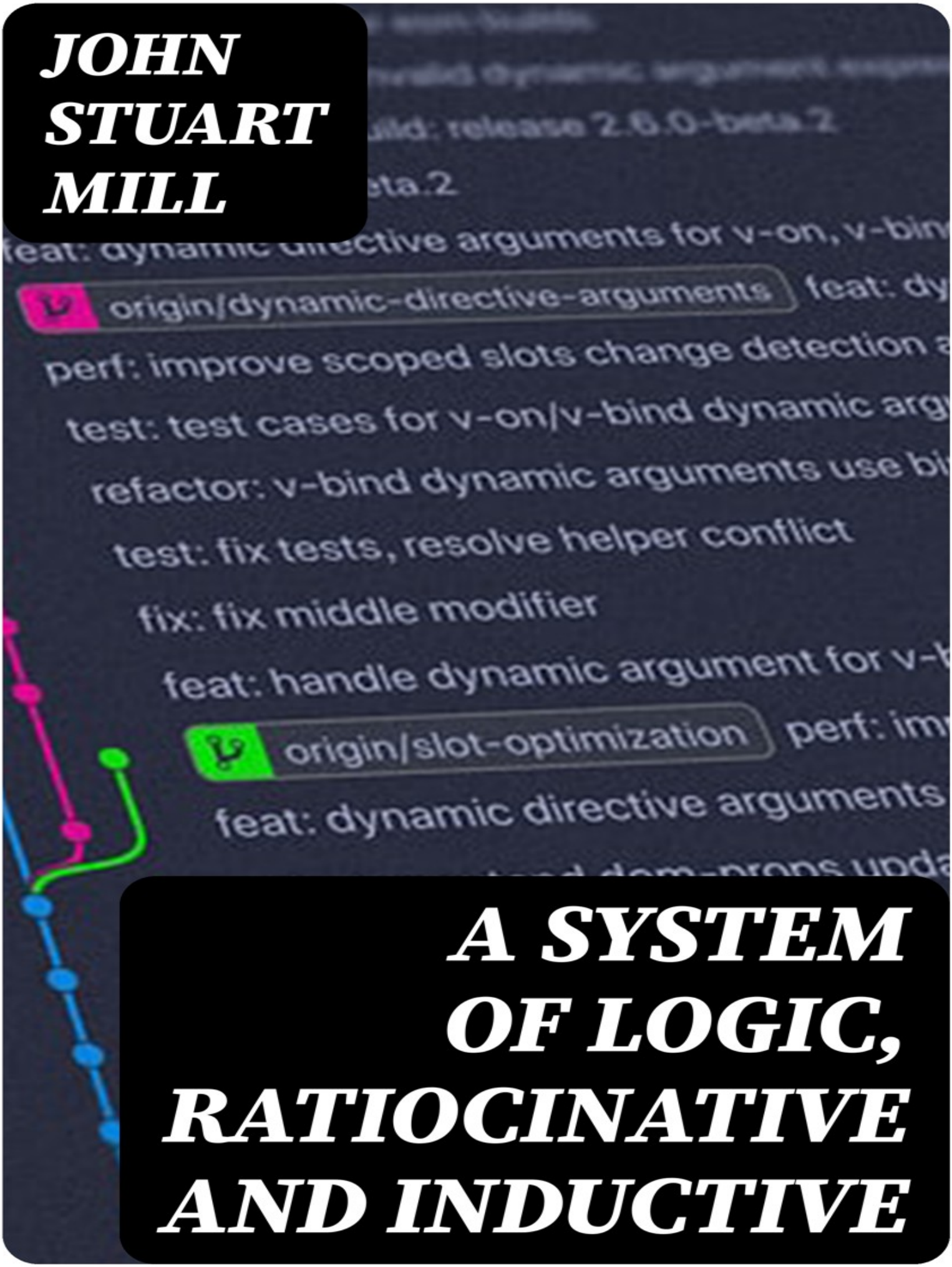
JOHN STUART MILL
origin/dynamic-directive-arguments
perf: improve scoped slots change detection
test: test cases for v-on/v-bind dynamic
refactor: v-bind dynamic arguments use
test: fix tests, resolve helper conflict
fix: fix middle modifier
feat: handle dynamic argument for
origin/slot-optimization
feat: dynamic directive arguments
A SYSTEM OF LOGIC, RATIOCINATIVE AND INDUCTIVE

John Stuart Mill

A System of Logic, Ratiocinative and Inductive

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[pg 003]

Preface To The First Edition.

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This book makes no pretense of giving to the world a new theory of the intellectual operations. Its claim to attention, if it possess any, is grounded on the fact that it is an attempt, not to supersede, but to embody and systematize, the best ideas which have been either promulgated on its subject by speculative writers, or conformed to by accurate thinkers in their scientific inquiries.

To cement together the detached fragments of a subject, never yet treated as a whole; to harmonize the true portions of discordant theories, by supplying the links of thought necessary to connect them, and by disentangling them from the errors with which they are always more or less

interwoven, must necessarily require a considerable amount of original speculation. To other originality than this, the present work lays no claim. In the existing state of the cultivation of the sciences, there would be a very strong presumption against any one who should imagine that he had effected a revolution in the theory of the investigation of truth, or added any fundamentally new process to the practice of it. The improvement which remains to be effected in the methods of philosophizing (and the author believes that they have much need of improvement) can only consist in performing more systematically and accurately operations with which, at least in their elementary form, the human intellect, in some one or other of its employments, is already familiar.

In the portion of the work which treats of Ratiocination, the author has not deemed it necessary to enter into technical details which may be obtained in so perfect a shape from the existing treatises on what is termed the Logic of the Schools. In the contempt entertained by many modern philosophers for the syllogistic art, it will be seen that he by no means participates; though the scientific theory on which its defense is usually rested appears to him erroneous: and the view which he has suggested of the nature and functions of the Syllogism may, perhaps, afford the means of conciliating the principles of the art with as much as is well grounded in the doctrines and objections of its assailants.

The same abstinence from details could not be observed in the First Book, on Names and Propositions; because many

useful principles and distinctions [pg 004] which were contained in the old Logic have been gradually omitted from the writings of its later teachers; and it appeared desirable both to revive these, and to reform and rationalize the philosophical foundation on which they stood. The earlier chapters of this preliminary Book will consequently appear, to some readers, needlessly elementary and scholastic. But those who know in what darkness the nature of our knowledge, and of the processes by which it is obtained, is often involved by a confused apprehension of the import of the different classes of Words and Assertions, will not regard these discussions as either frivolous, or irrelevant to the topics considered in the later Books.

On the subject of Induction, the task to be performed was that of generalizing the modes of investigating truth and estimating evidence, by which so many important and recondite laws of nature have, in the various sciences, been aggregated to the stock of human knowledge. That this is not a task free from difficulty may be presumed from the fact that even at a very recent period, eminent writers (among whom it is sufficient to name Archbishop Whately, and the author of a celebrated article on Bacon in the *Edinburgh Review*) have not scrupled to pronounce it impossible.[1] The author has endeavored to combat their theory in the manner in which Diogenes confuted the skeptical reasonings against the possibility of motion; remembering that Diogenes's argument would have been equally conclusive, though his individual perambulations might not have extended beyond the circuit of his own tub.

Whatever may be the value of what the author has succeeded in effecting on this branch of his subject, it is a duty to acknowledge that for much of it he has been indebted to several important treatises, partly historical and partly philosophical, on the generalities and processes of physical science, which have been published within the last few years. To these treatises, and to their authors, he has endeavored to do justice in the body of the work. But as with one of these writers, Dr. Whewell, he has occasion frequently to express differences of opinion, it is more particularly incumbent on him in this place to declare, that without the aid derived from the [pg 005] facts and ideas contained in that gentleman's “History of the Inductive Sciences,” the corresponding portion of this work would probably not have been written.

The concluding Book is an attempt to contribute toward the solution of a question which the decay of old opinions, and the agitation that disturbs European society to its inmost depths, render as important in the present day to the practical interests of human life, as it must at all times be to the completeness of our speculative knowledge—viz.: Whether moral and social phenomena are really exceptions to the general certainty and uniformity of the course of nature; and how far the methods by which so many of the laws of the physical world have been numbered among truths irrevocably acquired and universally assented to, can be made instrumental to the formation of a similar body of received doctrine in moral and political science.

Preface To The Third And Fourth Editions.

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Several criticisms, of a more or less controversial character, on this work, have appeared since the publication of the second edition; and Dr. Whewell has lately published a reply to those parts of it in which some of his opinions were controverted.[2]

I have carefully reconsidered all the points on which my conclusions have been assailed. But I have not to announce a change of opinion on any matter of importance. Such minor oversights as have been detected, either by myself or by my critics, I have, in general silently, corrected: but it is not to be inferred that I agree with the objections which have been made to a passage, in every instance in which I have altered or canceled it. I have often done so, merely that it might not remain a stumbling-block, when the amount of discussion necessary to place the matter in its

true light would have exceeded what was suitable to the occasion.

To several of the arguments which have been urged against me, I have thought it useful to reply with some degree of minuteness; not from any taste for controversy, but because the opportunity was favorable for placing my own conclusions, and the grounds of them, more clearly and completely before the reader. Truth on these subjects is militant, and can only establish itself by means of conflict. The most opposite opinions can make a plausible show of evidence while each has the statement of its own case; and it is only possible to ascertain which of them is in the right, after hearing and comparing what each can say against the other, and what the other can urge in its defense.

Even the criticisms from which I most dissent have been of great service to me, by showing in what places the exposition most needed to be improved, or the argument strengthened. And I should have been well pleased if the book had undergone a much greater amount of attack; as in that case I should probably have been enabled to improve it still more than I believe I have now done.

In the subsequent editions, the attempt to improve the work by additions and corrections, suggested by criticism or by thought, has been continued. [pg 008] The additions and corrections in the present (eighth) edition, which are not very considerable, are chiefly such as have been suggested by Professor Bain's “Logic,” a book of great merit and value.

Mr. Bain's view of the science is essentially the same with that taken in the present treatise, the differences of opinion being few and unimportant compared with the agreements; and he has not only enriched the exposition by many applications and illustrative details, but has appended to it a minute and very valuable discussion of the logical principles specially applicable to each of the sciences—a task for which the encyclopedical character of his knowledge peculiarly qualified him. I have in several instances made use of his exposition to improve my own, by adopting, and occasionally by controverting, matter contained in his treatise.

The longest of the additions belongs to the chapter on Causation, and is a discussion of the question how far, if at all, the ordinary mode of stating the law of Cause and Effect requires modification to adapt it to the new doctrine of the Conservation of Force—a point still more fully and elaborately treated in Mr. Bain's work.

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INTRODUCTION.

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§ 1. There is as great diversity among authors in the modes which they have adopted of defining logic, as in their treatment of the details of it. This is what might naturally be expected on any subject on which writers have availed themselves of the same language as a means of delivering different ideas. Ethics and jurisprudence are liable to the remark in common with logic. Almost every writer having taken a different view of some of the particulars which these branches of knowledge are usually understood to include; each has so framed his definition as to indicate beforehand his own peculiar tenets, and sometimes to beg the question in their favor.

This diversity is not so much an evil to be complained of, as an inevitable and in some degree a proper result of the imperfect state of those sciences. It is not to be expected that there should be agreement about the definition of any thing, until there is agreement about the thing itself. To define, is to select from among all the properties of a thing, those which shall be understood to be designated and declared by its name; and the properties must be well known to us before we can be competent to determine which of them are fittest to be chosen for this purpose. Accordingly, in the case of so complex an aggregation of particulars as are comprehended in any thing which can be called a science, the definition we set out with is seldom that which a more extensive knowledge of the subject shows to be the most appropriate. Until we know the particulars themselves, we can not fix upon the most correct

and compact mode of circumscribing them by a general description. It was not until after an extensive and accurate acquaintance with the details of chemical phenomena, that it was found possible to frame a rational definition of chemistry; and the definition of the science of life and organization is still a matter of dispute. So long as the sciences are imperfect, the definitions must partake of their imperfection; and if the former are progressive, the latter ought to be so too. As much, therefore, as is to be expected from a definition placed at the commencement of a subject, is that it should define the scope of our inquiries: and the definition which I am about to offer of the science of logic, pretends to nothing more than to be a statement of the question which I have put to myself, and which this book is an attempt to resolve. The reader is at liberty to object to it as a definition of logic; but it is at all events a correct definition of the subject of this volume.

§ 2. Logic has often been called the Art of Reasoning. A writer[3] who has done more than any other person to restore this study to the rank from which it had fallen in the estimation of the cultivated class in our own country, has adopted the above definition with an amendment; he has defined [pg 018] Logic to be the Science, as well as the Art, of reasoning; meaning by the former term, the analysis of the mental process which takes place whenever we reason, and by the latter, the rules, grounded on that analysis, for conducting the process correctly. There can be no doubt as to the propriety of the emendation. A right understanding of the mental process itself, of the conditions it depends on, and the steps of which it consists, is the only basis on which

a system of rules, fitted for the direction of the process, can possibly be founded. Art necessarily presupposes knowledge; art, in any but its infant state, presupposes scientific knowledge: and if every art does not bear the name of a science, it is only because several sciences are often necessary to form the groundwork of a single art. So complicated are the conditions which govern our practical agency, that to enable one thing to be *done*, it is often requisite to *know* the nature and properties of many things.

Logic, then, comprises the science of reasoning, as well as an art, founded on that science. But the word Reasoning, again, like most other scientific terms in popular use, abounds in ambiguities. In one of its acceptations, it means syllogizing; or the mode of inference which may be called (with sufficient accuracy for the present purpose) concluding from generals to particulars. In another of its senses, to reason is simply to infer any assertion, from assertions already admitted: and in this sense induction is as much entitled to be called reasoning as the demonstrations of geometry.

Writers on logic have generally preferred the former acceptation of the term: the latter, and more extensive signification is that in which I mean to use it. I do this by virtue of the right I claim for every author, to give whatever provisional definition he pleases of his own subject. But sufficient reasons will, I believe, unfold themselves as we advance, why this should be not only the provisional but the final definition. It involves, at all events, no arbitrary change in the meaning of the word; for, with the general usage of

the English language, the wider signification, I believe, accords better than the more restricted one.

§ 3. But reasoning, even in the widest sense of which the word is susceptible, does not seem to comprehend all that is included, either in the best, or even in the most current, conception of the scope and province of our science. The employment of the word Logic to denote the theory of Argumentation, is derived from the Aristotelian, or, as they are commonly termed, the scholastic, logicians. Yet even with them, in their systematic treatises, Argumentation was the subject only of the third part: the two former treated of Terms, and of Propositions; under one or other of which heads were also included Definition and Division. By some, indeed, these previous topics were professedly introduced only on account of their connection with reasoning, and as a preparation for the doctrine and rules of the syllogism. Yet they were treated with greater minuteness, and dwelt on at greater length, than was required for that purpose alone. More recent writers on logic have generally understood the term as it was employed by the able author of the Port Royal Logic; viz., as equivalent to the Art of Thinking. Nor is this acceptation confined to books, and scientific inquiries. Even in ordinary conversation, the ideas connected with the word Logic include at least precision of language, and accuracy of classification: and we perhaps oftener hear persons speak of a logical arrangement, or of expressions logically defined, than of conclusions logically deduced from premises. Again, a man is often called a great logician, or a [pg 019] man of powerful logic, not for the accuracy of his deductions, but for the extent of his command over premises; because the

general propositions required for explaining a difficulty or refuting a sophism, copiously and promptly occur to him: because, in short, his knowledge, besides being ample, is well under his command for argumentative use. Whether, therefore, we conform to the practice of those who have made the subject their particular study, or to that of popular writers and common discourse, the province of logic will include several operations of the intellect not usually considered to fall within the meaning of the terms Reasoning and Argumentation.

These various operations might be brought within the compass of the science, and the additional advantage be obtained of a very simple definition, if, by an extension of the term, sanctioned by high authorities, we were to define logic as the science which treats of the operations of the human understanding in the pursuit of truth. For to this ultimate end, naming, classification, definition, and all other operations over which logic has ever claimed jurisdiction, are essentially subsidiary. They may all be regarded as contrivances for enabling a person to know the truths which are needful to him, and to know them at the precise moment at which they are needful. Other purposes, indeed, are also served by these operations; for instance, that of imparting our knowledge to others. But, viewed with regard to this purpose, they have never been considered as within the province of the logician. The sole object of Logic is the guidance of one's own thoughts: the communication of those thoughts to others falls under the consideration of Rhetoric, in the large sense in which that art was conceived by the ancients; or of the still more extensive art of

Education. Logic takes cognizance of our intellectual operations only as they conduce to our own knowledge, and to our command over that knowledge for our own uses. If there were but one rational being in the universe, that being might be a perfect logician; and the science and art of logic would be the same for that one person as for the whole human race.

§ 4. But, if the definition which we formerly examined included too little, that which is now suggested has the opposite fault of including too much.

Truths are known to us in two ways: some are known directly, and of themselves; some through the medium of other truths. The former are the subject of Intuition, or Consciousness;[4] the latter, of Inference. The truths known by intuition are the original premises from which all others are inferred. Our assent to the conclusion being grounded on the truth of the premises, we never could arrive at any knowledge by reasoning, unless something could be known antecedently to all reasoning.

Examples of truths known to us by immediate consciousness, are our own bodily sensations and mental feelings. I know directly, and of my own knowledge, that I was vexed yesterday, or that I am hungry to-day. Examples of truths which we know only by way of inference, are occurrences which took place while we were absent, the events recorded in history, or the theorems of mathematics. The two former we infer from the testimony adduced, or from the traces of those past occurrences which still [pg

020] exist; the latter, from the premises laid down in books of geometry, under the title of definitions and axioms. Whatever we are capable of knowing must belong to the one class or to the other; must be in the number of the primitive data, or of the conclusions which can be drawn from these.

With the original data, or ultimate premises of our knowledge; with their number or nature, the mode in which they are obtained, or the tests by which they may be distinguished; logic, in a direct way at least, has, in the sense in which I conceive the science, nothing to do. These questions are partly not a subject of science at all, partly that of a very different science.

Whatever is known to us by consciousness is known beyond possibility of question. What one sees or feels, whether bodily or mentally, one can not but be sure that one sees or feels. No science is required for the purpose of establishing such truths; no rules of art can render our knowledge of them more certain than it is in itself. There is no logic for this portion of our knowledge.

But we may fancy that we see or feel what we in reality infer. A truth, or supposed truth, which is really the result of a very rapid inference, may seem to be apprehended intuitively. It has long been agreed by thinkers of the most opposite schools, that this mistake is actually made in so familiar an instance as that of the eyesight. There is nothing of which we appear to ourselves to be more directly conscious than the distance of an object from us. Yet it has

long been ascertained, that what is perceived by the eye, is at most nothing more than a variously colored surface; that when we fancy we see distance, all we really see is certain variations of apparent size, and degrees of faintness of color; that our estimate of the object's distance from us is the result partly of a rapid inference from the muscular sensations accompanying the adjustment of the focal distance of the eye to objects unequally remote from us, and partly of a comparison (made with so much rapidity that we are unconscious of making it) between the size and color of the object as they appear at the time, and the size and color of the same or of similar objects as they appeared when close at hand, or when their degree of remoteness was known by other evidence. The perception of distance by the eye, which seems so like intuition, is thus, in reality, an inference grounded on experience; an inference, too, which we learn to make; and which we make with more and more correctness as our experience increases; though in familiar cases it takes place so rapidly as to appear exactly on a par with those perceptions of sight which are really intuitive, our perceptions of color.[5]

Of the science, therefore, which expounds the operations of the human understanding in the pursuit of truth, one essential part is the inquiry: What are the facts which are the objects of intuition or consciousness, and what are those which we merely infer? But this inquiry has never been considered a portion of logic. Its place is in another and a perfectly distinct department of science, to which the name metaphysics more particularly belongs: that portion of mental philosophy which attempts to determine what part

of the furniture of the mind belongs to it originally, and [pg 021] what part is constructed out of materials furnished to it from without. To this science appertain the great and much debated questions of the existence of matter; the existence of spirit, and of a distinction between it and matter; the reality of time and space, as things without the mind, and distinguishable from the objects which are said to exist in them. For in the present state of the discussion on these topics, it is almost universally allowed that the existence of matter or of spirit, of space or of time, is in its nature unsusceptible of being proved; and that if any thing is known of them, it must be by immediate intuition. To the same science belong the inquiries into the nature of Conception, Perception, Memory, and Belief; all of which are operations of the understanding in the pursuit of truth; but with which, as phenomena of the mind, or with the possibility which may or may not exist of analyzing any of them into simpler phenomena, the logician as such has no concern. To this science must also be referred the following, and all analogous questions: To what extent our intellectual faculties and our emotions are innate—to what extent the result of association: Whether God and duty are realities, the existence of which is manifest to us *a priori* by the constitution of our rational faculty; or whether our ideas of them are acquired notions, the origin of which we are able to trace and explain; and the reality of the objects themselves a question not of consciousness or intuition, but of evidence and reasoning.

The province of logic must be restricted to that portion of our knowledge which consists of inferences from truths

previously known; whether those antecedent data be general propositions, or particular observations and perceptions. Logic is not the science of Belief, but the science of Proof, or Evidence. In so far as belief professes to be founded on proof, the office of logic is to supply a test for ascertaining whether or not the belief is well grounded. With the claims which any proposition has to belief on the evidence of consciousness—that is, without evidence in the proper sense of the word—logic has nothing to do.

§ 5. By far the greatest portion of our knowledge, whether of general truths or of particular facts, being avowedly matter of inference, nearly the whole, not only of science, but of human conduct, is amenable to the authority of logic. To draw inferences has been said to be the great business of life. Every one has daily, hourly, and momentary need of ascertaining facts which he has not directly observed; not from any general purpose of adding to his stock of knowledge, but because the facts themselves are of importance to his interests or to his occupations. The business of the magistrate, of the military commander, of the navigator, of the physician, of the agriculturist, is merely to judge of evidence, and to act accordingly. They all have to ascertain certain facts, in order that they may afterward apply certain rules, either devised by themselves or prescribed for their guidance by others; and as they do this well or ill, so they discharge well or ill the duties of their several callings. It is the only occupation in which the mind never ceases to be engaged; and is the subject, not of logic, but of knowledge in general.

Logic, however, is not the same thing with knowledge, though the field of logic is co-extensive with the field of knowledge. Logic is the common judge and arbiter of all particular investigations. It does not undertake to find evidence, but to determine whether it has been found. Logic neither observes, nor invents, nor discovers; but judges. It is no part of the business of logic to inform the surgeon what appearances are found to [pg 022] accompany a violent death. This he must learn from his own experience and observation, or from that of others, his predecessors in his peculiar pursuit. But logic sits in judgment on the sufficiency of that observation and experience to justify his rules, and on the sufficiency of his rules to justify his conduct. It does not give him proofs, but teaches him what makes them proofs, and how he is to judge of them. It does not teach that any particular fact proves any other, but points out to what conditions all facts must conform, in order that they may prove other facts. To decide whether any given fact fulfills these conditions, or whether facts can be found which fulfill them in a given case, belongs exclusively to the particular art or science, or to our knowledge of the particular subject.

It is in this sense that logic is, what it was so expressively called by the schoolmen and by Bacon, *ars artium*; the science of science itself. All science consists of data and conclusions from those data, of proofs and what they prove: now logic points out what relations must subsist between data and whatever can be concluded from them, between proof and every thing which it can prove. If there be any such indispensable relations, and if these can be precisely

determined, every particular branch of science, as well as every individual in the guidance of his conduct, is bound to conform to those relations, under the penalty of making false inferences—of drawing conclusions which are not grounded in the realities of things. Whatever has at any time been concluded justly, whatever knowledge has been acquired otherwise than by immediate intuition, depended on the observance of the laws which it is the province of logic to investigate. If the conclusions are just, and the knowledge real, those laws, whether known or not, have been observed.

§ 6. We need not, therefore, seek any further for a solution of the question, so often agitated, respecting the utility of logic. If a science of logic exists, or is capable of existing, it must be useful. If there be rules to which every mind consciously or unconsciously conforms in every instance in which it infers rightly, there seems little necessity for discussing whether a person is more likely to observe those rules, when he knows the rules, than when he is unacquainted with them.

A science may undoubtedly be brought to a certain, not inconsiderable, stage of advancement, without the application of any other logic to it than what all persons, who are said to have a sound understanding, acquire empirically in the course of their studies. Mankind judged of evidence, and often correctly, before logic was a science, or they never could have made it one. And they executed great mechanical works before they understood the laws of mechanics. But there are limits both to what mechanicians

can do without principles of mechanics, and to what thinkers can do without principles of logic. A few individuals, by extraordinary genius, or by the accidental acquisition of a good set of intellectual habits, may work without principles in the same way, or nearly the same way, in which they would have worked if they had been in possession of principles. But the bulk of mankind require either to understand the theory of what they are doing, or to have rules laid down for them by those who have understood the theory. In the progress of science from its easiest to its more difficult problems, each great step in advance has usually had either as its precursor, or as its accompaniment and necessary condition, a corresponding improvement in the notions and principles of logic received among the most advanced thinkers. And if several of the more difficult sciences are still [pg 023] in so defective a state; if not only so little is proved, but disputation has not terminated even about the little which seemed to be so; the reason perhaps is, that men's logical notions have not yet acquired the degree of extension, or of accuracy, requisite for the estimation of the evidence proper to those particular departments of knowledge.

§ 7. Logic, then, is the science of the operations of the understanding which are subservient to the estimation of evidence: both the process itself of advancing from known truths to unknown, and all other intellectual operations in so far as auxiliary to this. It includes, therefore, the operation of Naming; for language is an instrument of thought, as well as a means of communicating our thoughts. It includes, also, Definition, and Classification. For, the use of these

operations (putting all other minds than one's own out of consideration) is to serve not only for keeping our evidences and the conclusions from them permanent and readily accessible in the memory, but for so marshaling the facts which we may at any time be engaged in investigating, as to enable us to perceive more clearly what evidence there is, and to judge with fewer chances of error whether it be sufficient. These, therefore, are operations specially instrumental to the estimation of evidence, and, as such, are within the province of Logic. There are other more elementary processes, concerned in all thinking, such as Conception, Memory, and the like; but of these it is not necessary that Logic should take any peculiar cognizance, since they have no special connection with the problem of Evidence, further than that, like all other problems addressed to the understanding, it presupposes them.

Our object, then, will be, to attempt a correct analysis of the intellectual process called Reasoning or Inference, and of such other mental operations as are intended to facilitate this: as well as, on the foundation of this analysis, and *pari passu* with it, to bring together or frame a set of rules or canons for testing the sufficiency of any given evidence to prove any given proposition.

With respect to the first part of this undertaking, I do not attempt to decompose the mental operations in question into their ultimate elements. It is enough if the analysis as far as it goes is correct, and if it goes far enough for the practical purposes of logic considered as an art. The separation of a complicated phenomenon into its

component parts is not like a connected and interdependent chain of proof. If one link of an argument breaks, the whole drops to the ground; but one step toward an analysis holds good and has an independent value, though we should never be able to make a second. The results which have been obtained by analytical chemistry are not the less valuable, though it should be discovered that all which we now call simple substances are really compounds. All other things are at any rate compounded of those elements: whether the elements themselves admit of decomposition, is an important inquiry, but does not affect the certainty of the science up to that point.

I shall, accordingly, attempt to analyze the process of inference, and the processes subordinate to inference, so far only as may be requisite for ascertaining the difference between a correct and an incorrect performance of those processes. The reason for thus limiting our design, is evident. It has been said by objectors to logic, that we do not learn to use our muscles by studying their anatomy. The fact is not quite fairly stated; for if the action of any of our muscles were vitiated by local weakness, or other physical defect, a knowledge of their anatomy might be very necessary [pg 024] for effecting a cure. But we should be justly liable to the criticism involved in this objection, were we, in a treatise on logic, to carry the analysis of the reasoning process beyond the point at which any inaccuracy which may have crept into it must become visible. In learning bodily exercises (to carry on the same illustration) we do, and must, analyze the bodily motions so far as is necessary for distinguishing those which ought to be