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**THE CHARACTER AND LOGICAL METHOD
OF POLITICAL ECONOMY**

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THE
CHARACTER
AND
LOGICAL METHOD
OF
POLITICAL ECONOMY

BY

JOHN E. CAIRNES

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THE
CHARACTER AND LOGICAL METHOD
OF
POLITICAL ECONOMY.

By J. E. CAIRNES, LL.D.

EMERITUS PROFESSOR OF POLITICAL ECONOMY IN UNIVERSITY COLLEGE, LONDON,
AUTHOR OF "SOME LEADING PRINCIPLES OF POLITICAL
ECONOMY, NEWLY EXPUNDED"

London:
MACMILLAN AND CO
1888

PREFACE TO SECOND EDITION.

IN offering to the public a new edition of some lectures delivered in Dublin more than seventeen years ago, a few words of explanation are needed. As regards the substance of the opinions advanced—the view taken of Political Economy, and of its methods of proof and development—the present work does not differ from its predecessor; but extensive changes have been made in the form and treatment. Numerous passages have been recast; increased prominence has been given to aspects of the case only touched on in the former volume; and some entirely new topics have been introduced. To one of these—“Definition”—an additional lecture has been devoted. I would fain hope that in its new shape the work will be found somewhat less unworthy than in its earlier form of such favor as it has met with. No one, however, can be more conscious than the author how very far it still falls short of what such a work ought to be.

In connection with logical method, a good deal of discussion has of late taken place on a question that had been but little heard of when the book first ap-

peared—I mean the employment of Mathematics in the development of economic doctrine. The position then taken with reference to this point was that, having regard to the sources from which Political Economy derives its premises, the science does not admit of mathematical treatment. Since that time, my friend Professor Jevons has published an able work (“The Theory of Political Economy”), in which the opposite opinion is maintained; and some few others, both here and on the Continent of Europe, have followed in his track. Having weighed Professor Jevons’s argument to the best of my ability, and so far as this was possible for one unversed in Mathematics, I still adhere to my original view. So far as I can see, economic truths are not discoverable through the instrumentality of Mathematics. If this view be unsound, there is at hand an easy means of refutation—the production of an economic truth, not before known, which has been thus arrived at; but I am not aware that up to the present any such evidence has been furnished of the efficacy of the mathematical method. In taking this ground, I have no desire to deny that it may be possible to employ geometrical diagrams or mathematical formulæ for the purpose of exhibiting economic doctrines *reached by other paths*; and it may be that there are minds for which this mode of presenting the subject has advantages. What I venture to deny is the doctrine

which Professor Jevons and others have advanced—that economic knowledge can be extended by such means; that Mathematics can be applied to the development of economic truth, as it has been applied to the development of mechanical and physical truth; and, unless it can be shown either that mental feelings admit of being expressed in precise quantitative forms, or, on the other hand, that economic phenomena do not depend upon mental feelings, I am unable to see how this conclusion can be avoided. “The laws of Political Economy,” says Mr. Jevons, “must be mathematical for the most part, because they deal with quantities and the relations of quantities.” If I do not mistake, something more than this is needed to sustain Mr. Jevons’s position.

I have retained most of the discussions in the original notes, although some of the questions discussed have lost much of the practical interest they once had; what was formerly speculation having in some instances become realized fact. They will not on this account, however, serve less well the purpose of their first introduction—that of illustrating the principles of economic method.

It falls to me once again to have to express my deep obligations to my friend Professor Nesbitt, who, with his usual kindness in correcting the proofs, has not a little lightened my present labors.

J. E. CAIRNES.

KIDBROOK PARK ROAD, S. E., Feb., 1875.

PREFACE TO FIRST EDITION.

ONE of the conditions attached to the Whately Professorship of Political Economy requires that at least one lecture in the year shall be published by the Professor. In the following pages I have ventured considerably to exceed this requirement, the subject which I selected as most appropriate for my opening course not being such as could be conveniently compressed within a single lecture.

¹ With respect to the views advanced in this work, it may be well, in order to prevent misapprehension, to disclaim at the outset all pretense to the enunciation of any *new* method of conducting economic inquiries. My aim, on the contrary, has been to bring back the discussions of Political Economy to those tests and standards which were formerly considered the ultimate criteria of economic doctrine, but which have been completely lost sight of in many modern publications. With a view to this, I have endeavored to ascertain and clearly to state the character of Political Economy, as this science appears to have been conceived by that succession of writers of which Smith, Malthus, Ricardo, and Mill are

the most distinguished names; and from the character thus ascertained to deduce the logical method appropriate thereto; while I have sought further to fortify the conclusions to which I have been led by the analogy of the method which in the physical sciences has been fruitful of such remarkable results.¹

It may, perhaps, be thought that it would have conduced more to the advantage of economic science if, instead of pausing to investigate the logical principles involved in its doctrines, I had turned those principles to practical account by directing investigation into new regions. To this I can only reply that the contrarieties of opinion at present prevailing among writers on Political Economy are so numerous and so fundamental, that, as it seems to me, no other escape is open to economists, from the confusion and the contradictions in which the science is involved, than by a recurrence to those primary considerations by which the importance of doctrines and the value of evidence are to be determined. To disregard this conflict of opinion, and to proceed to develop principles the foundations of which are constantly impugned, would be to prosecute inquiry to little purpose.

The discussion of economic method with a view to this object has rendered it necessary for me to refer principally to those questions on which opinion is at present divided; and in doing so I have been led fre-

quently to quote from recent writers for the purpose simply of dissenting from their doctrines. This course, which I would gladly have avoided had it been compatible with the end in view, has given to portions of these lectures more of a controversial character than is, perhaps, desirable.

I feel also that some apology is due for the number and the length of the notes. As I have just stated, the nature of the subject required frequent reference to disputed topics. To have met the current objections to the principles which I assumed by stopping on each occasion to discuss them in the text, would have inconveniently broken the sequence of ideas, and hopelessly weakened the force of the general argument. On the other hand, to have wholly passed them by without notice would, perhaps, have been still more unsatisfactory to those who were disposed to adopt such objections. I should thus have been guilty of the imprudence of a commander who invades a country leaving numerous untaken fortresses in his rear. Under these circumstances I have had recourse to the only other alternative—that of transferring such discussions to the notes, or, where the argument is too long for a note, to an appendix.

* * * * *

J. E. CAIRNES.

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APPENDICES.

APPENDICES.

APPENDIX A.

IF, not confining myself to economists of established position and reputation, I were to include every writer on economic questions, there is not a single doctrine within the range of the science that could be said to be undisputed. A late writer (1857), *e. g.*, Mr. Macleod, in a work entitled "The Theory and Practice of Banking," proposes to make a complete *tabula rasa* of Political Economy (which he considers as "almost a branch of mechanics;"—"all sciences," he tells us, being "questions of force and motion"), and to reconstruct it, taking as its basis certain notions of credit and capital, which he claims to be the first to have evolved, and his title to the discovery of which will probably pass unchallenged. This writer thus delivers himself: "We do not hesitate to say that there is not a single writer on Political Economy who has given a correct account of them [the laws of wealth]; and more especially what has been written lately is the result of the most extraordinary misconception of the nature of the thing, the most profound ignorance of the details of business clothed in language so palpably self-contradictory and inaccurate as to excite nothing but surprise" (vol. ii., Introduction, p. lviii). . . . "THE TIME HAS COME WHEN ALL POLITICAL ECONOMY MUST BE REWRITTEN. Every error in thought and language, which confused and retarded all the other inductive sciences, now deforms and obscures monetary science. There is hardly an expression in common use among writers on the subject which is not totally erroneous" (p. lxxx.).

The weapons by which Mr. Macleod proposes to demolish the present edifice of the science would seem to be vituperative epithets. Here are a few examples of his method. Ricardo's theory

of rent he brands as a "prodigious delusion." Mr. Mill's nomenclature implies "the most ludicrous misconception," etc. Of the doctrine that cost of production regulates value, he says that "no more stupendous philosophical blunder ever infected the principles of any science" In the next sentence it is called a "tremendous fallacy," and further on a "pestilent heresy" Mr. Tooke's distinction between currency and capital exhibits "a profound misconception of the whole nature of monetary science—" . . . "one of the most profound delusions that ever existed." A passage quoted from Colonel Torrens is "nothing but a series of blunders and absurdities," his statements are "simply ridiculous," while in another place he confounds together in one sweeping category "Mr. Ricardo, Mr. McCulloch, Mr. John S. Mill, Mr. Samuel Jones Loyd, Colonel Torrens, Mr. Norman, Sir Robert Peel, and Sir Archibald Alison," as the propounders of every species of logical fallacy.

The cause of the failure of Political Economy hitherto, Mr. Macleod tells us, is "that no writer who has yet handled it possessed the indispensable qualifications for success." These qualifications the writer then not obscurely hints have been incarnated for the first time in the person of the author of "The Theory and Practice of Banking." Among the requisites for success, one would imagine a competency to write the English language, and a capacity to understand the views of previous writers before denouncing them, would be included. How far these are included among Mr. Macleod's qualifications the reader may judge from the following examples.

First, to take a specimen of this author's defining power. "Capital," he tells us, "is the circulating power of commodities" (vol. ii., Introduction, p. xlvii). When Mr. Macleod tells us elsewhere that "the object and function of capital is to circulate commodities," he uses language which, however objectionable and repugnant alike to scientific requirement and to popular usage, has at least the merit of being intelligible. Again, when he says that "capital and credit constitute the circulating medium," though the expression implies a fundamental misconception of the nature of the agencies in question, we may yet guess at what he means. But when he says that "capital is the circulating power of com-

modities," if he does not mean to attribute to commodities a faculty of locomotion, he uses language which is capable of conveying no idea whatever; yet this, he tells us, is "the original primary and genuine sense of capital" as distinguished from "the secondary or metaphorical sense." Let us suppose that Mr. Macleod meant by the expression, "circulating power of commodities," what assuredly the language does not convey, viz., the power which circulates commodities, even this will not help him. From his remarks elsewhere it is plain that he meant to designate money and credit. Now money and credit are not the *power* which circulates commodities, any more than air is the power which transmits sounds, or language the power which communicates ideas. The *power* which performs all these things is the human will; money and credit in the one case, air and language in the other, being the media or instruments by which the several ends are accomplished. But, without entering into the metaphysical question, let us ask what would be thought of a writer who should describe air as "the transmitting power of sounds," or language as "the communicating power of ideas?"

Take another example of Mr. Macleod's scientific precision. He thus lays down the criterion of a true principle, "*Every true formula, or general rule, must bear on the face of it all the elements which influence its action*" (p. lxxv.), i. e., which influence the action of the formula! One may guess at the idea which Mr. Macleod intends to express; but the words as they stand are destitute of meaning. Take another case. In p. lxi., etc., Mr. Macleod objects to the law of "cost of production regulating value," because it is inapplicable to "all cases where the same cost of production produces articles of different qualities." Will Mr. Macleod inform us how "cost of production" can "produce articles?" In another passage he writes thus, "Alone of all the political sciences, its phenomena [i. e., the phenomena of monetary science] may be expressed with the unerring certainty of the other laws of nature" (p. xxxv.). If I may venture to conjecture the meaning of this remarkable passage (which has a curiously Hibernian ring about it), possibly what Mr. Macleod *meant* to say was that the phenomena of monetary sciences may be expressed with the same unerring certainty as the phenomena of the other inductive sciences—a

thought, one would imagine, which might be conveyed without severely taxing the resources of the English tongue

These are a few specimens, and by no means unfavorable ones, of Mr. Macleod's ordinary scientific style,¹ they are taken, it will be observed, from that portion of his work in which accuracy of expression would be found, if it were to be found at all—namely, from his definitions and statements of general principles

I have called attention to them, not only because of the importance of accuracy of thought and language in economic discussion, but because this writer, not content with pronouncing a general and sweeping condemnation on all preceding writers on Political Economy, has singled out for special denunciation their defects in regard to precision of language, a quality on which it is evident he peculiarly values himself. Thus his anger passes all bounds against Mr Mill, because that author states at the opening of his treatise that it is no part of his design 'to aim at metaphysical nicety of definition, when the ideas suggested by a

¹ As a specimen of his style when he is less restrained by scientific considerations, take the following "Some Political Economists pretend that the rules of the science are not applicable to extreme cases. An extremely convenient cover for ignorance, truly! Such arguments only prove the incapacity of those who use them. If an architect had miscalculated the strength of the materials of his columns, and his building came tumbling down, and he were to run about, crying out, 'It is an extreme case, the laws of mechanics do not apply to it!' the world would set him down as a fool. If an engineer, whose boiler was to burst from bad workmanship, were to say that it was an extreme case, and that the laws of heat did not apply to it, he would be set down as a fool. In both these cases people would say that the architect and the engineer did not pay sufficient attention to the laws of nature. They would not say that the laws of nature paled before the incompetence of man. Those Political Economists who say that the laws of their science are not applicable to extreme cases are just like such an architect or such an engineer. Such a doctrine is the mere cloak of their own incompetence and ignorance. A false theory may account well enough for a particular case, like an engine may be at rest whose piston is crooked, whose wheels and cranks are all out of order. But the test of a well-finished engine is to work smoothly, it must be set in motion to test it properly. Just so with a theory, it must be worked—it must be set in motion. If it be true, like a well-fitting engine, it will work smoothly, it will explain all phenomena in the science, if it be not true, like a badly fitting engine it will crack, split, break in all directions.

"Mr Macaulay has used a similar line of argument with great skill and effect," etc.

term are already as determinate as practical purposes require." For this Mr. Mill is charged with deliberately adopting "all the loose phraseology of the public"—with seeking to "found a system on the loose babble of common talk." After the few samples given above, probably most readers will prefer the laxity of Mr. Mill to the rigid accuracy of Mr. Macleod. *Malleum, mehercule, errare cum Platone.*

But a word with regard to Mr. Macleod's capacity of understanding the authors whose writings he treats so contemptuously. A large portion of the introduction to his second volume is devoted to an attempt to controvert the received doctrine, which attributes to "cost of production" a governing influence on the value of certain classes of commodities. "Political Economy," he says, "can never advance a step until this arch-heresy be utterly rooted out." Well, what is his contradiction of the "arch-heresy?" Here it is, given in capitals: "VALUE DOES NOT SPRING FROM THE LABOR OF THE PRODUCER, BUT FROM THE DESIRE OF THE CONSUMER. To allege that value springs from the labor of the producer is exactly an analogous error in Political Economy to the doctrine of the fixity of the earth in Astronomy" (p. lxiv.).

Granting that the analogy is perfect (though, for one, I am unable to perceive it), will Mr. Macleod inform us who has said that "value springs from the labor of the producer?" His so-called "refutation" was more particularly addressed to the views of Mr. Ricardo and Mr. Mill. In the second paragraph of Mr. Ricardo's great work, he writes as follows: "Utility, then, is not the measure of exchangeable value, *although it is essential to it.* If a commodity were in no way useful—in other words, if it could in no way contribute to our gratification—it would be destitute of exchangeable value, however scarce it might be, or *whatever quantity of labor might be necessary to procure it.*" The first sentence in Mr. Mill's chapter "On Demand and Supply in their Relation to Value" is as follows: "That a thing may have any value in exchange, two conditions are necessary. *It must be of some use—that is, it must conduce to some purpose, satisfy some desire.* But, secondly, the thing must not only have some utility, there must also be some difficulty in its attainment."

Mr. Macleod's refutation of the doctrine that "cost of production

regulates value" is, therefore, simply a refutation of his own extravagant misconception of it. If any further evidence be necessary to show this, take the following passage, in which an objection is taken to the ordinary limitation which is given to this doctrine—"because for it to indicate price correctly, even in that one instance, it requires this essential qualification, that the supply should be unlimited" (p. 131). Now if the supply were "unlimited," the article could have no exchange value whatever. What the authors who have maintained this doctrine have stated, and what possibly Mr. Macleod intended to say, was that the articles, of which the value is regulated by cost of production, are only those which may be freely produced in any quantity required; but Mr. Macleod can see no distinction between this and an "unlimited supply."

When a writer thus shows an entire inability to comprehend the meaning of authors of such remarkable perspicuity and power of expression as Mr. Ricardo and Mr. Mill (for I will not suppose that he intentionally misrepresents them), his competency for the task he has undertaken of reconstructing the science of Political Economy, may be imagined. It is, of course, unnecessary to notice his "arguments" in refutation of the doctrine in question. It will be time enough to do so when he shows that he understands the principle he assails.

APPENDIX B.

THE limits of economic investigation contended for in the text, though, as has been seen, not in keeping with the theories of some distinguished economists, have, in the actual development of the science, been all but universally observed. As a rule, every economist, so soon as an economic fact has been traced to a mental principle, considers the question solved, so far as the science of wealth is concerned; just as he considers it equally solved when he has traced such a fact to a physical principle. Though Adam Smith has not formally discussed the question, his view may be inferred from the following passage. "The division of labor from which so many advantages are derived is not originally the effect of any human wisdom which foresees and intends that general opulence to which it gives occasion. It is the necessary though very slow and gradual consequence of a certain propensity in human nature which has in view no such extensive utility—the propensity to truck, barter, and exchange one thing for another. Whether this propensity be one of those original principles in human nature, of which no further account can be given, or whether, as seems more probable, it be the necessary consequence of the faculties of reason and speech, it belongs not to the present subject to inquire" ("Wealth of Nations," book i. chap. ii.). In other words, he distinctly declines to "explain the laws of mind" under which division of labor takes place; regarding them as facts not to be explained, but to be taken notice of and reasoned upon, in precisely the same way as in a subsequent chapter he notices the physical qualities of the precious metals—their portability, durability, divisibility, etc.—as physical facts to be taken account of, in order to understand the general adoption of them for the purposes of money. He no more attempts to explain the mental principles which lead to division of labor than he at-

tempts to explain the physical principles which render the precious metals suitable as a medium of exchange. In both cases, in the language of Mr. Senior, "he is satisfied with stating their existence."

The only writer, so far as I know, who has, *in practice*, transcended the limits indicated and observed by Adam Smith, is Mr. Jennings in his "Natural Elements of Political Economy." Not content with assuming mental principles as premises to be reasoned upon, in the same way as physical principles are assumed and reasoned upon, Mr. Jennings regards the explanation of the laws of mind as coming properly within the province of the political economist; and, agreeably with this view, his book is devoted to an analysis of the principles of human nature, psychological and physiological, which are brought into action in the pursuit of wealth. Thus, having resolved the operations of industry into certain movements of muscles and nerve-fibre, he proceeds "to inquire what is the *modus operandi* of the mental influence which actuates these organic instruments," and this *modus operandi* having been analyzed, and the mental elements of the process ascertained, he makes these the basis of the division of industrial actions. These he divides as follows, viz. firstly, those which are "marked simply by the law of former co-existence"—of which he gives the examples of "digging, threshing, rowing, sawing," etc.; secondly, those which are "marked by the application of judgment to the merely memorial trains of thought," *e g*, those of "superintendents, inspectors," etc.; thirdly, those which are "marked by the application of the law of resemblance to those processes of thought," *e g*, those of "painters and sculptors," and, fourthly, those which are "marked by the further application of judgment to resemblance," *e g*, those of "judges, legislators," etc. (pp 115 to 117).

Hitherto the nomenclature of Political Economy has been framed with reference to the phenomena of wealth, or the mode of its production and distribution. Mr. Jennings, taking a different view of the nature of economic science, defines and classifies on wholly different principles. Thus, "consumption" he defines as "that class of human actions in which the instrumentality of the afferent trunks of nerve-fibre is predominant." The sensa-

tions which attend upon consumption, again, he divides "into two classes, according as they are conveyed by the nerves of common sensation, or by the nerves of special sensation" In the former class are comprised "sensations of resistance," of "temperature," . . . "sensations consequent on the gratification of appetite," etc. In the latter, viz., those conveyed by nerves of special sensation, are included the charms of "color, of "form," and of "sound," . . . "the luscious taste which the palate derives from elaborate substances, in which sapid properties are joined with congenial odors, and diffused through substances agreeable to the touch."

If Political Economy is to be treated in this way, it is evident it will soon become a wholly different study from that which the world has hitherto known it. It is undoubtedly true, as Mr. Jennings remarks in his preface, that the subject-matter of Political Economy represents the complex result of mechanical, chemical, physiological, and biological laws, together with the laws of mental and political philosophy; but I can not think that it follows from this that "each of the more complex of these subjects, being governed by all the laws which govern every subject of inferior complexity, in addition to its own peculiar laws, ought not to be examined until the difficulties which surround each of these less complex subjects have been surmounted progressively and seriatim." Were this rule rigorously enforced, and were no one to be allowed to matriculate as a political economist till he had mastered all the less complex sciences, including mechanics, astronomy, chemistry, magnetism, electricity, general physics, physiology, biology, together with mental and political philosophy, the practice would certainly be attended with the advantage of effecting a very extensive reduction in the economic ranks; if, indeed, with the exception of Mr. Jennings himself, any should be found capable of passing the terrible ordeal. But I confess that I am quite unable to see the necessity of making such impossible demands upon the human intellect. Surely, to recur to the example taken from Adam Smith, it is possible to perceive that division of labor and exchange facilitate the production of wealth, without deciding whether the disposition which leads to this course of conduct be an original or derived faculty, or to

understand the advantages which the precious metals offer as a measure of value and medium of exchange, though we may be wholly ignorant whether they are simple or complex substances, or appear at the positive or negative pole of the battery. On to take an example from Mr Jennings's book, I confess I am quite unable to see what new light is thrown upon the causes which determine the laborer's condition, by his telling us that during "production the instrumentality of the efferent trunks of nerve-fibre is predominant," while during "consumption" it is "the afferent trunks of nerve-fibre which prevail." So long as the result is the same, so long as human beings possess the same energies, require the same subsistence, and are influenced by the same motives, the economic laws of wages will be the same, though they had neither "afferent" nor "efferent" trunks of nerve-fibre in their bodies. Even were the encyclopædic knowledge demanded by Mr Jennings easily attainable, it appears to me that nothing but confusion and error could arise from extending economic inquiry beyond the limits which have hitherto been observed. Take, *e g*, the division of industrial operations which I have quoted above from Mr Jennings, founded upon his analysis of the mental principles engaged—what is the *economic* value of this classification? What light does it throw on the phenomena and laws of wealth? Mr Jennings places in the same class of "industrial operators" judges and legislators, because the actions in which they engage are "marked by the application of judgment and resemblance to the merely memorial trains of thought," but, economically considered, if it be desirable to class them at all, judges are far more widely separated from legislators than from "superintendents," or from "diggers, threshers, rowers, or sawyers," who are placed in distinct classes; judges being highly paid officers, while legislators (at least in Great Britain), instead of being paid, are obliged to pay handsomely to be allowed to exercise their functions. If a judge be paid more highly than a digger, it is not because the exercise of the functions of the latter involve only "memorial trains of thought," while the exercise of those of the former involve besides the faculties of judgment and of perceiving analogies—this, economically considered, being an accident; but because the persons who are qualified to perform

the functions of a judge are much fewer than those who are qualified to dig; and the reason the former are more scarce is partly because the requisite natural faculties are more rare, and partly because the expense necessary to their due cultivation is considerable.

Classification will, I presume, be more or less perfect in proportion as it is founded upon those qualities in the objects of it which, with reference to the ends of the science, are essential; but a classification based upon an analysis of the psychological or physiological operations which take place in the production or distribution of wealth will not divide producers or distributors according to their economic importance, but according to circumstances which, economically considered, are purely accidental.

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APPENDIX C.

THE following passage from Dr. Whewell's "History of the Inductive Sciences" contains so elegant an example of the logical process by which the great generalizations in physical science are established, that, with a view to illustrate some occasional references to the line of reasoning pursued in physical investigations which occur in the text, I am induced to extract it:

"When we look at the history of the emission-theory of light, we see exactly what we may consider as the natural course of things in the career of a false theory. Such a theory may, to a certain extent, explain the phenomena which it was at first contrived to meet; but every new class of facts requires a new supposition—an addition to the machinery; and as observation goes on, these incoherent appendages accumulate, till they overwhelm and upset the original frame-work. Such was the history of the hypothesis of solid epicycles; such has been the history of the hypothesis of the material emission of light. In its simple form, it explained reflection and refraction; but the colors of thin plates added to it the hypothesis of fits of easy transmission and reflection; the phenomena of diffraction further invested the particles with complex hypothetical laws of attraction and repulsion, polarization gave them sides, double refraction subjected them to peculiar forces emanating from the axes of crystals; finally dipolarization loaded them with the complex and unconnected contrivance of movable polarization; and even when all this had been assumed, additional mechanism was wanting. There is here no unexpected success, no happy coincidence, no convergence of principles from remote quarters: the philosopher builds the machine, but its parts do not fit; they hold together only while he presses them: this is not the character of truth.

"In the undulatory theory, on the other hand, all tends to uni-

ty and simplicity. We explain reflection and refraction by undulations; when we come to thin plates, the requisite 'fits' are already involved in our fundamental hypothesis, for they are the length of an undulation: the phenomena of diffraction also require such intervals; and the intervals thus required agree exactly with the others in magnitude, so that no new property is needed. Polarization for a moment checks us; but not long; for the direction of our vibrations is hitherto arbitrary—we allow polarization to decide it. Having done this for the sake of polarization, we find that it also answers an entirely different purpose—that of giving the law of double refraction. Truth may give rise to such a coincidence; falsehood can not. But the phenomena became more numerous, more various, more strange; no matter the theory is equal to them all. It makes not a single new physical hypothesis; but out of its original stock of principles it educes the counterpart of all that observation shows. It accounts for, explains, simplifies the most entangled cases; corrects known laws and facts; predicts and discloses unknown ones; becomes the guide of its former teacher, observation; and, enlightened by mechanical conceptions, acquires an insight which pierces through shape and color to force and cause" (vol. ii. pp. 464-6)

Such has been the process by which the great inductions in physical investigation have been established. In economic inquiry (as I have shown in my third lecture) this circuitous method is unnecessary, the ultimate facts and assumptions being susceptible of direct proof.

THE END.