0	6.4	6.7	5.0	5.3	7.8	4.8	6.3
				— 10	— 8	— 11	— 13	— 14	— 5	+ 9	+ 22	+ 18	— 1	— 11	— 10
				— 4	— 4	— 8	— 10	— 12	— 2	+ 14	+ 20	+ 18	— 4	— 16	— 28
				— 4	— 7	— 10	— 6	+ 2	+ 8	+ 10	+ 10	+ 8	0		
				0	+ 3	+ 2	— 5	— 13	— 10	+ 3	+ 12	+ 12	— 3	— 7	— 8
				— 15	— 13	— 10	— 3	+ 4	+ 11	+ 14	+ 7	0	— 12	— 8	— 13
														— 12	— 8
				+ 10	+ 9	+ 1	— 8	— 15	— 13	0	+ 15	+ 20	+ 8	— 4	— 14

basis of the series previously calculated.

TABLE II (continued)

DESCRIPTION		Units	1892	1893	1894	1895	1896	1897
Supply aspect								
Total tonnage of the fleets of Great-Britain, the United States of North-America, Germany and Norway on July 1st		sail-tons × million	**25.79**	**26.49**	**72.12**	**27.59**	**27.97**	**28.27**
Coal price (Aver. export price: Great Britain)		sg./ton	**11.0**	**9.9**	**10.5**	**9.3**	**8.8**	**8.8**
Demand aspect	Quantities transported × distance from:							
1. Grain	United States of North-America and Canada (incl. flour to Great Britain . .	ton/miles × milliard	20.0	20.6	13.1	19.3	31.7	42.6
	Argentina	,,	2.5	5.6	8.4	6.1	3.2	0.0
		,,	(7.9)	(17.8)	(26.7)			
	Russia		*9.8	20.2	32.0	28.7	25.3	24.4
	Roumania	,,	4.5	6.8	4.7	4.6	6.1	4.6
	India	,,	11.6	9.7	11.0	12.0	7.6	7.3
	Australia	,,	1.1	3.3	3.2	1.6	0.0	0.1
			(47.6)					
	Total	,,	*49.5	66.2	72.4	72.3	73.9	79.0
2. Coal	Great Britain	,,	63.8	60.9	70.0	69.8	72.4	77.9
	United States of North-America	,,	2.7	2.4	2.4	2.4	1.8	2.1
	Total	,,	66.5	63.3	72.4	72.1	74.2	80.0
3. Oil	United States of North-America	,,	8.1	8.8	9.8	9.7	10.2	10.9
4. Nitrate of soda	. . . . .	,,	6.5	7.8	8.8	10.8	9.2	0.5
5. Timber	Imports into Great Britain .	,,	9.1	8.3	9.3	8.8	10.2	11.8
	Total demand subject to trade cycles (2 to 5 incl.) .	,,	90.2	88.2	90.3	101.1	103.8	112.2
			(138)					
	Total all demand	,,	***140**	**154**	**173**	**173**	**178**	**191**
Freight rate								
1. Index figure Hobson		1900 = 100	**87**	**84**	**80**	**75**	**79**	**83**
2. ,, ,, Fairplay, outward		,,						
2. ,, ,, Fairplay, homeward		,,	**85**	**86**	**82**	**80**	**76**	**78**
3. ,, ,, ,, , outward		,,	90	82	79	64	85	86
4. Aver. freight rate grain Montreal, New York to Liverpool		cents/60 liv.	5.3	4.8	3.8	5.1	5.8	6.9
Fairplay homeward, Procentual increases; weighted five-yearly progr. aver.; deviations from the aver.			— 9	— 6	+ 1	+ 8	+ 16	+ 27
Fairplay homeward, calculated, same. . .			— 4	+ 4	+ 6	+ 6	+ 12	+ 20
Influence on the calculated freight rate of:								
1. supply (incl. coal price), same.			— 7	— 1	+ 1	+ 3	+ 7	+ 15
demand, same.			+ 2	+ 7	+ 5	+ 2	+ 5	+ 7
2. factors not subject to cyclical factors, same			+ 10	+ 12	+ 16	+ 11	+ 11	+ 5
factors subject to cyclical factors, same . .			— 15	— 6	— 9	— 6	+ 1	+ 17

* points to a discontinuity in the series; the figures in brackets have been calculated on the basis of

1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913
28.90	**30.11**	**31.29**	**32.92**	**34.63**	**36.20**	**37.44**	**38.77**	**40.54**	**42.51**	**43.77**	**44.17**	**44.46**	**45.47**	**46.98**	**48.57**
9.8	**10.5**	**16.5**	**13.7**	**12.2**	**11.6**	**11.0**	**10.5**	**10.8**	**12.6**	**12.6**	**11.2**	**11.6**	**11.3**	**12.6**	**13.8**
34.4	39.0	35.9	23.9 (5.4)	24.0 (3.8)	15.3 (10.1)	12.0	23.4	20.2	19.5	16.5	13.7	13.8	13.2	26.5	23.8
3.0	10.8	10.8	*12.1	11.0	22.7	28.6	30.5	29.6	23.8	32.1	28.7	27.2	14.5	44.8	45.7
22.9	17.3	21.0	23.3	29.0	32.6	32.4	34.9	29.5	23.5	20.2	37.9	42.3	41.1	27.5	32.5
5.9	2.3	3.9	5.5	6.8	6.3	3.9	6.5	8.2	8.0	4.4	5.5	8.1	7.5	7.3	7.4
15.6	10.8	7.6	10.6	15.6	19.4	25.9	16.5	14.4	14.7	7.9	16.0	19.7	21.6	24.2	19.5
0.4	3.3	3.3	6.1 (74.8)	2.7	0.4	10.0	7.4	9.1	8.6	4.5	9.4	14.3	16.5	9.8	12.9
82.2	83.5	82.5	*81,5	89.1	96.7	112.8	119.2	111.0	98.1	85.6	111.2	125.4	114.4	140.1	141.8
78.3	90.6	97.0	92.2	95.0	102.5	106.0	108.7	127.2	145.4	143.4	144.5	141.9	148.1	147.4	168.7
2.4	4.2	9.0	9.9	7.2	5.1	6.9	7.5	8.1	11.7	6.9	6.6	10.2	12.3	12.6	15.0
80.7	94.8	106.0	102.1	102.2	107.6	112.9	116.2	135.3	157.1	150.3	151.1	152.1			
10.8	10.4	10.9	11.6	11.2	10.5	11.3	12.7	13.4	14.4	16.0	16.5	16.6	160.4	160.0	183.7
10.9	11.6	11.7	10.2	11.3	11.5	12.0	13.2	13.8	13.2	15.4	17.1	18.7	17.1	19.0	21.4
10.4	11.2	11.7	10.9	11.4	12.0	11.0	10.6	11.9	11.4	11.2	11.0	11.6	19.6	19.9	21.9
													11.2	11.5	13.2
112.8	128.0	140.3	134.8 (210)	136.1	141.6	147.2	152.7	174.4	196.1	193.9	195.7	199.0	208.3	210.4	240.2
195	**211**	**223**	***216**	**225**	**238**	**260**	**272**	**285**	**294**	**279**	**307**	**324**	**323**	**350**	**382**
93	**88**	**100**	**75**	**71**	**73**	**71**	**76**	**84**	**85**	**73**	**75**	**85**	**95**	**132**	
94	**85**	**100**	**74**	**66**	**71**	**72**	**69**	**68**	**70**	**58**	**64**	**65**	**75**	**105**	**85**
85	79	100	79	58	53	47	55	67	68	65	67	68	77	108	87
6.9	4.8	6.9	2.6	3.0	2.9	2.2	3.5	3.3	3.7	4.0	3.7	3.3	4.1	7.5	7.1
+ 12	+ 1	— 15	— 16	— 6	+ 7	+ 7	+ 1	— 1	— 2	+ 13					
+ 18	+ 2	— 16	— 16	— 10	+ 4	+ 4	— 2	— 4	— 4	+ 4					
+ 13	+ 9	— 7	— 13	— 15	— 10	— 6	— 1	+ 2	+ 3	+ 3					
+ 5	— 7	— 12	— 3	+ 5	+ 13	+ 10	0	— 7	— 7	0					
— 4	— 11	— 13	— 3	+ 6	+ 10	— 1	— 15	— 15	— 3	+ 13					
+ 23	+ 13	— 6	— 14	— 17	— 7	+ 6	+ 14	+ 10	— 1	— 10					

the series previously calculated.

be somewhat changeable (*e.g.* owing to a changed credit structure). Determining the influence of harvests on the economic system, if it is to be done accurately, will have to be carried out by investigating separately the important branches of trade and industry, such as shipping, for example, and combining the results.[8]

The influence of tonnage is, although on a limited scale, an example of a so-called "internal mechanism". It is an endogenous influence both in its general economic implication and with respect to these

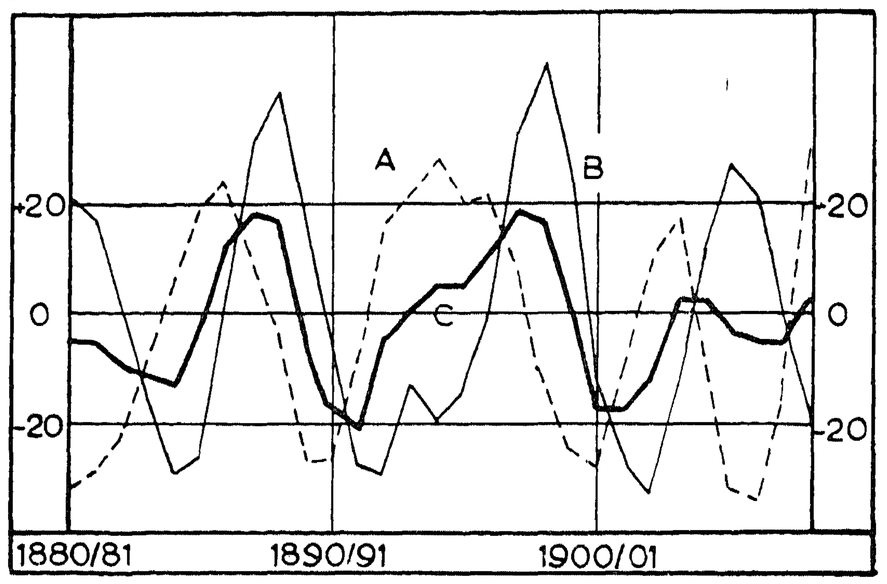

Fig. 4

A. Influence of the factors not subject to cyclical influences (grain transport and size of tonnage) on C.
B. Influence of the factors subject to cyclical influences (coal price and coal transport) on C.
C. Percentage increase (5 year moving averages) of the calculated freight index (Fairplay).

N.B. The scale applies only to the C line.

special branches of trade and industry. The tonnage carried at a certain time reflects the influence of the freight rate itself as it was at a previous time. As explained earlier, a similar relationship can (*cf.* "*A Shipbuilding Cycle,*" this volume, p. 139 *sq.*), lead to endogenous fluctuations. Here we find that fluctuations in freight rates have this character in part, but only in part.

The influence of the factors influenced by trade cycles can be considered as an exogenous influence with regard to shipping itself; with

[8] Another example is given by the determination of the influence of cotton harvests on the cotton industry; see *De Nederlandsche Conjunctuur*, December 1933, page 26.

regard to the entire economic system it is an endogenous influence. The influence of trade cycles is felt in two ways: (i) through changes in coal prices or, (ii) through changes in the quantities of coal transported. Of particular importance is the fact that the variations both in size of harvests and in tonnage are clearly distinct from the trade cycle fluctuations. Accordingly, there is little doubt regarding the relative influence of each. The history of freight rates can accordingly be told in a much more exact way. For example it can be determined that both in the eighties and in the nineties the first influence which led to a recovery of the freight rate sprang from the tonnage; subsequently we have the influence of harvests and finally, when a certain overproduction in tonnage had already become a fact, a boom caused freights to keep their level or even rise. Freights, however, always reached their turning-point before general trade cycles reached theirs. The recovery of freights after 1903 was due particularly to grain shipments; at that time tonnage was very ample

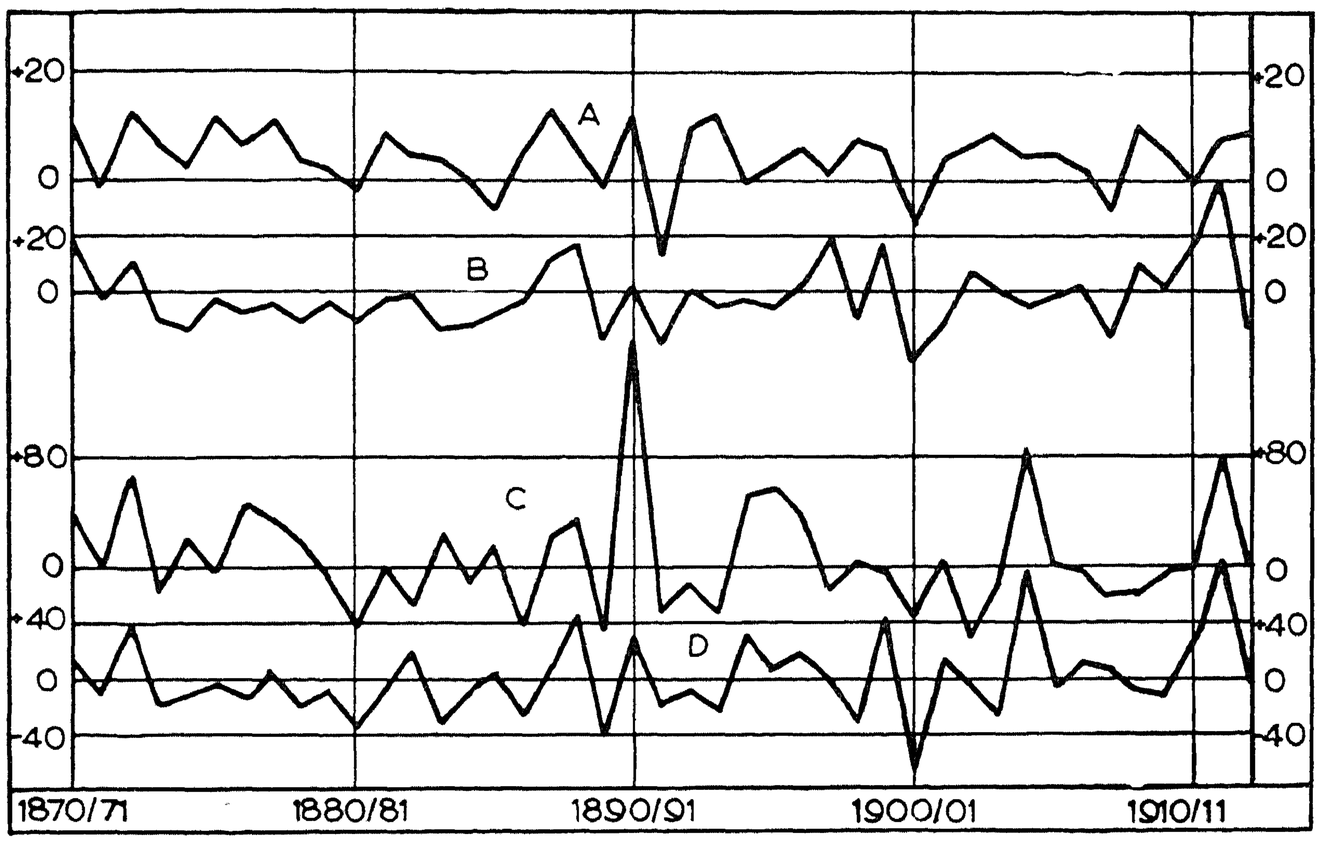

Fig. 5

Percentage increase from year to year of:

A. the general demand index.
B. the general freight index (Fairplay, homeward).
C. grain transport from the United States to Europe.
D. the freight index to the United States.

over a long period. Here again the boom in industry did not come until later. The short recapitulation given here does not imply, as a matter of course, that the mentioned sequence will occur each time; the irregular movement of the harvests creates the chief obstacle in this respect.

10. THE YEARLY FIGURES

Besides the five-year averages already reviewed the annual figures were also studied. Apart from a number of disturbing factors already mentioned and other "incidental" deviations, the harvest fluctuations exert the major influence on these annual figures. The latter is best illustrated when considering Fig. 5, where the annual percentage change in freight rates is compared to the total demand index, to the freights for grain transport from the United States to Europe and to the grain shipments along that route.

11. BREAKDOWN OF THE POST-WAR FIGURES INTO CONTINENTS

Finally Fig. 6 gives the result of a breakdown both of demand and

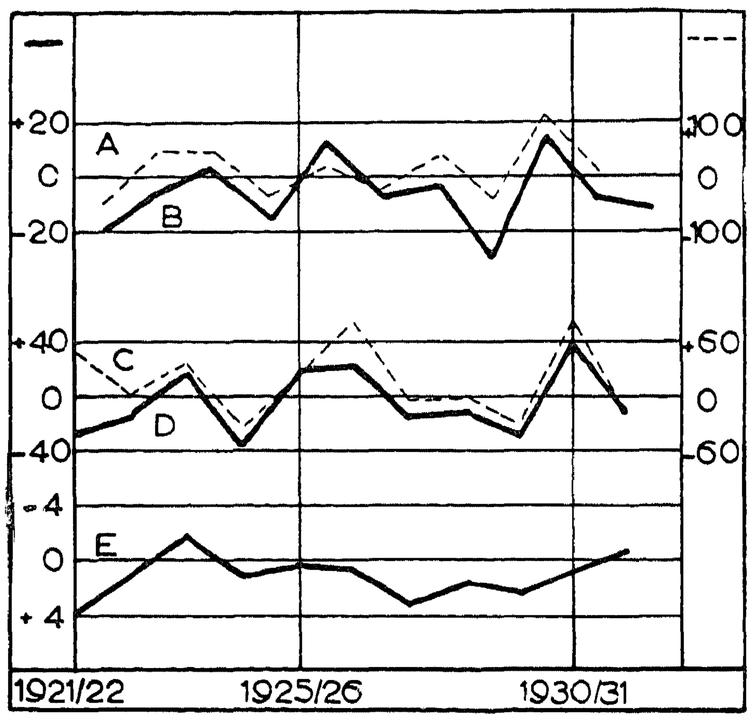

Fig. 6

A. (right-hand scale): Yearly percentage change in the demand for tonnage for Australia (for butter, wool, wheat and flour).
B. (left-hand scale): Yearly percentage change in the freight index to Australia (Statist), the figure for 1926/27 having been corrected in view of the coal strike).
C. (right-hand scale): Yearly percentage change in the demand for tonnage for the Argentine (wheat and maize).
D. (left-hand scale): Yearly percentage change in the freight index to Argentina.
E. Yearly percentage change in total world tonnage.

freight figures by a few continents. We find that good correlation exists between these figures, giving further support to the general correlation discussed in *De Ned. Conjunctuur* of March 1933, page 28.

The freight figures have been corrected in the same way in view of the influence of the coal strike in 1926 as the ones in the March 1933 issue, page 26, pertaining to the general freight index. The figures for Australia are respectively the increases for the harvest year 1922/23 as compared to 1921/22, those of the harvest year 1923/24 as compared to 1922/23, *etc.* The Argentine figures represent the increases from 1921 to 1922, and from 1922 to 1923 (calendar years), *etc.*

TABLE III

VOLUME OF TRANSPORT AND AVERAGE FREIGHT RATES ON CERTAIN ROUTES

DESCRIPTION	Unit	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Argentina													
Grain transport . . .	1.000 million t/km	79	79	107	71	83	150	140	139	83	162	130	
Freight rate:													
Argentina–Great Britain (Statist.)	1920 = 100	27.1	23.1	27.5	17.6	21.0[1]	25.8	22.6	20.2	14.8	19.2	17.1	
Australia													
Exports of Wheat, Maize, Wool and Butter, for years ending June 30th .	million quintal	79.1	35.8	52.6	78.4	52.3	63.4	49.5	70.0	42.5	91.2	98.9	95.9
Freight rate: Australia–Great Britain for years ending June 30th	1920 = 100	38.7	31.0	29.2	29.7	25.3	28.8[2]	27.2	26.3	18.7	21.6	20.1	17.9

[1] Figure, corrected for the influence of the coal strike in Great Britain which made freight rates rise during a few months; uncorrected figure: 23.9.

[2] See note 1; uncorrected figure: 31.2.