

directions, and the giving notices to tenants as to how this Act is to be carried into execution. (3) The scale of costs to be charged in carrying this Act into execution. Any rules made in pursuance of this section shall be laid before Parliament within three weeks after they are made, if Parliament be then sitting, and if Parliament be not then sitting, within three weeks after the beginning of the then next session of Parliament. The Commissioners shall prepare in such form and at such period as the Treasury shall direct, accounts of the monies received by them under this Act, and the expenditure of same, and shall transmit same to be audited, certified, and reported upon, with reference to the provision of this Act, and in conformity with the powers and regulations prescribed in the Exchequer and Audit Department Act, 1866.

"10. There shall be paid to such commissioners, such secretary, officers, agents, clerks, messengers, valutors, and under persons employed under this Act, such sums, subject to such provisions as the Lord Lieutenant shall appoint.

"11. Section 44 of the Landlord and Tenant (Ireland) Act, 1870, shall be amended, by substituting the words four-fifth for the words two-third, wherever such words occur in such section. The Board may lend to any tenant four-fifths of the purchase-money, under such section, to enable him to purchase his holding under this Act, notwithstanding that at the time of such purchase a portion of the holding of such tenant may be sublet. No holding purchased under this Act shall be forfeited under said section to the Board, by means of assignment or alienation of same, other than subletting.

"12. In this Act the following words shall have the following meanings:—'Residential holding' shall mean a holding within the meaning of the Landlord and Tenant (Ireland) Act, 1870, occupied by one tenant who usually resides on same. 'Tenant' shall have same meaning as in Landlord and Tenant (Ireland) Act, 1870.

"13. This Act may be cited as the Proprietors Purchase Act, 1879."

VI.—*The Periodicity of Commercial Crises, and its Physical Explanation.* By Professor W. Stanley Jevons, LL.D., F.R.S., Professor of Political Economy in University College, London.

THE depression of trade, which has now lasted for some four or five years, with gradually increasing intensity, has naturally attracted considerable attention. All kinds of reasons have been offered to explain its origin—wars, foreign competition, luxurious living, the greed of capitalists, the errors of trades unions, and the like. No accidental cause, however, is sufficient to explain so widespread and recurrent a state of trade. The present depression is no new and exceptional phenomenon; it is, as I shall show, only one instance added to a long series of events of the same kind, occurring with remarkable regularity at intervals of about ten years. The cause can only be found in some great and wide-spread meteorological influence recurring at like periods.

This suggestion is by no means a new one; for Sir William Herschel endeavoured, in the first year of this century, to discover a connection between the price of corn and the power of the sun's rays as marked by the decennial variations of the sun's spots. He failed; and so did Carrington subsequently. Three years ago, at the Bristol meeting of the British Association, I read a paper giving the supposed results of a new attempt to prove the relation suspected by Herschel. Subsequent inquiry convinced me that my figures would not support the conclusion I derived from them, and I withdrew the paper from publication. I have since made several attempts to discover a regular periodicity in the price of corn in Europe, but without success.

Nevertheless, I have long felt convinced that a well-marked decennial periodicity can be traced in the activity of trade and the recurrence of commercial crises. If we start backwards from the very distinct collapse of 1866, we observe that there was an almost equally distinct crisis in 1857, nine years before—a crisis, too, which was very severe in the United States. Just ten years before that we reach the memorable panic of 1847. Proceeding backwards, we find there was in England some kind of crisis in 1839, and a previous one in 1836, so that the series appears to be broken; but in the United States there was an intense crisis, and a general stoppage of the banks in 1837, punctually at the ten years' interval. In England some exceptional causes appear to have broken up the crisis into two minor crises, the mean position of which, however, satisfactorily accords with the theory. From 1837 we regress eleven or twelve years to the great bubble year 1825, and the collapse of 1825-'6, the most extraordinary event of its kind since the time of the South Sea Bubble. Receding yet nine or ten years more, we find in the year 1816 the commercial distress and increase of bankruptcy which mark a crisis. Here the series is somewhat interrupted, for there was in 1810, '11, and '12, a commercial panic, which can in no way be brought into accordance with the theory. Nevertheless, in 1805 there was a minor fluctuation* which falls well into the series, and that of 1810-'12 must be set down as exceptional. If we consider the political state of Europe at this time, and the manner in which trade was then disturbed by wars, tariffs, orders in council, etc., it can be no matter of wonder that the regular march of the decennial variation was somewhat broken.

The periodicity of the events which I have briefly enumerated has long been recognised by Dr. Hyde Clarke, Mr. John Mills, and others who have written upon the subject.

It does not seem to have occurred to any writer, however, to inquire whether the decennial period, so well marked in the 19th century, could be traced also in the 18th century. Yet for some

* Though I have seen the year 1805 mentioned as a year of crisis, it is doubtful whether it can be so described. That it was a year of great activity of investment is shown by the fact that the metals were higher in price in 1805-'6 than ever before or after in modern times. Bankruptcies were considerably more numerous in 1805 than in 1804 or '6, but much less than in 1807 to 1810, when the great, and as I hold exceptional collapse took place.

steps at least the periodicity is unquestionable. In 1793, just before the great wars of the Revolution, occurred a commercial panic so severe and genuine that it has been described as the first modern panic. It is true that 1793 precedes 1805 by an interval of twelve years, which is rather too much;* but now comes the remarkable fact that crises of more or less intensity also occurred in the years 1783, 1772-'3, and most distinctly in the year 1763. The mean interval here is almost exactly ten years.

It is impossible that I should in this paper adduce proper evidence of the accuracy of the statements I make. This I hope to do in some more detailed publication. But, as regards these crises, I may refer to Mr. Macleod's unfinished *Dictionary of Political Economy*, where in the article on "Crisis (Commercial)," is to be found a concise account of these events. Thus, on p. 627, we find a brief description of the crisis of 1763: Mr. Macleod then proceeds:—

"Ten years after the preceding crisis of 1763 another of a very severe nature took place—in 1772 and the beginning of 1773. It extended over all the trading nations of Europe."

The article which thus commences is headed "The Crisis of 1783," and Mr. Macleod goes on to explain how the termination of the war with America led to a great extension of foreign commerce, and soon after to a foreign drain of bullion, which greatly embarrassed the Bank of England, and occasioned a panic in October, 1783. Then Mr. Macleod proceeds to an article headed "The Crisis of 1793." Now Mr. Macleod, when he wrote his Dictionary, does not seem to have entertained any theory of periodicity, so that I can appeal with confidence to his unbiassed statement, that there were crises in 1763, 1772-'3, 1783, and 1793.

Reflecting upon the wonderful periodicity of these events, it at length occurred to me to ask why such a series should commence abruptly in 1763. If the sun-spot theory have any real foundation, we should properly expect to find some vestige of decennial variation in previous years. Everyone of course knows that the great South Sea Bubble occurred in 1720, and was accompanied with a commercial panic and subsequent collapse never since equalled. But this seemed to be an unique and isolated event. Inquiry, however, soon led me to doubt this isolation. The extreme intensity of the mania in 1720 has blinded both contemporary and subsequent writers to the existence of periods of "stock-jobbing," as it was commonly called, both before and after. Now the South Sea Bubble is generally attributed to the year 1720, and it is true that the South Sea Company got into serious trouble in that year. But the general European crisis—for European it was—is more correctly assigned to

* It is worthy of notice that in the interval between 1790 and 1820, which presents the greatest difficulty in tracing the periodical recurrence of crises, there is a corresponding irregularity in the sun's spot curve, as delineated in the diagram at the end of Carrington's work on the sun. This curve shows no maximum between 1789 and 1804, an interval of fifteen years, and then again there is a gap of twelve years more up to 1816. On the whole, the commercial crises recur with greater regularity than the flexures of the sun spot curve.

the year 1721 at the earliest. Turning to Mr. Fox Bourne's interesting work on *The Romance of Trade*, we find that it contains an excellent popular account of these early manias and panics, and it is curious to find that both the years 1701 and 1711 are mentioned in connection with "stock-jobbing." I suspect that there was a slight mania about 1700, but I will not at present attempt to adduce evidence about this early period, or about the previous bubbles of the 17th century. There were manias about the years 1682, 1692, and 1695; but so exceeding tedious and difficult have I found the labour of finding the right sort of contemporary information about such events, that I have confined myself as yet to the 18th century. There can be no doubt, however, about the existence of a stock-jobbing mania in the year 1710, or thereabouts. It was in 1710 that the French Ministry adopted Law's scheme, and in 1711 a charter was granted to the English South Sea Company, so that these two greatest of bubbles ran a parallel course of just about ten years. In 1710 and '11 we find Parliament complaining of the prevalence of gambling and bubbling, and in both these years Acts were passed to restrain these evils. (9th Anne, c. vi. s. 56, 57, and 10th Anne, c. xxvi. s. 109.)

But it is hardly requisite to quote further evidence than that which I have been fortunate enough to acquire, through the kindness of Mr. Cornelius Walford. In the course of his minute inquiries into the history of insurance, he compiled a nearly complete list of the numerous small insurance companies formed at the commencement of the 18th century. From this list I learn that the numbers of companies created in each of the following years were as follows:—

1704	...	...	2	1713	...	...	0
1705	...	...	0	1714	...	...	6
1706	...	...	2	1715	...	...	1
1707	...	...	1	1716	...	...	2
1708	...	...	2	1717	...	...	4
1709	...	...	8	1718	...	...	0
1710	...	...	37	1719	...	...	6
1711	...	...	35	1720	...	...	52
1712	...	...	20				

Nothing can be more plain, looking at these figures, than that there was a mania in the years 1710-'12, preceding by ten years the mania of 1720.

It now becomes a matter of great interest to discover whether there are connecting links between 1721 and 1763. One step can be made with confidence; there was unquestionably a period of stock-jobbing about 1731-'3. Thus in the second edition of *Defoe's Tour through the whole Island of Great Britain*, published in 1738, we read (vol. ii. p. 106):—

"This sort of trade is too well known to be insisted on here. It was in short by this that the madness of the year 1720 was carried on. . . . And it was again getting head as fast as it could, and possibly might in

time have utterly ruined the kingdom. . . . But a happy stop was put to this spreading mischief by a wise Act of Parliament against stock-jobbing, which passed in the year 1733."

The *Gentleman's Magazine* also (January, 1732, vol. ii. p. 561) remarks that the state of things "as much requires speedy and effectual remedies now as in 1720."

The state of things was thought to be so serious that Parliament passed an Act (7th Geo. II. c. 8, 1733-'4) to prevent "the infamous practice of stock-jobbing." Yet the evil was one arising rather from prosperity than adversity; for the *Gentleman's Magazine* expressly tells us (vol. ii. p. 1,047) that the woollen trade never was in a better condition, and there was a decided rise in the price of wool in 1731-'2. Some prices of lead and tin, which I have found in the *London Magazine* for the years 1732 to 1736, show a pretty steady decline, indicating that the years 1731-'2 were probably years of active trade. I have other evidence which there is not time to quote.

Assuming the existence of a mania ten or eleven years subsequent to the great South Sea collapse to be proved, it becomes still more important to discover corresponding events about the years 1742 and 1752; but here the real difficulty begins. It is quite clear that there was nothing to call a mania or a crisis at either of these periods. As Holland was at that time the commercial centre of the world, I thought it desirable to make inquiries in that country, and I was fortunate enough to receive assistance from the eminent and learned Dutch economists, Dr. S. Vissering and Dr. W. Vissering. The former wrote in 1856 a small treatise upon the South Sea mania, for a copy of which I am much indebted to him. In answer to my inquiries, Dr. W. Vissering wrote:—

"Of crises in 1731-'2 and 1741-'2 I found no trace whatever; perhaps a now forgotten depression of trade may have happened in those years; . . . but our economic history did not preserve any memory of it."

I feel bound to quote this adverse statement, and I have no doubt that it is correct as far as it goes. But I have already shown that 1731-'2 were years of bubbles and stock-jobbing, and I believe that there was a distinct tendency to brisk trade at the subsequent decennial periods.

The best proof I possess concerning 1743 consists in a remarkable rise in the price of wool; for wool which had been sold at 13s. per tod in 1739, rose to 19s. and 20s. in 1743-'4. This rise was said to be general all over the kingdom; it was attributed not to any deficiency in the growth, but either to the arts of stock-jobbing or more probably to the great demand for woollen goods for exportation. (Smith's *Memoirs of Wool*, vol. ii. pp. 468-472.) In Parliament the prosperity of the trade was attributed to the fact that the East India Company exported woollen goods to the value of £200,000 in 1742, while in the previous years the exports did not exceed £40,000. It is stated, too, that in the memory of man there had never been a larger demand for our woollen manufactures, and that the warehouses in Holland and other markets were emptied of goods which had been in hand several years. (*Gentleman's Magazine*, vol. xiii. p.

658.) I regret that I have been unable to meet with any prices of metals which would throw light upon this period.

Passing on to the next decennial period, we find a still greater rise in the price of wool, occasioned, as it was said, by a brisk trade, and a great consumption and exportation. Notwithstanding the complaints and the arts of the manufacturers to depress the price of wool, it rose, so that "in the years 1750, 1751, the very best and finest Lincolnshire wool was sold upon the spot at 25s. a tod." (*A Short View of the Rise, etc., of the Woollen Manufacture in England*, London, 1753, p. 61.) In another work we are told that English wool sold at Amsterdam in 1751 at 37s., and fell in two years to 21s. and 25s. (*Sheffield on the Trade of Ireland*, p. 167.) Light is thrown upon this period by a table of prices of tin in Cornwall, beginning in 1746, which is to be found in the *Journal of the Statistical Society of London*, vol. ii. p. 262. I quote the earlier part of the table:—

Years.		Price of Tin per cwt. s. d.	Years.		Price of Tin per cwt. s. d.
1746	...	60 0	1756	...	62 3
1747	...	62 0	1757	...	59 0
1748	...	63 4	1758	...	56 6
1749	...	63 9	1759	...	56 0
1750	...	65 0	1760	...	56 0
1751	...	65 0	1761	...	60 0
1752	...	67 0	1762	...	64 6
1753	...	68 0	1763	...	69 0
1754	...	67 9	1764	...	69 0
1755	...	66 3			

It may easily be shown that the prices of the metals form the best index to the general activity of trade and credit, and in the above figures we see a steady rise up to a maximum of 68s. in 1753, followed by a steady fall to 56s. in 1759, when a rapid rise, connected with the collapse of 1763, commences. In a book called *A General View of England, respecting its Policy, Trade, etc. from the Year 1600 to 1762*, translated from the French (London, 1766), I find the following statement (p. 150):—

"England being obliged to pay abroad what balances were against her, species became so scarce in 1753 and in 1754, that at the bankers of London you could scarcely obtain a payment of one hundred pounds sterling, in the lawful gold coin of the country, and as for silver, there was scarcely any left."

Without entering into further details at present, I hold, then, that there is more or less evidence that trade reached a maximum of activity in or about the years 1701, 1711, 1721, 1732, 1742, 1753, 1763, 1772, 1783, 1793, 1805, 1815, 1825, 1837, 1847, 1857, 1866. These years, whether marked by the bursting of a commercial panic or not, are as nearly as I can judge corresponding years, and the intervals vary from only nine to twelve years. There being in all an interval of 165 years broken into sixteen periods, the average length of the period is about 10.3 years. But the earlier dates, 1701 and 1711, are not well established, and the panic of 1866 was prob-

ably precipitated by the fall of Overends, Gurney and Company. Judging by the events of 1837, 1847, and 1857, we should naturally place the proper date of the collapse in 1867. If we compare the unquestionable collapse of 1721 with 1867, the average interval is 10.43 years; if we prefer to compare 1721 with 1857, in which year there was an undoubted collapse, then the mean interval becomes 10.46. As the year 1763 was also a year of well-marked crisis, it is instructive to compare it with 1857, which gives the average interval just 10.444 years, which falls nearly between the previous results and may be accepted as the most probable.

Now it is very curious to bring this result into connection with the following statement of Mr. J. A. Broun, in *Nature*, of the 24th May, 1877 (vol. xvi. p. 63):—

“The mean duration of the period at which I arrive is therefore almost exactly that which Dr. Lamont had previously obtained, or 10.45 years.”

Judging this close coincidence of results according to the theory of probabilities, it becomes highly probable that two periodic phenomena, varying so nearly in the same mean period, are connected as cause and effect. Mr. John Mills, who has so ably treated of *Credit Cycles*, as he has named them, in the Transactions of the Manchester Statistical Society, attributes the periodic variation to mental action. A commercial panic he holds is the destruction of belief and hope in the minds of merchants and bankers. But though I quite agree with him so far, I can see no reason why the human mind in its own spontaneous action should select a period of just 10.44 years to vary in. Surely we must go beyond the mind to its industrial environment. Merchants and bankers are continually influenced in their dealings by accounts of the success of harvests, the comparative abundance or scarcity of goods; and when we know that there is a cause, the variation of the solar activity, which is just of the nature to affect the produce of agriculture, and which does vary in the same period, it becomes almost certain that the two series of phenomena—credit cycles and solar variations—are connected as effect and cause.

It is no doubt a great difficulty in the way of this theory that no one has yet been able to detect a periodic variation in the price of corn in Europe, coincident with the sun-spot variation. But the fact, no doubt, is that the success of the European corn harvest depends upon a conjunction of fortunate events—a frosty winter to prepare the ground, a good ploughing and sowing season, moisture for the growing plant, a favourable blooming time, a warm sun to ripen the grain, and a dry period to harvest it. Failure in any one of several points involves a poor harvest. Under such circumstances, it is quite likely that no obvious connection could be traced. The conditions of our climate are too complicated. But we must not suppose that things are the same all over the world as they are in England, or in western Europe. As Mr. F. Schuster has pointed out (*Nature*, 17th May, 1877, p. 45), the good wine years in Germany correspond closely with the years of minimum sun-spots, and it is quite likely that if we had the requisite information and the patience to investigate the matter thoroughly, similar relations might be discovered as regards other products.

But however this may be as regards Europe, there cannot be much doubt that in India periods of scarcity and plenty show a decennial tendency. The theory of Dr. W. W. Hunter concerning the periodicity of famines in India has been too recently and fully discussed to need recapitulation here; and it is quite likely that what takes place in India may also occur more or less distinctly in China, tropical Africa, and other tropical parts of the earth, which contain by far the largest part of the world's population. The population of those parts, too, lives almost entirely upon vegetable produce, so that any important variation in the solar activity might be expected to affect them profoundly and immediately.

It is well worthy of notice that nearly forty years ago (in 1840), Mr. James Wilson, the well-known founder of the *Economist* newspaper, published a small book, or large pamphlet, on *Fluctuations of Currency, Commerce, and Manufactures, referable to the Corn-laws*. Mr. Wilson speaks of "the frequent recurrence of periods of excitement and depression in the monetarial and commercial interests of the country," as if the idea of periods was familiar to him; and he attributes them (p. 10), "to the huge fluctuations in the amount of its means, which from time to time have been required to pay for the necessary subsistence of life; or, in other words, to the fluctuations of the price of food." The idea may have been a novel one forty years ago; but it is now well known to manufacturers that an active demand for their produce is to be expected only when food is cheap. By far the largest part of the population have but a small margin of income remaining when their necessary expenditure on food has been provided for. Thus arises the singular connection between the prosperity of Lancashire and the price of rice in India, which has been well explained by Mr. J. C. Ollerenshaw in the Transactions of the Manchester Statistical Society (session 1869-'70, p. 109). It might seem that Tenterden Church steeple and the Goodwin Sands are not more remotely connected than the cotton mills of Lancashire, the paddy fields of India, and the spots on the sun; yet the connection is obvious when we carefully trace it out. The depressed trade of Lancashire at the present time is generally attributed to the slackness of the export trade to India which is due to the scarcity of food in many parts of that country — this scarcity absorbing the whole earnings of the poorer classes.

In corroboration of this view I may point to the remarkable curves exhibited in the accompanying diagram,* which represent the variation of the value of merchandise exported to India, in each year from 1708-'9 to 1809-'10, as given in Milburn's treatise on *Oriental Commerce*, vol. i. pp. xlvi., lii., xci. In diagram No. 1 are shown the simple yearly values of merchandise (without bullion) exported. To make the general form of the curve more apparent, I have prepared diagram No. 2, by substituting for each yearly amount the average of three years of which the year in question is the centre, represent-

* The diagrams shown at the meeting of the Section cannot be reproduced here. The reader is referred to the tables in Milburn's *Oriental Commerce*.

ing these averages logarithmically, so as to show the true comparative importance of the variations. On examining this curve attentively it will be seen that there is in most parts of its course a strongly marked decennial variation. Thus, after 1711 or '12, the curve begins to fall rapidly; not to attain a maximum again until 1721 or '22. A second marked depression is followed by a new raise up to 1731. These three maximum correspond satisfactorily with the crises which I have already described. Then the curve becomes somewhat irregular, and we have no decided maximum until we come to 1743 or '44. In 1753 we have a further decided maximum, and the same may perhaps be said of 1763. After this point the correspondence of the curve with the decennial crisis is much less marked, if not doubtful; but we may notice a retrogression after 1783, and an important continuous rise up to 1795. I ought to add that I have examined many tables of exports and imports, and other statistical facts, without finding evidence of decennial variation so strongly marked as in these diagrams; but the subject is altogether too new and complicated to make the absence of variation in certain figures conclusive negative evidence. The distinct and unquestionable tendency to a decennial period shown in these curves, seems to me an important corroborative fact, and outweighs a great deal of failure and discouragement which attends any one investigating a subject of this nature.

I have so far made no allusion to the last decade of years now just terminating. The latest panic mentioned was that of 1866. The kind of collapse which took place in the United States in 1872-'3, and which was followed both there and here by commercial depression, might seem to conflict with the sun-spot theory. But from a circular of Messrs. John Kemp & Co., reprinted in the last number of the *Statistical Journal*, p. 384, it appears that the number of bankruptcies was comparatively small about the year 1871-'3, and has been increasing since—reaching a maximum in the United States in 1876, and in England either in 1877 or possibly in the present year—the number in the first quarter of this year having been very great. Thus, in spite of all peculiar and exceptional influences, the period of disaster is recurring almost as inexorably and regularly as the march of the seasons.

Taken altogether, the historical facts concerning the periodic recurrence of crises appear to me too strong to admit of doubt, and it is only the nature of the explanation of that recurrence which is matter of speculation. So far as can be seen at present, brisk trade is produced by the abundance of certain kinds of produce, yielded by the harvest in certain parts of the earth, especially in India; but much fuller information and more careful investigation will be needed to trace out the details of this explanation and place them beyond doubt.
