

# Contents

## PART I

### A CLARIFICATION OF MEANING

I. CAUSATION AND DETERMINATION, CAUSALISM AND DETERMINISM	
I.1. Causation, Causal Principle, and Causal Determinism . . . . .	3
I.1.1. The Threefold Meaning of the Word 'Causality'	
I.1.2. Causation: A Purely Epistemological Category of Relation, or an Ontological Category?	
I.2. Toward a General Concept of Determination . . . . .	6
I.2.1. Two Meanings of 'Determination': Property, and Constant Connection	
I.2.2. Constant Unique Connections Need Not Be Causal	
I.2.3. A Third Meaning of 'Determination': Way of Becoming	
I.2.4. Chance: Alien to Determinism?	
I.2.5. The Quantum Theory: A Restriction on Determinism or on Causality?	
I.3. The Spectrum of Categories of Determination . . . . .	17
I.4. Connections Among Different Types of Determination . . . . .	19
I.5. The Essential Components of All Types of Determinacy: Productivity and Lawfulness . . . . .	22
I.5.1. The Principle of Lawfulness or Orderliness	
I.5.2. The Genetic Principle	
I.5.3. The Principle of Determinacy	

1.6. Causation and Determination: Main Views . . . . .	26
1.7. Conclusions . . . . .	29
2. FORMULATIONS OF THE CAUSAL PRINCIPLE	
2.1. Definitions of Cause . . . . .	31
2.1.1. The Aristotelian Teaching of Causes	
2.1.2. Galileo's Definition of Cause	
2.2. General Features of any Formulation of the Causal Principle . . . . .	35
2.3. The Constant-Conjunction Formula of Causation . . . . .	37
2.4. Criticism of the Constant-Conjunction Formula of Causation . . . . .	40
2.4.1. The Uniqueness of the Causal Bond: Neglected in the Previous Formula	
2.4.2. The Efficacy of Causation: Denied by the Humean Doctrine of Causation	
2.4.3. Inadequacy of the Constant-Conjunction Formula	
2.5. Causation as Necessary (Constant and Unique) Production . . . . .	46
2.6. Supposed Further Refinements of the Necessary-Production Formula of Causation . . . . .	48
2.7. Retrospect and Conclusion . . . . .	52

## PART II

### WHAT CAUSAL DETERMINISM DOES NOT ASSERT

3. AN EXAMINATION OF THE EMPIRICIST CRITIQUE OF CAUSALITY	
3.1. Does Causality Involve Contiguity? . . . . .	58
3.1.1. Contiguity: An Essential Component of Causation According to Humeans	

3.1.2.	Contiguity: A Hypothesis Inconsistent with Empiricism	
3.1.3.	Explicit Definitions of Causation Do Not Involve Contiguity	
3.2.	Does Causality Involve Antecedence? . . . . .	62
3.2.1.	Causality Is Consistent with Instantaneous Links	
3.2.2.	The Principle of Retarded Action in Special Relativity	
3.3.	Is Causation Identical with Invariable Succession in Time? . . . . .	68
3.3.1.	The Interpretation of Causal Process as Succession of States	
3.3.2.	The Interpretation of Causation as Predictive Ability	
3.3.3.	Descriptions of Change as Sequence of States Need Not Be Causal	
3.4.	Is Causation Mirrored by Differential Equations? . . . . .	74
3.4.1.	Differential Equations as Mirror Images of Uniform Sequences: A Confusion of Dimensions of Language	
3.4.2.	Noncausal Laws Formulated with the Help of Differential Equations	
3.4.3.	Integral Equations and Teleology	
3.4.4.	The Empirical Test of Differential Equations and the Question of the "True Elementary Laws of Nature"	
3.5.	Summary and Conclusions . . . . .	86
4.	AN EXAMINATION OF THE ROMANTIC CRITIQUE OF CAUSALITY	
4.1.	Should Causation Be Replaced by Interdependence? . . . . .	91
4.1.1.	The Functional View of Causation	
4.1.2.	Criticism of the Functional View of Causation	
4.1.3.	Strange Features of the Functional View of Causation	

4.2.	Causality and Universal Interconnection: The Block Universe and Chance . . . . .	98
4.3.	Is Causality Fatalistic? . . . . .	101
4.3.1.	The Other-Worldliness of Fatalism	
4.3.2.	The Lawlessness of Fatalism	
4.3.3.	The Interference of Causes Defeats Fate	
4.3.4.	Are Historical Events Inevitable?	
4.4.	Is Causality Mechanistic—And is Mechanics Altogether Causal? . . . . .	107
4.4.1.	Mechanics Restricts Causes to Forces	
4.4.2.	Self-Movement in Mechanics: Inertia	
4.4.3.	Causation in the Laws of Motion of Aristotle, Newton, and Einstein	
4.4.4.	Action-Reaction, and Inner Stress	
4.5.	Summary and Conclusions . . . . .	115

### PART III

## WHAT CAUSAL DETERMINISM DOES ASSERT

5.	THE LINEARITY OF CAUSATION	
5.1.	Is Multiple Causation Strictly Causal? . . . . .	119
5.1.1.	Simple and Multiple Causation	
5.1.2.	Conjunctive Plurality of Causes: Reducible to Simple Causation	
5.1.3.	Disjunctive Plurality of Causes: Genuine Multiple Causation	
5.1.4.	Multiple Causation Is Not Strictly Causal	
5.2.	Causality Involves Artificial Isolation . . . . .	125
5.2.1.	The Universal Chaining	
5.2.2.	Isolation: Fictitious	
5.2.3.	Isolation: A Methodological Requirement	
5.2.4.	Paradoxes of Isolation	
5.2.5.	Causal Chains: A First Approximation	

5.3.	Causality Requires Either a First Cause or Infinite Regress . . . . .	134
5.3.1.	The Two Alternatives	
5.3.2.	Evaluation of Infinite Causal Regress	
5.4.	Causality Involves Continuity of Action . . . . .	137
5.4.1.	Ground and Consequences of Continuity of Action	
5.4.2.	An Argument Against the Continuity of Causation	
5.4.3.	Criticism of Hypothesis of Universal Validity of Law of Continuity	
5.4.4.	Continuity: A Hypothesis with a Wide but Limited Range of Validity	
5.5.	Summary and Conclusions . . . . .	146
6.	THE UNIDIRECTIONALITY OF CAUSATION	
6.1.	Causality Neglects the Response . . . . .	148
6.1.1.	Asymmetry of <i>Actio</i> and <i>Passio</i> : Essential for Causality	
6.1.2.	Reciprocal Action in Physics	
6.1.3.	Force as One of the Poles of Interaction	
6.1.4.	Causality and Feedback	
6.1.5.	Interaction in the Social Field	
6.1.6.	Interaction in the Theory of Knowledge	
6.1.7.	The Relation of the Category of Causation to That of Interaction	
6.1.8.	Exaggerations of Interactionism	
6.1.9.	Does Dialectics Require the Subsumption of Causation Under Interaction?	
6.2.	Causality Involves the Superposition of Causes . . . . .	165
6.2.1.	Summative Character of Causes: Necessary for Causalism	
6.2.2.	Nonlinearity as Illustration of Nonadditive Connection	

6.2.3. Randomness as Further Illustration of Non-additivity of Causal Factors	
6.3. Summary and Conclusions . . . . .	170
7. THE EXTERNALITY OF CAUSATION	
7.1. Causality: Restricted to Extrinsic Determination . . . . .	173
7.1.1. Efficient Causes: External by Definition	
7.1.2. The Peripatetic Principle " <i>Omne quod movetur ab alio movetur</i> "	
7.1.3. Causal Determinism Opposes Self-Movement	
7.1.4. The Doctrine of Self-Movement	
7.1.5. External Causes Combine with Inner Conditions	
7.1.6. Freedom: Is It Restricted to the Ethical Domain?	
7.2. Does Man Make Himself? . . . . .	183
7.2.1. Anthropological Environmentalism	
7.2.2. Externalism in Sociopolitical History	
7.2.3. The Doctrine of Borrowing in the History of Ideas	
7.2.4. Man, the Self-Domesticated Animal	
7.3. Causality Requires the Persistent Maintenance of the Cause to Secure the Continuance of Process . . . . .	190
7.3.1. The Peripatetic Maxim " <i>Causa cessante cessat effectus</i> "	
7.3.2. Instances of Self-Sustained Processes	
7.4. Summary and Conclusions . . . . .	194
8. CAUSALITY AND NOVELTY	
8.1. Causalism Entails the Scholastic Dichotomy Substance-Attribute . . . . .	198
8.1.1. The Impact of Causalism on the Theory of the Substance-Attribute Relation	
8.1.2. Contingency of Attributes in Hegelianism and Positivism	
8.1.3. Beyond Causalism and Accidentalism	

8.2. Causality Renders Genuine Novelty Impossible . . . . .	203
8.2.1. The Principle " <i>Causa aequat effectum</i> "	
8.2.2. Archaic Origins of Belief in Immutability	
8.2.3. Conservative Evolution: From Thomism to Mechanism	
8.2.4. Qualitative Immutability and Causation in Kantianism	
8.2.5. General Lawfulness Accounts for the Novelty Excluded by Causalism	
8.2.6. Positive Features of the Invariance Asserted by Causality	
8.3. Summary and Conclusions . . . . .	217

PART IV

THE FUNCTION OF THE CAUSAL PRINCIPLE IN SCIENCE

9. CAUSALITY AND RATIONAL KNOWLEDGE	
9.1. Is Causality Characteristic of Modern Science? . . . . .	224
9.2. Cause and Reason . . . . .	226
9.3. Causation and the Principle of Sufficient Reason . . . . .	229
9.4. Limits of the Principle of Sufficient Reason in Connection with Theoretical Systems . . . . .	232
9.4.1. Should Everything Be Rationalized?	
9.4.2. The "Principle" of Insufficient Reason	
9.5. Limits of the Principle of Sufficient Reason in Connection with Matters of Fact . . . . .	236
9.6. On the Formalization of Causal Statements . . . . .	239
9.6.1. Logical Equivalents, or Logical Correlates of the Causal Connection?	
9.6.2. Causation and Implication (Material, Strict, and Causal); the Relational Approach	
9.7. Recapitulation and Conclusions . . . . .	245

10. CAUSALITY AND SCIENTIFIC LAW	
10.1. Law and Law Statement . . . . .	248
10.2. The Traditional Identification of Causality and Lawfulness . . . . .	252
10.3. Some Noncausal Types of Scientific Law . . . . .	255
10.3.1. Taxonomical and Morphological Laws	
10.3.2. Kinematical Laws	
10.3.3. Further Noncausal Laws: Statistical Laws, Principles of Relativity, and Quantum Prohibitions	
10.4. Causality and Lawfulness in the Sociohistorical Sciences . . . . .	262
10.4.1. Are Sociology and History Scientific Dis- ciplines?	
10.4.2. The Uniqueness of Historical Events	
10.4.3. The Lawfulness of Historical Processes	
10.4.4. Obstacles to Disclosure of Historical Laws	
10.4.5. Noncausal Features of Sociohistorical Events	
10.4.6. Scientific Exactness: Not Exhausted by Numerical Accuracy	
10.4.7. The Defense of Scientific Method in the Sociohistorical Sciences	
10.5. Conclusions . . . . .	280
11. CAUSALITY AND SCIENTIFIC EXPLANATION	
11.1. Is Science Explanatory? . . . . .	282
11.2. Some Aspects of the Problem of Scientific Explana- tion . . . . .	286
11.2.1. Conditions for an Explanation to Be Scientific	
11.2.2. The Logical Structure and Epistemological Meaning of Scientific Explanation	



11.2.3. The Ontological Basis of Scientific Explanation. Explanation of Facts and Explanation of Laws	295
11.3. Explanations That Can Be Causal . . . . .	295
11.4. Noncausal Explanations . . . . .	298
11.5. Conclusions . . . . .	305
12. CAUSALITY AND SCIENTIFIC PREDICTION	
12.1. Nature and Functions of Scientific Prediction . . . . .	307
12.1.1. Nature of Prediction According to Law	
12.1.2. Predictive Nomological Statements: A Third Level of Meaning of 'Law'	
12.1.3. Functions of Scientific Prediction	
12.2. Kinds of Prediction . . . . .	312
12.3. Statistical Prediction . . . . .	315
12.3.1. Insufficiency of Prediction of Individual Events	
12.3.2. The Statistical Predictions of the Sciences of Man	
12.3.3. Are Statistical Predictions Less Complete Than Others?	
12.4. Degrees of Certainty in Prediction . . . . .	320
12.4.1. Uncertainty with Causal Laws and Quasi Certainty with Statistical Laws	
12.4.2. Almost Necessary Truths of Fact	
12.4.3. Grounds for the Failure of Specific Predictions	
12.5. Should Causality be Defined in Terms of Predictability? . . . . .	326
12.5.1. The Positivist Criterion of Causality	
12.5.2. Uncertainty and Causality in Quantum Mechanics	

12.5.3. Uncertainty and Indeterminacy. Is Ontological Determinism Inconsistent with Epistemological Probabilism?	
12.6. Conclusions . . . . .	330
13. THE PLACE OF THE CAUSAL PRINCIPLE IN MODERN SCIENCE	
13.1. Causality: Neither Myth nor Panacea . . . . .	333
13.2. The Domain of Causal Determinacy . . . . .	335
13.2.1. Conditions of Applicability of Causal Hypotheses	
13.2.2. Range of Validity of the Causal Principle	
13.3. Delimitation of the Causal Range of a Particular Law . . . . .	338
13.3.1. Statement of the Problem	
13.3.2. First Stage of the Process: Cycle of Determinants	
13.3.3. Second Stage of the Process: Causal Nexus	
13.3.4. Third Stage of the Process: Self-Determination	
13.4. Any Causality Tomorrow? . . . . .	345
13.4.1. A Verbal Trap into Which Philosophers of Verb Have Fallen	
13.4.2. How Quantum Mechanics Finally Disappointed Acausalists	
13.5. General Conclusions . . . . .	351
BIBLIOGRAPHY . . . . .	354
INDEX . . . . .	365