

Science and
Social Welfare
in the
Age of Newton

SECOND EDITION

G. N. CLARK

THIS BOOK deals with the economic and social aspects of scientific discovery in the seventeenth century, and was first published in 1937. This second edition has been revised and brought up to date.

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PREFACE

THE first four chapters of this essay give the substance of four lectures delivered in the University of London in Lent Term, 1936. For permission to reprint the third and fourth, which were published as articles, I have to thank the editor of the *Economic Journal* and the Royal Economic Society, the editor of the *Economic History Review* and the Economic History Society. For the like permission for the Appendix I have to thank the editor of the *English Historical Review* and Messrs. Longmans, Green & Co.

I was fortunate in having among my hearers at the London School of Economics several distinguished authorities on the subjects touched in the lectures. They made a number of valuable comments for which I wish to express my gratitude. Finally, I must record my sincere thanks to the University of London for honouring me with its invitation to deliver the lectures.

G. N. C.

OXFORD,
15 May 1937.

In the present reprint some small corrections have been made and some further references added at the ends of the chapters.

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INTRODUCTION

MANY questions have been asked in recent years, and more will be asked in the future, about the place of science in our civilization. The most urgent are those which arise from the application of science to industry and transport: the questions whether we can secure the benefits of improved technology without the economic evils which they sometimes bring; and whether scientists themselves have the power to cure all the social evils which seem to arise from the misuse of science. Although they are urgent, these questions are not new; and history has much to contribute to the answers. This essay is intended to show how these matters stood and what was thought about them, especially in England, in one of the periods in which western civilization was most rapidly moving towards its present state. The period is that from about the time of King Charles II to about the time of Queen Anne.

This may be called the age of Newton, for Newton was the greatest figure in the last and most brilliant phase of the great scientific movement which began long before his time and reached its highest activity in the late seventeenth century. The scientific movement coincided in time with great changes in other spheres: it was in this age that the western countries, England, France, and Holland, took the lead in European industry and commerce, and also in spreading European influence over the world. They were

able to do so partly because they prepared the way for our own age by anticipating something of its character in one special point, namely in the co-operation of science and economic life.

We all know that in our own days this co-operation is one of the driving-shafts of the world. Without it we could have neither the vast industrial production, nor the vast concentrations of economic and political power that make so much of what is best and so much of what is worst in our lives. But science and business are not merely very highly developed, and very closely connected: they are developed and connected by organized social effort. To further them and to draw them together is the work of certain institutions, the whole work of some, part of the work of others. There are research institutions, some of them created by the state, some by industry, some by private wealth. Some are professedly technological, some devoted to 'pure science'. Some are engaged not only in research but also in teaching, and technical education is an integral part of all modern educational systems. Even the elementary and secondary education of boys and girls is moulded by the requirements of a 'machine age'. Thought on many subjects, and not least on social subjects, is influenced by the engineer and the chemist. Applied science has thus influenced the whole structure of society; and we must consider in this earlier period not only the state of knowledge and the practical applications of science, but also the connecting-links supplied by educational

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institutions and by social control. We shall find that science, on the one hand, was not a mere product of social development, while, on the other hand, it could not by itself afford sufficient guidance for the movement of society. Between these two limits we shall look, not for a formula or definition, but for a concrete picture of its work.

APPENDIX

THE OCCASION OF FLEETWOOD'S *CHRONICON PRECIOSUM*

THERE is a little antiquarian puzzle about the reason why William Fleetwood published his book on the history of prices when he did; the question is in itself of no importance, and the solution is easy, but the evidence suggests some considerations of wider interest. The title-page of the book, which first appeared anonymously, gives a good description of the contents. Printed continuously, and without some of the capital letters, it runs thus :

Chronicon Preciosum: or, an account of English gold and silver money; the price of corn and other commodities; and of stipends, salaries, wages, jointures, portions, day labour, etc., in England, for six hundred years—showing from the decrease of the value of money, and from the increase of the value of corn and other commodities that a Fellow, who has an estate in land of inheritance or a perpetual pension of five pounds per annum, may conscientiously keep his Fellowship, and ought not to be compelled to leave the same, though the statutes of his College (founded between the years 1440 and 1460) did then vacate his Fellowship on such condition.

The college has been identified as King's College, Cambridge, of which Fleetwood was himself a fellow: it was founded by King Henry VI in 1441.

King Henry was also co-founder of an Oxford College: but as All Souls was founded in 1437, not between 1440 and 1460, it might seem to have nothing to do with this case of conscience. A doubt, however, arises when we observe that the title just quoted is that of the second

edition (1745),¹ and that the first is quite different, reading simply 'Chronicon Preciosum or an account of English money, the price of corn and other commodities for the last six hundred years. In a letter to a student in the University of Oxford'. This is explained by an entry of 16 November 1706 in the diary of Thomas Hearne:

There is come out . . . a book call'd *Chronicon Pretiosum* . . . the design of which is to keep Mr. Worth in his fellowship of All-Souls, which in justice and according to the letter of the statutes he ought to leave on account of the archdeaconry of Worcester conferred on him which is rated more in the Queen's Books than is consistent with his oath, though to avoid this the author (whoever he be, some say Dr. Fleetwood) has endeavoured to shew (but as far as I can yet perceive very knavishly and weakly) that he ought to keep both because his archdeaconry is not so much as required by the statute, provided the value of money be conferred as 'twas at that time when the statutes were made. . . . The author in the preface shews himself ignorant of our coyns in several respects, and not to know that formerly payments were made in kind not specie.²

But then Fleetwood and Worth were Whigs, which Hearne decidedly was not.

Hearne's story is confirmed by a volume of papers in

¹ There is no evidence to show how the title came to be altered in this posthumous edition; but I conjecture that the book was reprinted not from the first edition (dated 1707) but from the reprint in the folio volume of Fleetwood's *Works* published in 1737. Here the title was abbreviated to *Chronicon Preciosum, or An Account of English Money, Corn, &c.* The remaining words may well have been added in good faith to fill up the new title-page.

² I have corrected the text given in *Remarks and Collections of Thomas Hearne*, i (1885), 307. There is a further reference to the incident on p. 316.

the muniments of All Souls. Before they were bound the papers bore the inscription in Warden Gardiner's hand 'Concerning the Unnecessary Trouble given to myself and the College by Mr. Worth'.¹ There is no need to recount how Worth appealed to the archbishop of Canterbury as visitor, but finally withdrew his appeal and lost his fellowship.² It must be admitted that the papers contain no reference to Fleetwood's book, but the interesting point which emerges from them would be reinforced instead of being weakened if it could yet be proved that the book was not published to help Worth. The point is that this was not an isolated incident, but that the principle involved in it was at that time exercising the minds of a number of people. Among these papers is a letter from the warden to Sir Nathaniel Lloyd, a jurist and a member of the college, which mentions an earlier occurrence of the same kind. In 1702, shortly after pronouncing sentence in a case similar to that of Worth, the bishop of Winchester, as visitor of New College, had at the request of the warden and fellows fixed the income which under their statutes should be incompatible with a fellowship at the new and higher amount of £80.³

Here then were New College and All Souls both thinking about this question, and we may add King's after all, for, although Fleetwood published his book as a *pièce d'occasion*, he must have spent time in collecting the materials for it. The book was published less than a year after the collation of Worth to the archdeaconry: it is therefore very unlikely that it was this incident which

¹ C. Trice Martin, *Catalogue of the Archives of All Souls College*, pp. 340-1.

² See *Dictionary of National Biography*, s.n. 'Worth, William'.

³ No. 189 in the volume of papers.

suggested to Fleetwood that questions of this sort were monetary questions. It is often assumed that this interest in the change in the value of money since the Middle Ages was new at this time. One precursor of Fleetwood has, indeed, been recognized, Rice Vaughan, whose posthumous *Discourse of Coin and Coinage*, published in 1675, attempted a comparison of the value of money in 1352 and about 1630, and tried to prove that it had 'grown principally, and in a manner solely, out of the great quantities of gold and silver come into the Kingdom of Spain out of the *West* and *East Indies*, within this Hundred years or thereabouts'.¹ It does not appear from Vaughan's text why he took up this question. He dealt with almost every aspect of money and had a considerable knowledge of earlier English and French writers. There need not indeed be any specific reason: the contrast between current and earlier prices was striking enough to attract the attention of antiquarian writers who were not profound thinkers on social and economic questions. Thomas Fuller, for instance, in his *Worthies* of 1662 several times noticed that this or that commodity had become much cheaper or much dearer, in much the same way as medieval or Elizabethan chroniclers noted years of special cheapness or dearness. It was, however, a real problem which was raised by the late François Simiand when, after considering the books of Vaughan and Fleetwood, he asked, with his usual acuteness, why it was that, although the price-revolution went through its most decisive phase in the sixteenth century, it was not until so much later, not

¹ In cap. xi, pp. 56 ff., in the reprint in *Select Collection of Scarce and Valuable Tracts on Money*, ed. J. R. McCulloch (1856). The date of composition was c. 1630-5.

in fact until it had ended, that it was studied in terms of exact figures.

Il est véritablement surprenant que ces si nombreux intéressés, surtout ceux qui étaient lésés . . . ne se soient pas préoccupés plus tôt de rechercher dans les faits s'il ne s'était pas produit un changement dans ces équivalences monétaires et souciés de le constater ou faire constater et d'en tirer argument.¹

He suggested that the social changes which resulted from the fall in the value of money, the reversals of fortune for individuals and classes, may themselves have prevented serious investigation. That may well be so, but something may be added to this very general answer.

In the first place it is not altogether true that the question was ignored before the time of Vaughan. There is a continuous series of discussions of it in England from the late sixteenth century. The spectacle of the price-revolution and the loss it caused to those who granted long leases of their lands at fixed rents led to the well-known statute of 1575-6, 18 Elizabeth, c. 6, by which a third part of the rent upon leases made by colleges should be reserved in corn.² This statute had the incidental result of providing historians of prices with some of their best materials in the records of corn prices of Eton, Winches-

¹ *Recherches anciennes et nouvelles sur le mouvement général des prix* (1932), p. 289.

² For the antecedents and working of this act see H. F. Howard, *The Finances of St. John's College, Cambridge* (1935), pp. 33-4. O. van Rees, *Geschiedenis der staathuishoudkunde in Nederland*, i (1865), 340-1, refers to a *plakkaat* of 5 March 1571 for changing money-leases into leases in *vruchten* and to Graswinckel's unfavourable view of it. For the effects of the price-revolution on long leases see Sir Thomas Wilson, 'State of England in 1600' in *Camden Miscellany*, xvi (1936), 39.

ter, Oxford, and Cambridge. It protected the colleges against the full effects of the rise in prices; but in the early seventeenth century, about a generation after it was enacted, a new attack was made on their revenues and those of the parochial clergy. This was the Puritan attack on tithes. Both in the attack and the defence the main arguments were scriptural and legal, but the economic facts did not escape notice. It was recognized that over long periods of time tithes paid in kind provided a more stable remuneration for the clergy than fixed money payments. Sir Henry Spelman, one of the most learned historians among the defenders of tithe, owned the manuscript and was probably the author of a tract on the price-revolution written as early as 1594.¹ In this now incomplete dialogue he gave one to three as the proportion of the change in prices, and mentioned, as one among other causes contributing to it, the influx of silver since 'we have wimbled even into the Bowels of *Plutus's* Treasure (the Indies)'.² In his posthumous work on tithes he referred here and there to the great change in the value of money since the Middle Ages.³ In a shorter piece on the same subject he expressed himself very vaguely about the reasons for this change. After mentioning a number of facts in evidence of it he wrote:

¹ 'Discourse Concerning the Coin of the Kingdom', in *Reliquiae Spelmannianae*, ed. E. Gibson (1698), pp. 203 ff. He deals with monetary standards in the first part of his *Glossary* (1626) under 'Esterlingus' and 'Libra'.

² For the earlier history of this explanation see E. J. Hamilton, *American Treasure and the Price Revolution in Spain* (1934), pp. 292 ff.; *Discourse of the Common Weal of this Realm of England*, ed. Elizabeth Lamond (1893), p. xxxiii.

³ 'Larger Worke of Tithes' in the collection *Tithes Too Hot to be Touched* (1646), pp. 130-1, 153.

'How rates are raised in the present age (whether by scarcity of things, or by the increase of people, or multiplication of coyne, or all) is not unknowne to any, and much too experientally by many whose portion is too penurious for their necessary expenses.'¹ Spelman's collaborator Jeremy Stephens, published these works in the critical year of the tithe controversy, 1646. In his preface he set out the orthodox view of the price-revolution:

If an hundred pounds according to these times, should be allowed for a stipend to a Minister yearly, it maybe as much in value as £300, or £400 in the compasse of an hundred years past; and so likewise of every hundred years since the Conquest, and before it: which hath happened of late times by the discovery of the West-Indies, the trade and commerce thither, and the riches of their mines brought into Europe, all which may fail in the next age, or be otherwise diverted, and stopt, beyond the imagination or providence of any man.²

The book in which this last passage occurs has a direct connexion with Fleetwood's work. It is mentioned in the long extract from the Whig clergyman and historian White Kennet, with which, in order to prove the utility of the historical study of prices, Fleetwood concludes.³ White Kennet recapitulated some of the historical examples which had already been cited in the discussion of tithes, added more of his own, and argued with convincing force 'how fatal' the commuting of tithe for fixed money payments would in time prove to be.

The question of college fellowships was then neither the most important nor the earliest which had directed

¹ *An Answer to a Question of a Gentleman of Quality—Concerning the Settlement or Abolition of Tithes* (1646), p. 6. ² p. 18.

³ The original is White Kennet, *Parochial Antiquities* (1695), pp. 604-6.

attention to the history of prices, and in working at that history Fleetwood was continuing the studies of predecessors whose books he knew. He had, however, further reasons for doing so. There were two other tendencies in the economic thought of the period which led to the study of prices. The first, we know, affected Fleetwood directly: he was interested in currency problems. In 1694 he published a *Sermon on Clipping*,¹ and in the *Chronicon* he expressed a view of his own about how the recoinage in William III's time might have been avoided.² Now, in the controversy about monetary theory which preceded the recoinage, the price-revolution was discussed: Locke was well aware of its significance.³

The second tendency which is relevant here is one which economics then shared with other sciences, the tendency to use quantitative methods. It was the period of the rise of statistics, not only of vital statistics but of commercial statistics and the application of arithmetic to economic problems of all kinds. Fleetwood seems to have been the first writer who effectively impressed on economists the value of collecting the exact facts of prices in the past. After the publication of his book, but not, so far as I am aware, before it, some of the early statisticians worked on price-history. Fleetwood made it one of the regular branches of economic study, and he did so because economic thought had reached a stage where it was needed.

¹ Reprinted in his *Works* (1737), p. 69.

² p. 57 in the first edition.

³ 'Considerations of the Lowering of Interest', in *Works* (1823), v. 46 ff.

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