CHAPTER V.

Philosophy.—Stuart Mill.¹

I.

When at Oxford some years ago, during the meeting of the British Association, I met, amongst the few students still in residence, a young Englishman, a man of intelligence, with whom I became intimate. He took me in the evening to the New Museum, well filled with specimens. Here short lectures were delivered, new models of machinery were set to work; ladies were present and took an interest in the experiments; on the last day, full of enthusiasm, God save

¹ M. Taine has published this "Study on Mill" separately, and preceded it by the following note, as a preface:—"When this Study first appeared, Mr. Mill did me the honour to write to me that it would not be possible to give in a few pages a more exact and complete notion of the contents of his work, considered as a body of philosophical teaching. 'But,' he added, 'I think you are wrong in regarding the views I adopt as especially English. They were so in the first half of the eighteenth century, from the time of Locke to that of the reaction against Hume. This reaction, beginning in Scotland, assumed long ago the German form, and ended by prevailing universally. When I wrote my book, I stood almost alone in my opinions; and though they have met with a degree of sympathy which I by no means expected, we may still count in England twenty a priori and spiritualist philosophers for every partisan of the doctrine of Experience.'

"This remark is very true. I myself could have made it; having been brought up in the doctrines of Scottish philosophy and the writings of Reid. I simply answer, that there are philosophers whom we do not count, and that all such, whether English or not, spiritualist or not,
the Queen was sung. I admired this zeal, this solidity of mind, this organisation of science, these voluntary subscriptions, this aptitude for association and for labour, this great machine pushed on by so many arms, and so well fitted to accumulate, criticise, and classify facts. But yet, in this abundance, there was a void; when I read the Transactions, I thought I was present at a congress of heads of manufactories. All these learned men verified details and exchanged recipes. It was as though I listened to foremen, busy in communicating their processes for tanning leather or dyeing cotton; general ideas were wanting. I used to regret this to my friend; and in the evening, by his lamp, amidst that great silence in which the university town lay wrapped, we both tried to discover its reasons.

II.

One day I said to him: You lack philosophy—I mean, what the Germans call metaphysics. You have may be neglected without much harm. Once in a half century, or perhaps in a century, or two centuries, some thinker appears; Bacon and Hume in England, Descartes and Condillac in France, Kant and Hegel in Germany. At other times the stage is unoccupied, or ordinary men come forward, and offer the public that which the public likes—Sensualists or Idealists, according to the tendency of the day, with sufficient instruction and skill to play leading parts, and enough capacity to re-set old airs, well drilled in the works of their predecessors, but destitute of real invention—simple executant musicians, who stand in the place of composers. In Europe, at present, the stage is a blank. The Germans adapt and alter effete French materialism. The French listen from habit, but somewhat wearily and distractedly, to the scraps of melody and eloquent commonplace which their instructors have repeated to them for the last thirty years. In this deep silence, and from among these dull mediocrities, a master comes forward to speak. Nothing of the sort has been seen since Hegel.
learned men, but you have no thinkers. Your God impedes you. He is the Supreme Cause, and you dare not reason on causes, out of respect for him. He is the most important personage in England, and I see clearly that he merits his position; for he forms part of your constitution, he is the guardian of your morality, he judges in final appeal on all questions whatsoever, he replaces with advantage the prefects and gendarmes with whom the nations on the Continent are still encumbered. Yet, this high rank has the inconvenience of all official positions; it produces a cant, prejudices, intolerance, and courtiers. Here, close by us, is poor Mr. Max Müller, who, in order to acclimatise the study of Sanscrit, was compelled to discover in the Vedas the worship of a moral God, that is to say, the religion of Paley and Addison. Some time ago, in London, I read a proclamation of the Queen, forbidding people to play cards, even in their own houses, on Sundays. It seems that, if I were robbed, I could not bring my thief to justice without taking a preliminary religious oath; for the judge has been known to send a complainant away who refused to take the oath, deny him justice, and insult him into the bargain. Every year when we read the Queen's speech in your papers, we find there the compulsory mention of Divine Providence, which comes in mechanically, like the invocation to the immortal gods on the fourth page of a rhetorical declamation; and you remember that once, the pious phrase having been omitted, a second communication was made to Parliament for the express purpose of supplying it. All these cavillings and pedantries indicate to my mind a celestial monarchy; naturally it resembles all

1 This law has been abrogated by an Act of Parliament. —Tn.
others; I mean that it relies more willingly on tradition and custom than on examination and reason. A monarchy never invited men to verify its credentials. As yours is, however, useful, well adapted to you, and moral, you are not revolted by it; you submit to it without difficulty, you are, at heart, attached to it; you would fear, in touching it, to disturb the constitution and morality. You leave it in the clouds, amidst public homage. You fall back upon yourselves, confine yourselves to matters of fact, to minute dissections, to experiments in the laboratory. You go culling plants and collecting shells. Science is deprived of its head; but all is for the best, for practical life is improved, and dogma remains intact.

III.

You are truly French, he answered; you ignore facts, and all at once find yourself settled in a theory. I assure you that there are thinkers amongst us, and not far from hence, at Christ Church, for instance. One of them, the professor of Greek, has spoken so deeply on inspiration, the creation and final causes, that he is out of favour. Look at this little collection which has recently appeared, Essays and Reviews; your philosophic freedom of the last century, the latest conclusions of geology and cosmogony, the boldness of German exegesis, are here in abstract. Some things are wanting, amongst others the waggeries of Voltaire, the misty jargon of Germany, and the prosaic coarseness of Comte; to my mind, the loss is small. Wait twenty years, and you will find in London the ideas of Paris and Berlin. But they will still be the ideas of Paris and Berlin.
Whom have you that is original?—Stuart Mill.—Who is he?—A political writer. His little book *On Liberty* is as admirable as Rousseau's *Contrat Social* is bad.—That is a bold assertion.—No, for Mill decides as strongly for the independence of the individual as Rousseau for the despotism of the State.—Very well, but that is not enough to make a philosopher. What besides is he?—An economist who goes beyond his science, and subordinates production to man, instead of man to production.—Well, but this is not enough to make a philosopher. Is he anything else?—A logician. Very good; but of what school?—Of his own. I told you he was original.—Is he Hegelian?—By no means; he is too fond of facts and proofs.—Does he follow Port-Royal?—Still less; he is too well acquainted with modern sciences.—Does he imitate Condillac?—Certainly not; Condillac has only taught him to write well.—Who, then, are his friends?—Locke and Comte in the first rank; then Hume and Newton.—Is he a system-monger, a speculative reformer?—He has too much sense for that; he only arranges the best theories, and explains the best methods. He does not attitudinise majestically in the character of a restorer of science; he does not declare, like your Germans, that his book will open up a new era for humanity. He proceeds gradually, somewhat slowly, often creepingly, through a multitude of particular facts. He excels in giving precision to an idea, in disentangling a principle, in discovering it amongst a number of different facts; in refuting, distinguishing, arguing. He has the astuteness, patience, method, and sagacity of a lawyer.—Very well, you admit that I was right. A lawyer, an ally of Locke, Newton, Comte, and Hume; we have here
only English philosophy; but no matter. Has he reached a grand conception of the universe?—Yes.—Has he an individual and complete idea of nature and the mind?—Yes.—Has he combined the operations and discoveries of the intellect under a single principle which puts them all in a new light?—Yes; but we have to discover this principle.—That is your business, and I hope you will undertake it.—But I shall fall into abstract generalities.—There is no harm in that?—But this close reasoning will be like a quick-set hedge. We will prick our fingers with it.—But three men out of four would cast aside such speculations as idle.—So much the worse for them. For in what does the life of a nation or a century consist, except in the formation of such theories? We are not thoroughly men unless so engaged. If some dweller in another planet were to come down here to ask us the nature of our race, we should have to show him the five or six great ideas which we have formed of the mind and the world. That alone would give him the measure of our intelligence. Expound to me your theory, and I shall go away better instructed than after having seen the masses of brick, which you call London and Manchester.

§ 1.—Experience.

I.

Let us begin, then, at the beginning, like logicians. Mill has written on logic. What is logic? It is a science. What is its object? The sciences; for, suppose that you have traversed the universe, and that you know it thoroughly, stars, earth, sun, heat, gravity, chemical affinities, the species of minerals, geological
revolutions, plants, animals, human events, all that classifications and theories explain and embrace, there still remain these classifications and theories to be learnt. Not only is there an order of beings, but also an order of the thoughts which represent them; not only plants and animals, but also botany and zoology; not only lines, surfaces, volumes, and numbers, but also geometry and arithmetic. Sciences, then, are as real things as facts themselves, and therefore, as well as facts, become the subject of study. We can analyse them as we analyse facts, investigate their elements, composition, order, relations, and object. There is, therefore, a science of sciences; this science is called logic, and is the subject of Mill's work. It is no part of logic to analyse the operations of the mind, memory, the association of ideas, external perception, etc.; that is the business of psychology. We do not discuss the value of such operations, the veracity of our consciousness, the absolute certainty of our elementary knowledge; this belongs to metaphysics. We suppose our faculties to be at work, and we admit their primary discoveries. We take the instrument as nature has provided it, and we trust to its accuracy. We leave to others the task of taking its mechanism to pieces, and the curiosity which criticises its results. Setting out from its primitive operations, we inquire how they are added to each other; how they are combined; how one is convertible into another; how, by dint of additions, combinations, and transformations, they finally compose a system of connected and developed truths. We construct a theory of science, as others construct theories of vegetation, of the mind, or of numbers. Such is the idea of logic; and it is plain that it has, as other sciences, a real
subject-matter, its distinct province, its manifest importance, its special method, and a certain future.

II.

Having premised so much, we observe that all these sciences which form the subject of logic, are but collections of propositions, and that each proposition merely connects or separates a subject and an attribute, that is, two names, a quality and a substance; that is to say, a thing and another thing. We must then ask what we understand by a thing, what we indicate by a name; in other words, what it is we recognise in objects, what we connect or separate, what is the subject-matter of all our propositions and all our science. There is a point in which all our several items of knowledge resemble one another. There is a common element which, continually repeated, constitutes all our ideas. There is, as it were, a minute primitive crystal which, indefinitely and variably repeating itself, forms the whole mass, and which, once known, teaches us beforehand the laws and composition of the complex bodies which it has formed.

Now, when we attentively consider the idea which we form of anything, what do we find in it? Take first substances, that is to say, Bodies and Minds.¹ This

¹ "It is certain, then, that a part of our notion of a body consists of the notion of a number of sensations of our own or of other sentient beings, habitually occurring simultaneously. My conception of the table at which I am writing is compounded of its visible form and size, which are complex sensations of sight; its tangible form and size, which are complex sensations of our organs of touch and of our muscles; its weight, which is also a sensation of touch and of the muscles; its colour, which is a sensation of sight; its hardness, which is a sensation of the muscles; its composition, which is another word
table is brown, long, wide, three feet high, judging by the eye: that is, it forms a little spot in the field of vision; in other words, it produces a certain sensation on the optic nerve. It weighs ten pounds: that is, it would require to lift it an effort less than for a weight of eleven pounds, and greater than for a weight of nine pounds; in other words, it produces a certain muscular sensation. It is hard and square, which means that, if first pushed, and then run over by the hand, it will excite two distinct kinds of muscular sensations. And so on. When I examine closely what I know of it, I find that I know nothing else except the impressions it makes upon me. Our idea of a body comprises nothing else than this: we know nothing of it but the sensations it excites in us; we determine it by the nature, number, and order of these sensations; we know nothing of its inner nature, nor whether it has one; we simply affirm that it is the unknown cause of these sensations. When we say that a body has existed in the absence of our sensations we mean simply that if, during that time, we had been within reach of it, we should have had sensations which we have not had. We never define it save by our present or past, future or possible, complex or simple impressions. This is so true, that philosophers like Berkeley have maintained, with some

for all the varieties of sensation which we receive, under various circumstances, from the wood of which it is made; and so forth. All or most of these various sensations frequently are, and, as we learn by experience, always might be, experienced simultaneously, or in many different orders of succession, at our own choice: and hence the thought of any one of them makes us think of the others, and the whole becomes mentally amalgamated into one mixed state of consciousness, which, in the language of Locke and Hartley, is termed a Complex Idea.”—M Riley’s System of Logic, 4th ed. 2 vols., i. 62.
show of truth, that matter is a creature of the imagination, and that the whole universe of sense, is reducible to an order of sensations. It is at least so, as far as our knowledge is concerned; and the judgments which compose our sciences, have reference only to the impressions by which things are manifested to us.

So, again, with the mind. We may well admit that there is in us a soul, an "ego," a subject or recipient of our sensations, and of our other modes of being, distinct from those sensations and modes of existence; but we know nothing of it. Mr. Mill says:

"For, as our conception of a body is that of an unknown exciting cause of sensations, so our conception of a mind is that of an unknown recipient, or perciept, of them; and not of them alone, but of all our other feelings. As body is the mysterious something which excites the mind to feel, so mind is the mysterious something which feels, and thinks. It is unnecessary to give in the case of mind, as we gave in the case of matter, a particular statement of the sceptical system by which its existence as a Thing in itself, distinct from the series of what are denominated its states, is called in question. But it is necessary to remark, that on the inmost nature of the thinking principle, as well as on the inmost nature of matter, we are, and with our faculties must always remain, entirely in the dark. All which we are aware of, even in our own minds, is a certain 'thread of consciousness;' a series of feelings, that is, of sensations, thoughts, emotions, and volitions, more or less numerous and complicated." ¹

We have no clearer idea of mind than of matter; we can say nothing more about it than about matter. So that substances, of whatever kind, bodies or minds, within or without us, are never for us more than tissues.

¹ Mill's Logic, i. 68.
more or less complex, more or less regular, of which our impressions and modes of being form all the threads.

This is still more evident in the case of attributes than of substances. When I say that snow is white, I mean that, when snow is presented to my sight, I have the sensation of whiteness. When I say that fire is hot, I mean that, when near the fire, I have the sensation of heat. We call a mind devout, superstitious, meditative, or gay, simply meaning that the ideas, the emotions, the volitions, designated by these words, recur frequently in the series of its modes of being. When we say that bodies are heavy, divisible, movable, we mean simply that, left to themselves, they will fall; when cut, they

1 "Every attribute of a mind consists either in being itself affected in a certain way, or affecting other minds in a certain way. Considered in itself, we can predicate nothing of it but the series of its own feelings. When we say of any mind, that it is devout, or superstitious, or meditative, or cheerful, we mean that the ideas, emotions, or volitions implied in those words, form a frequently recurring part of the series of feelings, or states of consciousness, which fill up the sentient existence of that mind.

"In addition, however, to those attributes of a mind which are grounded on its own states of feeling, attributes may also be ascribed to it, in the same manner as to a body, grounded on the feelings which it excites in other minds. A mind does not, indeed, like a body, excite sensations, but it may excite thoughts or emotions. The most important example of attributes ascribed on this ground, is the employment of terms expressive of approbation or blame. When, for example, we say of any character, or (in other words) of any mind, that it is admirable, we mean that the contemplation of it excites the sentiment of admiration; and indeed somewhat more, for the word implies that we not only feel admiration, but approve that sentiment in ourselves. In some cases, under the semblance of a single attribute, two are really predicated: one of them, a state of the mind itself; the other, a state with which other minds are affected by thinking of it. As when we say of any one that he is generous. The word generosity expresses a certain state of mind, but being a term of praise, it also expresses that this state of mind excites in us another mental state, called approbation.
will separate; or when pushed, they will move: that is, under such and such circumstances they will produce such and such a sensation in our muscles, or our sight. An attribute always designates a mode of our being, or a series of our modes of being. In vain we disguise these modes by grouping, concealing them under abstract words, dividing and transforming them, so that we are frequently puzzled to recognise them: whenever we pierce to the basis of our words and ideas, we find them and nothing but them. Mill says:

"Take the following example: A generous person is worthy of honour. Who would expect to recognise here a case of coexistence between phenomena? But so it is. The attribute which causes a person to be deemed generous is ascribed to him on the ground of states of his mind, and particulars of his conduct; both are phenomena; the former are facts of internal consciousness, the latter, so far as distinct from the former, are physical facts, or perceptions of the senses. Worthy of honour, admits of a similar analysis. Honour, as here used, means a state of approving and admiring emotion, followed on occasion by corresponding outward acts. 'Worthy of honour' connotes all this, together with an approval of the act of showing honour. All these are phenomena; states of internal consciousness, accompanied or followed by physical facts. When we say, A generous person is worthy of honour, we affirm coexistence between the two complicated phenomena connoted by the two terms respectively. We affirm, that wherever and whenever the inward feelings and outward facts implied in the word generosity, have place, then and there the existence and manifestation of an inward feeling, honour, would be followed in our minds by another inward feeling, approval."¹

¹ This assertion made, therefore, is twofold, and of the following purport: Certain feelings form habitually a part of this person's sentient existence; and the idea of those feelings of his, excites the sentiment of approbation in ourselves or others." — Mill's Logic, i. 80.
In vain we turn about as we please, we remain still in the same circle. Whether the object be an attribute or a substance, complex or abstract, compound or simple, its material is to us always the same; it is made up only of our modes of being. Our mind is to nature what a thermometer is to a boiler: we define the properties of nature by the impressions of our mind, as we indicate the conditions of the boiling water by the changes of the thermometer. Of both we know but condition and changes; both are made up of isolated and transient facts; a thing is for us but an aggregate of phenomena. These are the sole elements of our knowledge: consequently the whole effort of science will be to link facts to facts.

III.

This brief phrase is the abstract of the whole system. Let us master it, for it explains all Mill's theories. He has defined and restated everything from this starting-point. In all forms and all degrees of knowledge, he has recognised only the knowledge of facts, and of their relations.

Now we know that logic has two corner-stones, the Theories of Definition and of Proof. From the days of Aristotle logicians have spent their time in polishing them. They have only dared to touch them respectfully, as if they were sacred. At most, from time to time, some innovator ventured to turn them over cautiously, to put them in a better light. Mill shapes, cuts, turns them over, and replaces them both in a similar manner and by the same means.
IV.

I am quite aware that now-a-days men laugh at those who reason on definitions; the laughers deserve to be laughed at. There is no theory more fertile in universal and important results; it is the root by which the whole tree of human science grows and lives. For to define things is to mark out their nature. To introduce a new idea of definition is to introduce a new idea of the nature of things; it is to tell us what beings are, of what they are composed, into what elements they are capable of being resolved. In this lies the merit of these dry speculations; the philosopher seems occupied with arranging mere formulas; the fact is that in them he encloses the universe.

Take, say logicians, an animal, a plant, a feeling, a geometrical figure, an object or group of objects of any kind. Doubtless the object has its properties, but it has also its essence. It is manifested to the outer world by an indefinite number of effects and qualities; but all these modes of being are the results or products of its inner nature. There is within it a certain hidden substratum which alone is primitive and important, without which it can neither exist nor be conceived, and which constitutes its being and our notion of it.\(^1\) They call the propositions which denote this essence definitions, and assert that the best part of our knowledge consists of such propositions.

\(^1\) According to idealist logicians, this being is arrived at by examining our notion of it; and the idea, on analysis, reveals the essence. According to the classifying school, we arrive at the being by placing the object in its group, and the notion is defined by stating the genus and the difference. Both agree in believing that we are capable of grasping the essence.
On the other hand, Mill says that these kinds of propositions teach us nothing; they show the mere sense of a word, and are purely verbal. What do I learn by being told that man is a rational animal, or that a triangle is a space contained by three lines? The first part of such a phrase expresses by an abbreviative word what the second part expresses in a developed phrase. You tell me the same thing twice over; you put the same fact into two different expressions; you do not add one fact to another, but you go from one fact to its equivalent. Your proposition is not instructive. You might collect a million such, my mind would remain entirely void; I should have read a dictionary, but not have acquired a single piece of knowledge. Instead of saying that essential propositions are important, and those relating to qualities merely accessory, you ought to say that the first are accessory, and the second important. I learn nothing by being told that a circle is a figure formed by the revolution of a straight line about one of its points as centre; I do learn something when told that the chords which subtend equal arcs in the circle are themselves equal, or that three given points determine the circumference. What we call the nature of a being is the connected system of facts which constitutes that being. The nature of a carnivorous mammal consists

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"An essential proposition, then, is one which is purely verbal; which asserts of a thing under a particular name, only what is asserted of it in the fact of calling it by that name; and which therefore either gives no information, or gives it respecting the name, not the thing. Non-essential or accidental propositions, on the contrary, may be called Real Propositions, in opposition to Verbal. They predicate of a thing, some fact not involved in the signification of the name by which the proposition speaks of it; some attribute not connoted by that name."

—Mill's Logic, i. 127.
in the fact that the property of giving milk, and all its implied peculiarities of structure, are combined with the possession of sharp teeth, instincts of prey, and the corresponding faculties. Such are the elements which compose its nature. They are facts linked together as mesh to mesh in a net. We perceive a few of them; and we know that beyond our present knowledge and our future experience, the network extends to infinity its interwoven and manifold threads. The essence or nature of a being is the indefinite sum of its properties. Mill says:

"The definition, they say, unfolds the nature of the thing: but no definition can unfold its whole nature; and every proposition in which any quality whatever is predicated of the thing, unfolds some part of its nature. The true state of the case we take to be this. All definitions are of names, and of names only; but in some definitions it is clearly apparent, that nothing is intended except to explain the meaning of the word; while in others, besides explaining the meaning of the word, it is intended to be implied that there exists a thing, corresponding to the word."

Abandon, then, the vain hope of eliminating from properties some primitive and mysterious being, the source and abstract of the whole; leave entities to Duns Scotus; do not fancy that, by probing your ideas in the German fashion, by classifying objects according to genera and species like the schoolmen, by reviving the nominalism of the Middle Ages or the riddles of Hegelian metaphysics, you will ever supply the want of experience. There are no definitions of things; if there are definitions, they only define names. No phrase can tell me what a horse is; but there are phrases which will in-

1 Mill’s Logic, i. 162.
form me what is meant by these five letters. No phrase can exhaust the inexhaustible sum of qualities which make up a being; but several phrases may point out the facts corresponding to a word. In this case definition is possible, because we can always make an analysis, which will enable us to pass from the abstract and summary term to the attributes which it represents, and from these attributes to the inner or concrete feelings which constitute their foundation. From the term "dog" it enables us to rise to the attributes "mammiferous," "carnivorous," and others which it represents; and from these attributes to the sensations of sight, of touch, of the dissecting knife, on which they are founded. It reduces the compound to the simple, the derived to the primitive. It brings back our knowledge to its origin. It transforms words into facts. If some definitions, such as those of geometry, seem capable of giving rise to long sequences of new truths, it is because, in addition to the explanation of a word, they contain the affirmation of a thing. In the definition of a triangle there are two distinct propositions,—the one stating that "there may exist a figure bounded by three straight lines;" the other, that "such a figure may be termed a triangle." The first is a postulate, the second a definition. The first is hidden, the second evident; the first

1 "The definition above given of a triangle obviously comprises not one, but two propositions, perfectly distinguishable. The one is, 'There may exist a figure bounded by three straight lines;' the other, 'And this figure may be termed a triangle.' The former of these propositions is not a definition at all; the latter is a mere nominal definition, or explanation of the use and application of a term. The first is susceptible of truth or falsehood, and may therefore be made the foundation of a train of reasoning. The latter can neither be true nor false; the only character it is susceptible of is that of conformity to the ordinary usage of language."—Mill's Logic, i. 162.
may be true or false, the second can be neither. The first is the source of all possible theorems as to triangles, the second only resumes in a word the facts contained in the other. The first is a truth, the second, is a convention; the first is a part of science, the second an expedient of language. The first expresses a possible relation between three straight lines, the second gives a name to this relation. The first alone is fruitful, because it alone conforms to the nature of every fruitful proposition, and connects two facts. Let us, then, understand exactly the nature of our knowledge: it relates either to words or to things, or to both at once. If it is a matter of words, as in the definition of names, it attempts to refer words to our primitive feelings, that is to say, to the facts which form their elements. If it relates to beings, as in propositions about things, its whole effort is to link fact to fact, in order to connect the finite number of known properties with the infinite number to be known. If both are involved, as in the definitions of names which conceal a proposition relating to things, it attempts to do both. Everywhere its operation is the same. The whole matter in any case is to understand each other,—that is, to revert to facts, or to learn,—that is, to add facts to facts.

V.

The first rampart is destroyed; our adversaries take refuge behind the second—the Theory of Proof. This theory has passed for two thousand years for a substantiated, definite, unassailable truth. Many have deemed it useless, but no one has dared to call it false. On all sides it has been considered as an established
theorem. Let us examine it closely and attentively. What is a proof? According to logicians, it is a syllogism. And what is a syllogism? A group of three propositions of this kind: "All men are mortal; Prince Albert is a man; therefore Prince Albert is mortal." Here we have the type of a proof, and every complete proof is conformable to this type. Now what is there according to logicians, in this proof? A general proposition concerning all men, which gives rise to a particular proposition concerning a certain man. From the first we pass to the second, because the second is contained in the first; from the general to the particular, because the particular is comprised in the general. The second is but an instance of the first; its truth is contained beforehand in that of the first, and this is why it is a truth. In fact, as soon as the conclusion is no longer contained in the premisses, the reasoning is false, and all the complicated rules of the Middle Ages have been reduced by the Port-Royalists to this single rule, "The conclusion must be contained in the premisses." Thus the entire process of the human mind in its reasonings consists in recognising in individuals what is known of a whole class; in affirming in detail what has been established for the aggregate; in laying down a second time, and piecemeal, what has been laid down once for all at first.

By no means, replies Mill; for if it were so, our reasoning would be good for nothing. It would not be a progress, but a repetition. When I have affirmed that all men are mortal, I have affirmed implicitly that Prince Albert is mortal. In speaking of the whole class, that is to say, of all the individuals of the class, I have spoken of each individual, and therefore of Prince
Albert, who is one of them. I say nothing new, then, when I now mention him expressly. My conclusion teaches me nothing; it adds nothing to my positive knowledge; it only puts in another shape a knowledge which I already possessed. It is not fruitful, but purely verbal. If, then, reasoning be what logicians represent it, it is not instructive. I know as much of the subject at the beginning of my reasoning as at the end. I have transformed words into other words; I have been moving without gaining ground. Now this cannot be the case; for, in fact, reasoning does teach us new truths. I learn a new truth when I discover that Prince Albert is mortal, and I discover it by dint of reasoning; for, since he is still alive, I cannot have learnt it by direct observation. Thus logicians are mistaken; and beyond the scholastic theory of syllogism, which reduces reasoning to substitutions of words, we must look for a positive theory of proof, which shall explain how it is that, by the process of reasoning, we discover facts.

For this purpose, it is sufficient to observe, that general propositions are not the true proof of particular propositions. They seem so, but are not. It is not from the mortality of all men that I conclude Prince Albert to be mortal; the premises are elsewhere, and in the background. The general proposition is but a memento, a sort of abbreviative register, to which I have consigned the fruit of my experience. This memento may be regarded as a notebook to which we refer to refresh our memory; but it is not from the book that we draw our knowledge, but from the objects which we have seen. My memento is valuable only for the facts which it recalls. My general proposition
has no value except for the particular facts which it sums up.

"The mortality of John, Thomas, and company is, after all, the whole evidence we have for the mortality of the Duke of Wellington. Not one iota is added to the proof by interpolating a general proposition. Since the individual cases are all the evidence we can possess, evidence which no logical form into which we choose to throw it can make greater than it is; and since that evidence is either sufficient in itself, or, if insufficient for the one purpose, cannot be sufficient for the other; I am unable to see why we should be forbidden to take the shortest cut from these sufficient premisses to the conclusion, and constrained to travel the 'high priori road' by the arbitrary fiat of logicians." ¹

"The true reason which makes us believe that Prince Albert will die is, that his ancestors, and our ancestors, and all the other persons who were their contemporaries, are dead. These facts are the true premisses of our reasoning." It is from them that we have drawn the general proposition; they have taught us its scope and truth; it confines itself to mentioning them in a shorter form; it receives its whole substance from them; they act by it and through it, to lead us to the conclusion to which it seems to give rise. It is only their representative, and on occasion they do without it. Children, ignorant people, animals know that the sun will rise, that water will drown them, that fire will burn them, without employing this general proposition. They reason, and we reason, too, not from the general to the particular, but from particular to particular:

"All inference is from particulars to particulars; General propositions are merely registers of such inferences already made,

¹ Mill's Logic, i. 211.
and short formulae for making more: The major premise of a syllogism, consequently, is a formula of this description: and the conclusion is not an inference drawn from the formula, but an inference drawn according to the formula: the real logical antecedent, or premisses, being the particular facts from which the general proposition was collected by induction. Those facts, and the individual instances which supplied them, may have been forgotten; but a record remains, not indeed descriptive of the facts themselves, but showing how those cases may be distinguished respecting which the facts, when known, were considered to warrant a given inference. According to the indications of this record we draw our conclusion; which is to all intents and purposes, a conclusion from the forgotten facts. For this it is essential that we should read the record correctly: and the rules of the syllogism are a set of precautions to ensure our doing so."  

"If we had sufficiently capacious memories, and a sufficient power of maintaining order among a huge mass of details, the reasoning could go on without any general propositions; they are mere formulae for inferring particulars from particulars."  

Here, as before, logicians are mistaken: they gave the highest place to verbal operations, and left the really fruitful operations in the background. They gave the preference to words over facts. They perpetuated the nominalism of the Middle Ages. They mistook the explanation of names for the nature of things, and the transformation of ideas for the progress of the mind. It is for us to overturn this order in logic, as we have overturned it in science, to exalt particular and instructive facts, and to give them in our theories that superiority and importance which our practice has conferred upon them for three centuries past.

1 Mill's Logie, i. 218.  
2 Ibid. i. 240.
VI.

There remains a kind of philosophical fortress in which the Idealists have taken refuge. At the origin of all proof are Axioms, from which all proofs are derived. Two straight lines cannot enclose a space; two things, equal to a third, are equal to one another; if equals be added to equals, the wholes are equal. These are instructive propositions, for they express, not the meanings of words, but the relations of things. And, moreover, they are fertile propositions; for arithmetic, algebra, and geometry are all the result of their truth. On the other hand, they are not the work of experience, for we need not actually see with our eyes two straight lines in order to know that they cannot enclose a space; it is enough for us to refer to the inner mental conception which we have of them: the evidence of our senses is not needed for this purpose; our belief arises wholly, with its full force, from the simple comparison of our ideas. Moreover, experience follows these two lines only to a limited distance, ten, a hundred, a thousand feet; and the axiom is true for a thousand, a hundred thousand, a million miles, and for an unlimited distance. Thus, beyond the point at which experience ceases, it is no longer experience which establishes the axiom. Finally, the axiom is a necessary truth; that is to say, the contrary is inconceivable. We cannot imagine a space enclosed by two straight lines: as soon as we imagine the space enclosed, the two lines cease to be straight; and as soon as we imagine the two lines to be straight, the space ceases to be enclosed. In the assertion of axioms, the constituent ideas are irresistibly drawn together. In
the negation of axioms, the constituent ideas inevitably repel each other. Now this does not happen with truths of experience: they state an accidental relation, not a necessary connection; they lay down that two facts are connected, and not that they must be connected; they show us that bodies are heavy, not that they must be heavy. Thus, axioms are not, and cannot be the results of experience. They are not so, because we can form them mentally without the aid of experience; they cannot be so, because the nature and scope of their truths lie beyond the limits of experience. They have another and a deeper source. They have a wider scope, and they come from elsewhere.

Not so, answers Mill. Here again you reason like a schoolman; you forget the facts concealed behind your conceptions; for examine your first argument. Doubtless you can discover, without making use of your eyes, and by purely mental contemplation, that two straight lines cannot enclose a space; but this contemplation is but a displaced experiment. Imaginary lines here replace real lines: you construct the figure in your mind instead of on paper: your imagination fulfils the office of a diagram on paper: you trust to it as you trust to the diagram, and it is as good as the other; for in regard to figures and lines the imagination exactly reproduces the sensation. What you have seen with your eyes open, you will see again exactly the same a minute afterwards with your eyes closed; and you can study geometrical properties transferred to the field of mental vision, as accurately as if they existed in the field of actual sight. There are, therefore, experiments of the brain as there are
ocular ones; and it is after just such an experiment that you deny to two straight lines, indefinitely prolonged, the property of enclosing a space. You need not for this purpose pursue them to infinity, you need only transfer yourself in imagination to the point where they converge, and there you have the impression of a bent line, that is of one which ceases to be straight.¹ Your presence there in imagination takes the place of an actual presence; you can affirm by it what you affirmed by your actual presence, and as positively. The first is only the second in a more commodious form, with greater flexibility and scope. It is like using a telescope instead of the naked eye; the revelations of the telescope are propositions of experience; so are those of the imagination. As to the argument which distinguishes axioms from propositions of experience under the pretext that the contraries of the latter are conceivable, while the contraries of axioms are inconceivable, it is nugatory, for this distinction does not exist. Nothing prevents the contraries of certain propositions of experience from being conceivable, and

¹ "For though, in order actually to see that two given lines never meet, it would be necessary to follow them to infinity; yet without doing so we may know that if they ever do meet, or if, after diverging from one another, they begin again to approach, this must take place not at an infinite, but at a finite distance. Supposing, therefore, such to be the case, we can transport ourselves thither in imagination, and can frame a mental image of the appearance which one or both of the lines must present at that point, which we may rely on as being precisely similar to the reality. Now, whether we fix our contemplation upon this imaginary picture, or call to mind the generalisations we have had occasion to make from former ocular observation, we learn by the evidence of experience, that a line which, after diverging from another straight line, begins to approach to it, produces the impression on our senses which we describe by the expression 'a bent line,' not by the expression 'a straight line.'"—MILL'S Logic, i. 364.
the contraries of others inconceivable. That depends on the constitution of our minds. It may be that in some cases the mind may contradict its experience, and in others not. It is possible that in certain cases our conceptions may differ from our perceptions, and sometimes not. It may be that, in certain cases, external sight is opposed to internal, and in certain others not. Now, we have already seen that in the case of figures, the internal sight exactly reproduces the external. Therefore, in axioms of figures, the mental sight cannot be opposed to the actual; imagination cannot contradict sensation. In other words, the contraries of such axioms will be inconceivable. Thus axioms, although their contraries are inconceivable, are experiments of a certain class, and it is because they are so that their contraries are inconceivable. At every point there results this conclusion, which is the abstract of the system: every instructive or fruitful proposition is derived from experience, and is simply a connecting together of facts.

VII.

Hence it follows that Induction is the only key to nature. This theory is Mill’s masterpiece. Only so thorough-going a partisan of experience could have constructed the theory of Induction.

What, then, is Induction?

"Induction is that operation of the mind by which we infer that what we know to be true in a particular case or cases, will be true in all cases which resemble the former in certain assignable respects. In other words, Induction is the process by which we conclude that what is true of certain individuals
of a class is true of the whole class, or that what is true at
certain times will be true in similar circumstances at all
times."  

This is the reasoning by which, having observed that
Peter, John, and a greater or less number of men have
died, we conclude that all men will die. In short,
induction connects "mortality" with the quality of
"man;" that is to say, connects two general facts
ordinarily successive, and asserts that the first is the
Cause of the second.

This amounts to saying that the course of nature is
uniform. But induction does not set out from this
axiom, it leads up to it; we do not find it at the begin-
ning, but at the end of our researches. Fundamentally,
experience presupposes nothing beyond itself. No à
priori principle comes to authorise or guide her. We
observe that this stone has fallen, that this hot coal
has burnt us, that this man has died, and we have no
other means of induction except the addition and
comparison of these little isolated and transient facts.
We learn by simple practical experience that the sun
gives light, that bodies fall, that water quenches thirst,

1 Mill's Logic, i. 315.

2 "We must first observe, that there is a principle implied in the
very statement of what Induction is; an assumption with regard to the
course of nature and the order of the universe: namely, that there are
such things in nature as parallel cases; that what happens once, will,
under a sufficient degree of similarity of circumstances, happen again,
and not only again, but as often as the same circumstances recur.
This, I say, is an assumption, involved in every case of induction.
And, if we consult the actual course of nature, we find that the
assumption is warranted. The universe, so far as known to us, is so
constituted, that whatever is true in any one case, is true in all cases
of a certain description; the only difficulty is, to find what description."
—Mill's Logic, i. 337.
and we have no other means of extending or criticising these inductions than by other like inductions. Every observation and every induction draws its value from itself, and from similar ones. It is always experience which judges of experience, and induction of induction. The body of our truths has not, then, a soul distinct from it, and vivifying it; it subsists by the harmony of all its parts taken as a whole, and by the vitality of each part taken separately.

"Why is it that, with exactly the same amount of evidence, both negative and positive, we did not reject the assertion that there are black swans, while we should refuse credence to any testimony which asserted that there were men wearing their heads underneath their shoulders? The first assertion was more credible than the latter. But why more credible? So long as neither phenomenon had been actually witnessed, what reason was there for finding the one harder to be believed than the other? Apparently because there is less constancy in the colours of animals, than in the general structure of their internal anatomy. But how do we know this? Doubtless from experience. It appears, then, that we need experience to inform us in what degree, and in what cases, or sorts of cases, experience is to be relied on. Experience must be consulted in order to learn from it under what circumstances arguments from it will be valid. We have no ulterior test to which we subject experience in general; but we make experience its own test. Experience testifies, that among the uniformities which it exhibits, or seems to exhibit, some are more to be relied on than others; and uniformity, therefore, may be presumed, from any given number of instances, with a greater degree of assurance, in proportion as the case belongs to a class in which the uniformities have hitherto been found more uniform."  

1 Mill's Logic, i. 351.
Experience is the only test, and it is to be found everywhere.

Let us then consider how, without any help but that of experience, we can form general propositions, especially the most numerous and important of all, those which connect two successive events, by saying that the first is the cause of the second.

Cause is a great word; let us examine it. It carries in itself a whole philosophy. From the idea we have of Cause depend all our notions of nature. To give a new idea of Causation is to transform human thought; and we shall see how Mill, like Hume and Comte, but better than they, has put this idea into a new shape.

What is a cause? When Mill says that the contact of iron with moist air produces rust, or that heat dilates bodies, he does not speak of the mysterious bond by which metaphysicians connect cause and effect. He does not busy himself with the intimate force and generative virtue which certain philosophers insert between the thing producing and the product. Mill says:

"The only notion of a cause, which the theory of induction requires, is such a notion as can be gained from experience. The Law of Causation, the recognition of which is the main pillar of inductive science, is but the familiar truth, that invariability of succession is found by observation to obtain between every fact in nature and some other fact which has preceded it; independently of all consideration respecting the ulterior mode of production of phenomena, and of every other question regarding the nature of 'Things in themselves.'" ¹

No other foundation underlies these two expressions. We mean simply that everywhere, always, the contact

¹ Mill's *Logic*, i. 359.
of iron with the moist air will be followed by the appearance of rust; the application of heat by the dilatation of bodies: "The real cause is the whole of these antecedents."1 "There is no scientific foundation for distinguishing between the cause of a phenomenon and the conditions of its happening. . . . The distinction drawn between the patient and the agent is purely verbal." "The cause, then, philosophically speaking, is the sum total of the conditions, positive and negative, taken together; the whole of the contingencies of every description, which being realised, the consequent invariably follows."2 Much argument has been expended on the word necessary: "If there be any meaning which confessedly belongs to the term necessity, it is unconditionalness. That which is necessary, that which must be, means that which will be, whatever supposition we may make in regard to all other things."3 This is all we mean when we assert that the notion of cause includes the notion of necessity. We mean that the antecedent is sufficient and complete, that there is no need to suppose any additional antecedent, that it contains all requisite conditions, and that no other condition need exist. To follow unconditionally, then, is the whole notion of cause and effect. We have none else. Philosophers are mistaken when they discover in our will a different type of causation, and declare it an example of efficient cause in act and in exercise. We see nothing of the kind, but there, as elsewhere, we find only continuous successions. We do not see a fact engendering another fact, but a fact accompanying another. "Our will," says Mill, "produces our bodily actions as cold produces ice, or as a spark

1 Mill's Logic, i. 360.  
2 Ibid. i. 365.  
3 Ibid. i. 372.
produces an explosion of gunpowder.” There is here, as elsewhere, an antecedent, the resolution or state of mind, and a consequent, the effort or physical sensation. Experience connects them, and enables us to foresee that the effort will follow the resolution, as it enables us to foresee that the explosion of gunpowder will follow the contact of the spark. Let us then have done with all these psychological illusions, and seek only, under the names of cause and effect, for phenomena which form pairs without exception or condition.

Now, to establish these connections of phenomena, Mill discovers four methods, and only four,—namely, the Methods of Agreement,¹ of Difference,² of Resi-

¹ “If we take fifty crucibles of molten matter and let them cool, and fifty solutions and let them evaporate, all will crystallize. Sulphur, sugar, alum, salt—substances, temperatures, circumstances—all are as different as they can be. We find one, and only one, common fact—the change from the liquid to the solid state—and conclude, therefore, that this change is the invariable antecedent of crystallization. Here we have an example of the Method of Agreement. Its canon is:—

“‘I. If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon.’”—Mill’s Logic, i. 422.

² ‘A bird in the air breathes; plunged into carbonic acid gas, it ceases to breathe. In other words, in the second case, suffocation ensues. In other respects the two cases are as similar as possible, since we have the same bird in both, and they take place in immediate succession. They differ only in the circumstance of immersion in carbonic acid gas being substituted for immersion in the atmosphere, and we conclude that this circumstance is invariably followed by suffocation. The Method of Difference is here employed. Its canon is:—

“‘II. If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or the cause, or a necessary part of the cause, of the phenomenon.’”—
Mill’s Logic, i. 423.
due,¹ and of Concomitant Variations.² These are the only ways by which we can penetrate into nature. There are no other, and these are everywhere. And they all employ the same artifice, that is to say, elimination; for, in fact, induction is nothing else. You have two

¹ ["A combination of these methods is sometimes employed, and is termed the Indirect Method of Difference, or the Joint Method of Agreement and Difference. It is, in fact, a double employment of the Method of Agreement, first applying that method to instances in which the phenomenon in question occurs, and then to instances in which it does not occur. The following is its canon:—

"III. If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common, save the absence of that circumstance; the circumstance in which alone the two sets of instances differ, is the effect, or the cause, or a necessary part of the cause, of the phenomenon.""—Mill’s Logic, i. 429.

"If we take two groups—one of antecedents and one of consequents—and can succeed in connecting by previous investigations all the antecedents but one to their respective consequents, and all the consequents but one to their respective antecedents, we conclude that the remaining antecedent is connected to the remaining consequent. For example, scientific men had calculated what ought to be the velocity of sound according to the laws of the propagation of sonorous waves, but found that a sound actually travelled quicker than their calculations had indicated. This surplus or residue of speed was a consequent for which an antecedent had to be found. Laplace discovered the antecedent in the heat developed by the condensation of each sonorous wave, and this new element, when introduced into the calculation, rendered it perfectly accurate. This is an example of the Method of Residues, the canon of which is as follows:—

"IV. Subduct from any phenomenon such part as is known by previous inductions to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents."
—Mill’s Logic, i. 431

"Let us take two facts—as the presence of the earth and the oscillation of the pendulum, or again the presence of the moon and the flow of the tide. To connect these phenomena directly, we should have to suppress the first of them, and see if this suppression would occasion the stoppage of the second. Now, in both instances, such suppression
groups, one of antecedents, the other of consequents, each of them containing more or fewer elements, ten, for example. To what antecedent is each consequent joined? Is the first consequent joined to the first antecedent, or to the third, or sixth? The whole difficulty, and the only possible solution lie there. To resolve the difficulty, and to effect the solution, we must eliminate, that is, exclude those antecedents which are not connected with the consequent we are considering. But as we cannot exclude them effectually, and as in nature the pair of phenomena we are seeking is always surrounded with circumstances, we collect various cases, which by their diversity enable the mind to lop off these circumstances, and to discover the pair of phenomena distinctly. In short, we can only perform induction by discovering pairs of phenomena: we form these only by isolation; we isolate only by means of comparisons.

is impossible. So we employ an indirect means of connecting the phenomena. We observe that all the variations of the one correspond to certain variations of the other; that all the oscillations of the pendulum correspond to certain different positions of the earth; that all states of the tide correspond to positions of the moon. From this we conclude that the second fact is the antecedent of the first. These are examples of the Method of Concomitant Variations. Its canon is:—

"V. Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some fact of causation."—Mill's Logic, i. 435.

1 "The Method of Agreement," says Mill (Logic, i. 424), "stands on the ground that whatever can be eliminated, is not connected with the phenomenon by any law. The Method of Difference has for its foundation, that whatever can not be eliminated, is connected with the phenomenon by a law." The Method of Residues is a case of the Method of Differences. The Method of Concomitant Variations is another case of the same method; with this distinction, that it is applied, not to the phenomena, but to their variations.
VIII.

These are the rules; an example will make them clearer. We will show you the methods in exercise; here is an example which combines nearly the whole of them, namely, Dr. Well’s theory of dew. I will give it to you in Mill’s own words, which are so clear that you must have the pleasure of pondering over them: “We must separate dew from rain and the moisture of fogs, and limit the application of the term to what is really meant, which is, the spontaneous appearance of moisture on substances exposed in the open air when no rain or visible wet is falling.”¹ What is the cause of the phenomena we have thus defined, and how was that cause discovered?

‘Now, here we have analogous phenomena in the moisture which bedews a cold metal or stone when we breathe upon it; that which appears on a glass of water fresh from the well in hot weather; that which appears on the inside of windows when sudden rain or hail chills the external air; that which runs down our walls when, after a long frost, a warm moist thaw comes on.’ Comparing these cases, we find that they all contain the phenomenon which was proposed as the subject of investigation. Now ‘all these instances agree in one point, the coldness of the object dewed in comparison with the air in contact with it.’ But there still remains the most important case of all, that of nocturnal dew: does the same circumstance exist in this case? ‘Is it a fact that the object dewed is colder than the air? Certainly not, one would at first be inclined to say; for what is to make it so? But . . . the experiment is easy; we have only to lay a thermometer in contact with the dewed substance,

¹ This quotation, and all the others in this paragraph, are taken from Mill’s Logic, i. 451-9. Mr. Mill quotes from Sir John Herschel’s Discourse on the Study of Natural Philosophy.
and hang one at a little distance above it, out of reach of its influence. The experiment has been therefore made; the question has been asked, and the answer has been invariably in the affirmative. Whenever an object contracts dew, it is colder than the air.

"Here then is a complete application of the Method of Agreement, establishing the fact of an invariable connection between the deposition of dew on a surface, and the coldness of that surface compared with the external air. But which of these is cause, and which effect? or are they both effects of something else? On this subject the Method of Agreement can afford us no light: we must call in a more potent method. 'We must collect more facts, or, which comes to the same thing, vary the circumstances; since every instance in which the circumstances differ is a fresh fact: and especially, we must note the contrary or negative cases, i.e. where no dew is produced.' for a comparison between instances of dew and instances of no dew, is the condition necessary to bring the Method of Difference into play.

"'Now, first, no dew is produced on the surface of polished metals, but it is very copiously on glass, both exposed with their faces upwards, and in some cases the under side of a horizontal plate of glass is also dewed.' Here is an instance in which the effect is produced, and another instance in which it is not produced; but we cannot yet pronounce, as the canon of the Method of Difference requires, that the latter instance agrees with the former in all its circumstances except one: for the differences between glass and polished metals are manifold, and the only thing we can as yet be sure of is, that the cause of dew will be found among the circumstances by which the former substance is distinguished from the latter."

To detect this particular circumstance of difference, we have but one practicable method, that of Concomitant Variations:
‘In the cases of polished metal and polished glass, the contrast shows evidently that the substance has much to do with the phenomenon; therefore let the substance alone be diversified as much as possible, by exposing polished surfaces of various kinds. This done, a scale of intensity becomes obvious. Those polished substances are found to be most strongly dewed which conduct heat worst, while those which conduct well resist dew most effectually.’

‘The conclusion obtained is, that ceteris paribus the deposition of dew is in some proportion to the power which the body possesses of resisting the passage of heat; and that this, therefore (or something connected with this), must be at least one of the causes which assist in producing the deposition of dew on the surface.

‘But if we expose rough surfaces instead of polished, we sometimes find this law interfered with. Thus, roughened iron, especially if painted over or blackened, becomes dewed sooner than varnished paper: the kind of surface, therefore, has a great influence. Expose, then, the same material in very diversified states as to surface’ (that is, employ the Method of Difference to ascertain concomitance of variations), ‘and another scale of intensity becomes at once apparent; those surfaces which part with their heat most readily by radiation, are found to contract dew most copiously.’

‘The conclusion obtained by this new application of the method is, that ceteris paribus the deposition of dew is also in some proportion to the power of radiating heat; and that the quality of doing this abundantly (or some cause on which that quality depends) is another of the causes which promote the deposition of dew on the substance.

‘Again, the influence ascertained to exist of substance and surface leads us to consider that of texture; and here, again, we are presented on trial with remarkable differences, and with a third scale of intensity, pointing out substances of a close firm texture, such as stones, metals, etc., as unfavourable, but those
of a loose one, as cloth, velvet, wool, eiderdown, cotton, etc., as eminently favourable to the contraction of dew.' The Method of Concomitant Variations is here, for the third time, had recourse to; and, as before, from necessity, since the texture of no substance is absolutely firm or absolutely loose. Looseness of texture, therefore, or something which is the cause of that quality, is another circumstance which promotes the deposition of dew; but this third cause resolves itself into the first, viz., the quality of resisting the passage of heat: for substances of loose texture 'are precisely those which are best adapted for clothing, or for impeding the free passage of heat from the skin into the air, so as to allow their outer surfaces to be very cold, while they remain warm within.' 

"It thus appears that the instances in which much dew is deposited, which are very various, agree in this, and, so far as we are able to observe, in this only, that they either radiate heat rapidly or conduct it slowly: qualities between which there is no other circumstance of agreement than that by virtue of either, the body tends to lose heat from the surface more rapidly than it can be restored from within. The instances, on the contrary, in which no dew or but a small quantity of it, is formed, and which are also extremely various, agree (so far as we can observe) in nothing except in not having this same property.

"This doubt we are now able to resolve. We have found that, in every such instance, the substance must be one which, by its own properties or laws, would, if exposed in the night, become colder than the surrounding air. The coldness, therefore, being accounted for independently of the dew, while it is proved that there is a connection between the two, it must be the dew which depends on the coldness; or, in other words, the coldness is the cause of the dew.

"This law of causation, already so amply established, admits, however, of efficient additional corroboration in no less than three ways. First, by deduction from the known laws of aqueous vapour when diffused through air or any other gas,
and though we have not yet come to the Deductive Method, we will not omit what is necessary to render this speculation complete. It is known by direct experiment that only a limited quantity of water can remain suspended in the state of vapour at each degree of temperature, and that this maximum grows less and less as the temperature diminishes. From this it follows deductively, that if there is already as much vapour suspended as the air will contain at its existing temperature, any lowering of that temperature will cause a portion of the vapour to be condensed, and become water. But, again, we know deductively, from the laws of heat, that the contact of the air with a body colder than itself, will necessarily lower the temperature of the stratum of air immediately applied to its surface; and will therefore cause it to part with a portion of its water, which accordingly will, by the ordinary laws of gravitation or cohesion, attach itself to the surface of the body, thereby constituting dew. This deductive proof, it will have been seen, has the advantage of proving at once causation as well as co-existence; and it has the additional advantage that it also accounts for the exceptions to the occurrence of the phenomenon, the cases in which, although the body is colder than the air, yet no dew is deposited, by showing that this will necessarily be the case when the air is so undersupplied with aqueous vapour, comparatively to its temperature, that even when somewhat cooled by the contact of the colder body, it can still continue to hold in suspension all the vapour which was previously suspended in it; thus in a very dry summer there are no dews, in a very dry winter no hoar frost.

"The second corroboration of the theory is by direct experiment, according to the canon of the Method of Difference. We can, by cooling the surface of any body, find in all cases some temperature (more or less inferior to that of the surrounding air, according to its hygrometric condition) at which dew will begin to be deposited. Here, too, therefore, the causation is directly proved. We can, it is true, accomplish this only on a small
scale; but we have ample reason to conclude that the same operation, if conducted in Nature's great laboratory, would equally produce the effect.

"And, finally, even on that great scale we are able to verify the result. The case is one of those rare cases, as we have shown them to be, in which nature works the experiment for us in the same manner in which we ourselves perform it; introducing into the previous state of things a single and perfectly definite new circumstance, and manifesting the effect so rapidly that there is not time for any other material change in the pre-existing circumstances. 'It is observed that dew is never copiously deposited in situations much screened from the open sky, and not at all in a cloudy night; but if the clouds withdraw even for a few minutes, and leave a clear opening, a deposition of dew presently begins, and goes on increasing.... Dew formed in clear intervals will often even evaporate again when the sky becomes thickly overcast.' The proof, therefore, is complete, that the presence or absence of an uninterrupted communication with the sky causes the deposition or non-deposition of dew. Now, since a clear sky is nothing but the absence of clouds, and it is a known property of clouds, as of all other bodies between which and any given object nothing intervenes but an elastic fluid, that they tend to raise or keep up the superficial temperature of the object by radiating heat to it, we see at once that the disappearance of clouds will cause the surface to cool; so that Nature in this case produces a change in the antecedent by definite and known means, and the consequent follows accordingly: a natural experiment which satisfies the requisitions of the Method of Difference."

IX.

These four are not all the scientific methods, but they lead up to the rest. They are all linked together, and no one has shown their connection better than Mill.
In many cases these processes of isolation are powerless; namely, in those in which the effect, being produced by a concourse of causes, cannot be reduced into its elements. Methods of isolation are then impracticable. We cannot eliminate, and consequently we cannot perform induction. This serious difficulty presents itself in almost all cases of motion, for almost every movement is the effect of a concurrence of forces; and the respective effects of the various forces are found so mixed up in it that we cannot separate them without destroying it, so that it seems impossible to tell what part each force has in the production of the movement. Take a body acted upon by two forces whose directions form an angle: it moves along the diagonal; each part, each moment, each position, each element of its movement, is the combined effect of the two impelling forces. The two effects are so commingled, that we cannot isolate either of them, and refer it to its source. In order to perceive each effect separately, we should have to consider the movements apart, that is, to suppress the actual movement, and to replace it by others. Neither the Method of Agreement, nor of Difference, nor of Residues, nor of Concomitant Variations, which are all decomposing and eliminative, can avail against a phenomenon which by its nature excludes all elimination and decomposition. We must therefore evade the obstacle; and it is here that the last key of nature appears, the Method of Deduction. We quit the study of the actual phenomenon to observe other and simpler cases; we establish their laws, and we connect each with its cause by the ordinary methods of induction. Then, assuming the concurrence of two or of several of these causes, we conclude from their known laws what
will be their total effect. We next satisfy ourselves as to whether the actual movement exactly coincides with the movement foretold; and if this is so, we attribute it to the causes from which we have deduced it. Thus, in order to discover the causes of the planetary motions, we seek by simple induction the laws of two causes: first, the force of primitive impulsion in the direction of the tangent; next, an accelerative attracting force. From these inductive laws we deduce by calculation the motion of a body submitted to their combined influence; and satisfying ourselves that the planetary motions observed coincide exactly with the predicted movements, we conclude that the two forces in question are actually the causes of the planetary motions. "To the Deductive Method," says Mill, "the human mind is indebted for its most conspicuous triumphs in the investigation of nature. To it we owe all the theories by which vast and complicated phenomena are embraced under a few simple laws." Our deviations have led us further than the direct path; we have derived efficiency from imperfection.

X.

If we now compare the two methods, their aptness, function, and provinces, we shall find, as in an abstract, the history, divisions, hopes, and limits of human science. The first appears at the beginning, the second at the end. The first necessarily gained ascendancy in Bacon's time,¹ and now begins to lose it; the second necessarily lost ascendancy in Bacon's time, and now begins to regain it. So that science, after having

¹ Mill's Logic, i. 526.
passed from the deductive to the experimental state, is now passing from the experimental to the deductive. Induction has for its province phenomena which are capable of being decomposed, and on which we can experiment. Deduction has for its province indecomposable phenomena, or those on which we cannot experiment. The first is efficacious in physics, chemistry, zoology, and botany, in the earlier stages of every science, and also whenever phenomena are but slightly complicated, within our reach, capable of being modified by means at our disposal. The second is efficacious in astronomy, in the higher branches of physics, in physiology, history, in the higher grades of every science, whenever phenomena are very complicated, as in animal and social life, or lie beyond our reach, as the motions of the heavenly bodies and the changes of the atmosphere. When the proper method is not employed, science is at a stand-still: when it is employed, science progresses. Here lies the whole secret of its past and its present. If the physical sciences remained stationary till the time of Bacon, it was because men used deduction when they should have used induction. If physiology and the moral sciences are now making slow progress, it is because we employ induction when deduction should be used. It is by deduction, and according to physical and chemical laws, that we shall be enabled to explain physiological phenomena. It is by deduction, and according to mental laws, that we shall be enabled to explain historical phenomena.\footnote{See chapter 9, book vi. v. 2, 478, on The Physical or Concrete Deductive Method as applied to Sociology; and chapter 13, book iii., for explanations, after Liebig, of Decomposition, Respiration, the Action of Poisons, etc. A whole book is devoted to the logic of the moral sciences; I know no better treatise on the subject.} And that which has
become the instrument of these two sciences, it is the object of all the others to employ. All tend to become deductive, and aim at being summed up in certain general propositions, from which the rest may be deduced. The less numerous these propositions are, the more science advances. The fewer suppositions and postulates a science requires, the more perfect it is become. Such a reduction is its final condition. Astronomy, acoustics, optics, present its models; we shall know nature when we shall have deduced her millions of facts from two or three laws.

I venture to say that the theory which you have just heard is perfect. I have omitted several of its characteristics, but you have seen enough to recognise that induction has nowhere been explained in so complete and precise a manner, with such an abundance of fine and just distinctions, with such extensive and exact applications, with such a knowledge of the practical methods and ascertained results of science, with so complete an exclusion of metaphysical principles and arbitrary suppositions, and in a spirit more in conformity with the rigorous procedure of modern experimental science. You asked me just now what Englishmen have effected in philosophy; I answer, the theory of Induction Mill is the last of that great line of philosophers, which begins at Bacon, and which, through Hobbes, Newton, Locke, Hume, Herschell, is continued down to our own times. They have carried our national spirit into philosophy; they have been positive and practical; they have not soared above facts; they have not attempted out-of-the-way paths; they have cleared the human mind of its illusions, presumptions, and fancies. They have employed it in the only direction in which
it can act; they only wished to mark out and light up the already well-trodden ways of the progressive sciences. They have not been willing to spend their labour vainly in other than explored and verified paths; they have aided in the great modern work, the discovery of applicable laws; they have contributed, as men of special attainments do, to the increase of man's power. Can you find many philosophers who have done as much?

XI.

You will tell me that our philosopher has clipped his wings in order to strengthen his legs. Certainly; and he has acted wisely. Experience limits the career which it opens to us; it has given us our goal, but also our boundaries. We have only to observe the elements of which our experience is composed, and the facts from which it sets out, to understand that its range is limited. Its nature and its method confine its progress to a few steps. And, in the first place,¹ the ultimate laws of nature cannot be less numerous than the several distinct species of our sensations. We can easily reduce a movement to another movement, but not the sensation of heat to that of smell, or of colour, or of sound, nor either of these to a movement. We can easily connect together phenomena of different degrees, but not phenomena differing in species. We find distinct sensations at the bottom of all our knowledge, as simple indecomposable elements, separated absolutely one from another, absolutely incapable of being reduced one to another. Let experience do what she will, she cannot suppress these diversities which

¹ Mill's Logic, ii. 4.
constitute her foundation. On the other hand, experience, do what she will, cannot escape from the conditions under which she acts. Whatever be her province, it is bounded by time and space; the fact which she observes, is limited and influenced by an infinite number of other facts to which she cannot attain. She is obliged to suppose or recognise some primordial condition from whence she starts, and which she does not explain.\(^1\) Every problem has its accidental or arbitrary data: we deduce the rest from these, but there is nothing from which these can be deduced. The sun, the earth, the planets, the initial impulse of the heavenly bodies, the primitive chemical properties of substances, are such data.\(^2\) If we possessed them all we could explain

\(^1\) "There exists in nature a number of Permanent Causes, which have subsisted ever since the human race has been in existence, and for an indefinite and probably an enormous length of time previous. The sun, the earth, and planets, with their various constituents, air, water, and the other distinguishable substances, whether simple or compound, of which nature is made up, are such Permanent Causes. They have existed, and the effects or consequences which they were fitted to produce have taken place (as often as the other conditions of the production met), from the very beginning of our experience. But we can give no account of the origin of the Permanent Causes themselves."—Mill’s Logic, i. 378.

\(^2\) "The resolution of the laws of the heavenly motions established the previously unknown ultimate property of a mutual attraction between all bodies: the resolution, so far as it has yet proceeded, of the laws of crystallisation, or chemical composition, electricity, magnetism, etc., points to various polarities, ultimately inherent in the particles of which bodies are composed; the comparative atomic weights of different kinds of bodies were ascertained by resolving, into more general laws, the uniformities observed in the proportions in which substances combine with one another; and so forth. Thus, although every resolution of a complex uniformity into simpler and more elementary laws has an apparent tendency to diminish the number of the ultimate properties, and really does remove many properties from the list; yet (since the result of this simplifying process is to trace

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everything by them, but we could not explain these themselves. Mill says:

"Why these particular natural agents existed originally and no others, or why they are commingled in such and such proportions, and distributed in such and such a manner throughout space, is a question we cannot answer. More than this: we can discover nothing regular in the distribution itself; we can reduce it to no uniformity, to no law. There are no means by which, from the distribution of these causes or agents in one part of space, we could conjecture whether a similar distribution prevails in another."\(^1\)

And astronomy, which, just now, afforded us the model of a perfect science, now affords us an example of a limited science. We can predict the numberless positions of all the planetary bodies; but we are obliged to assume, beside the primitive impulse and its amount, not only the force of attraction and its law, but also the masses and distances of all the bodies in question. We understand millions of facts, but it is by means of a hundred facts which we do not comprehend; we arrive at necessary results, but it is only by means of accidental antecedents; so that if the theory of our universe were completed there would still remain two great voids: one at the commencement of the physical world, the other at the beginning of the moral world; the one comprising the elements of being, the other embracing the elements of experience; one containing primary up an ever greater variety of different effects to the same agents), the further we advance in this direction, the greater number of distinct properties we are forced to recognise in one and the same object; the co-existences of which properties must accordingly be ranked among the ultimate generalities of nature."—Mill's Logic, ii. 108.

\(^1\) Ibid. i. 378.
sensations, the other primitive agents. “Our knowledge,” says Royer-Collard, “consists in tracing ignorance as far back as possible.”

Can we at least affirm that these irreducible data are so only in appearance, and in relation to our mind? Can we say that they have causes, like the derived facts of which they are the causes? Can we conclude that every event, always and everywhere, happens according to laws, and that this little world of ours, so well regulated, is a sort of epitome of the universe? Can we by aid of the axioms, quit our narrow confines, and affirm anything of the universe? In no wise; and it is here that Mill pushes his principles to their furthest consequences: for the law which attributes a cause to every event, has to him no other foundation, worth, or scope, than what it derives from experience. It has no inherent necessity; it draws its whole authority from the great number of cases in which we have recognised it to be true; it only sums up a mass of observations; it unites two data, which, considered in themselves, have no intimate connection; it joins antecedents generally to consequents generally, just as the law of gravitation joins a particular antecedent to a particular consequent; it determines a couple, as do all experimental laws, and shares in their uncertainty and in their restrictions. Listen to this bold assertion:

“I am convinced that any one accustomed to abstraction and analysis, who will fairly exert his faculties for the purpose, will, when his imagination has once learnt to entertain the notion, find no difficulty in conceiving that in some one, for instance, of the many firmaments into which sidereal astronomy now divides the universe, events may succeed one another at random, without any fixed law; nor can anything in our experience, or in
our mental nature, constitute a sufficient, or indeed any, reason for believing that this is nowhere the case. The grounds, therefore, which warrant us in rejecting such a supposition with respect to any of the phenomena of which we have experience, must be sought elsewhere than in any supposed necessity of our intellectual faculties."  

Practically, we may trust in so well-established a law; but

"In distant parts of the stellar regions, where the phenomena may be entirely unlike those with which we are acquainted, it would be folly to affirm confidently that this general law prevails, any more than those special ones which we have found to hold universally on our own planet. The uniformity in the succession of events, otherwise called the law of causation, must be received not as a law of the universe, but of that portion of it only which is within the range of our means of sure observation, with a reasonable degree of extension to adjacent cases. To extend it further is to make a supposition without evidence, and to which, in the absence of any ground from experience for estimating its degree of probability, it would be idle to attempt to assign any."  

We are, then, irrevocably driven back from the infinite; our faculties and our assertions cannot attain to it; we remain confined in a small circle; our mind reaches not beyond its experience; we can establish no universal and necessary connection between facts; such a connection probably does not even exist. Mill stops here; but certainly, by carrying out his idea to its full extent, we should arrive at the conception of the world as a mere collection of facts; no internal necessity would induce their connection or their existence; they would be simple arbitrary, accidentally-existing facts.

1 Mill's Logic, ii. 95.  2 Ibid. ii. 104.
Sometimes, as in our system, they would be found assembled in such a manner as to give rise to regular recurrences; sometimes they would be so assembled that nothing of the sort would occur. Chance, as Democritus taught, would be at the foundation of all things. Laws would be the result of chance, and sometimes we should find them, sometimes not. It would be with existences as with numbers—decimal fractions, for instance, which according to the chance of their two primitive factors, sometimes recur regularly, and sometimes not. This is certainly an original and lofty conception. It is the final consequence of the primitive and dominant idea, which we have discovered at the beginning of the system, which has transformed the theories of Definition, of Propositions, and of the Syllogism; which has reduced axioms to experimental truths; which has developed and perfected the theory of induction; which has established the goal, the limits, the province, and the methods of science; which everywhere, in nature and in science, has suppressed interior connections; which has replaced the necessary by the accidental; cause by antecedent; and which consists in affirming that every assertion which is not merely verbal forms in effect a couple, that is to say, joins together two facts which were separate by their nature.

§ 2.—Abstraction.

I.

An abyss of chance and an abyss of ignorance. The prospect is gloomy: no matter, if it be true. At all events, this theory of science is a theory of English science. Rarely, I grant you, has a thinker better
summed up in his teaching the practice of his country; seldom has a man better represented by his negations and his discoveries the limits and scope of his race. The operations, of which he constructs science, are those in which the English excel all others, and those which he excludes from science are precisely those in which the English are deficient more than any other nation. He has described the English mind whilst he thought to describe the human mind. That is his glory, but it is also his weakness. There is in your idea of knowledge a flaw of which the incessant repetition ends by creating the gulf of chance, from which, according to him, all things arise, and the gulf of ignorance, at whose brink, according to him, our knowledge ends. And see what comes of it. By cutting away from science the knowledge of first causes, that is, of divine things, you reduce men to become sceptical, positive, utilitarian, if they are cool-headed; or mystical, enthusiastic, methodistical, if they have lively imaginations. In this huge unknown void which you place beyond our little world, passionate men and uneasy consciences find room for all their dreams; and men of cold judgment, despairing of arriving at any certain knowledge, have nothing left but to sink down to the search for practical means which may serve for the amelioration of our condition. It seems to me that these two dispositions are most frequently met with in an English mind. The religious and the positive spirit dwell there side by side, but separate. This produces an odd medley, and I confess that I prefer the way in which the Germans have reconciled science with faith.—But their philosophy is but badly written poetry.—Perhaps so.—But what they call reason, or intuition of principles, is only
the faculty of building up hypotheses.—Perhaps so.—But the systems which they have constructed have not held their ground before experience.—I do not defend what they have done.—But their absolute, their subject, their object, and the rest, are but big words.—I do not defend their style.—What, then, do you defend?—Their idea of Causation.—You believe with them that causes are discovered by a revelation of the reason!—By no means.—You believe with us that our knowledge of causes is based on simple experience?—Still less.—You think, then, that there is a faculty, other than experience and reason, capable of discovering causes?—Yes.—You think there is an intermediate course between intuition and observation, capable of arriving at principles, as it is affirmed that the first is, capable of arriving at truths, as we find that the second is?—Yes.—What is it? Abstraction. Let us return to your original idea; I will endeavour to show in what I think it incomplete, and how you seem to me to mutilate the human mind. But my argument will be the formal one of an advocate, and requires to be stated at length.

II.

Your starting-point is good: man, in fact, does not know anything of substances; he knows neither minds nor bodies; he perceives only transient, isolated, internal conditions; he makes use of these to affirm and name exterior states, positions, movements, changes, and avails himself of them for nothing else. He can only attain to facts, whether within or without, sometimes transient, when his impression is not repeated; sometimes permanent, when his impression many times
repeated, makes him suppose that it will be repeated as often as he wishes to experience it. He only grasps colours, sounds, resistances, movements, sometimes momentary and variable, sometimes like one another, and renewed. To group these facts more advantageously, he supposes, by an artifice of language, qualities and properties. We go even further than you: we think that there are neither minds nor bodies, but simply groups of present or possible movements or thoughts. We believe that there are no substances, but only systems of facts. We regard the idea of substance as a psychological illusion. We consider substance, force, and all the modern metaphysical existences, as the remains of scholastic entities. We think that there exists nothing but facts and laws, that is, events and the relations between them; and we recognise, with you, that all knowledge consists first of all in connecting or adding fact to fact. But when this is done, a new operation begins, the most fertile of all, which consists in reducing these complex into simple facts. A splendid faculty appears, the source of language, the interpreter of nature, the parent of religions and philosophies, the only genuine distinction, which, according to its degree, separates man from the brute, and great from little men. I mean Abstraction, which is the power of isolating the elements of facts, and of considering them one by one. My eyes follow the outline of a square, and abstraction isolates its two constituent properties, the equality of its sides and angles. My fingers touch the surface of a cylinder, and abstraction isolates its two generative elements, the idea of a rectangle, and of the revolution of this rectangle about one of its sides as an axis. A hundred thousand
experiments develop for me, by an infinite number of
details, the series of physiological operations which
constitute life; and abstraction isolates the law of this
series, which is a round of constant loss and continual
reparation. Twelve hundred pages teach me Mill's
opinion on the various facts of science, and abstraction
isolates his fundamental idea, namely, that the only
fertile propositions are those which connect a fact with
another not contained in the first. Everywhere the
case is the same. A fact, or a series of facts, can
always be resolved into its components. It is this
resolution which forms our problem, when we ask what
is the nature of an object. It is these components we
look for when we wish to penetrate into the inner
nature of a being. These we designate under the
names of forces, causes, laws, essences, primitive pro-
properties. They are not new facts added to the first,
but an essence or extract from them; they are contained
in the first, they have no existence apart from the
facts themselves. When we discover them, we do not
pass from one fact to another, but from one to another
aspect of the same fact; from the whole to a part,
from the compound to the components. We only see
the same thing under two forms; first, as a whole, then
as divided: we only translate the same idea from one
language into another, from the language of the senses
into abstract language, just as we express a curve by
an equation, or a cube as a function of its side. It
signifies little whether this translation be difficult or
not; or that we generally need the accumulation or
comparison of a vast number of facts to arrive at it,
and whether our mind may not often succumb before
accomplishing it. However this may be, in this opera-
tion, which is evidently fertile, instead of proceeding from one fact to another, we go from the same to the same; instead of adding experiment to experiment, we set aside some portion of the first; instead of advancing, we pause to examine the ground we stand on. There are, thus, fruitful judgments, which, however, are not the results of experience: there are essential propositions, which, however, are not merely verbal: there is, thus, an operation, differing from experience, which acts by cutting down instead of by addition; which, instead of acquiring, devotes itself to acquired data; and which, going farther than observation, opening a new field to the sciences, defines their nature, determines their progress, completes their resources, and marks out their end.

This is the great omission of your system. Abstraction is left in the background, barely mentioned, concealed by the other operations of the mind, treated as an appendage of Experience; we have but to re-establish it in the general theory, in order to reform the particular theories in which it is absent.

III.

To begin with Definitions. Mill teaches that there is no definition of things, and that when you define a sphere as the solid generated by the revolution of a semicircle about its diameter, you only define a name. Doubtless you tell me by this the meaning of a name, but you also teach me a good deal more. You state that all the properties of every sphere are derived from this generating formula; you reduce an infinitely complex system of facts to two elements; you transform
sensible into abstract data; you express the essence of the sphere, that is to say, the inner and primordial cause of all its properties. Such is the nature of every true definition; it is not content with explaining a name, it is not a mere description; it does not simply indicate a distinctive property; it does not limit itself to that ticketing of an object which will cause it to be distinguished from all others. There are, besides its definition, several other ways of causing the object to be recognised; there are other properties belonging to it exclusively: we might describe a sphere by saying that, of all bodies having an equal surface, it occupies the most space; or in many other ways. But such descriptions are not definitions; they lay down a characteristic and derived property, not a generating and primitive one; they do not reduce the thing to its factors, and reconstruct it before our eyes; they do not show its inner nature and its irreducible elements. A definition is a proposition which marks in an object that quality from which its others are derived, but which is not derived from others. Such a proposition is not verbal, for it teaches the quality of a thing. It is not the affirmation of an ordinary quality, for it reveals to us the quality which is the source of the rest. It is an assertion of an extraordinary kind, the most fertile and valuable of all, which sums up a whole science, and in which it is the aim of every science to be summed up. There is a definition in every science, and one for each object. We do not in every case possess it, but we search for it everywhere. We have arrived at defining the planetary motion by the tangential force and attraction which compose it; we can already partially define a chemical body by the notion
of equivalent, and a living body by the notion of type. We are striving to transform every group of phenomena into certain laws, forces, or abstract notions. We endeavour to attain in every object the generating elements, as we do attain them in the sphere, the cylinder, the circle, the cone, and in all mathematical loci. We reduce natural bodies to two or three kinds of movement—attraction, vibration, polarisation—as we reduce geometrical bodies to two or three kinds of elements—the point, the movement, the line; and we consider our science partial or complete, provisional or definite, according as this reduction is approximate or absolute, imperfect or complete.

IV.

The same alteration is required in the Theory of Proof. According to Mill, we do not prove that Prince Albert will die by premising that all men are mortal, for that would be asserting the same thing twice over; but from the facts that John, Peter, and others, in short, all men of whom we have ever heard, have died.—I reply that the real source of our inference lies neither in the mortality of John, Peter, and company, nor in the mortality of all men, but elsewhere. We prove a fact, says Aristotle, by showing its cause. We shall therefore prove the mortality of Prince Albert by showing the cause which produces his death. And why will he die? Because the human body, being an unstable chemical compound, must in time be resolved; in other words, because mortality is added to the quality

1 See the Posterior Analytics, which are much superior to the Prior
—St alium eal wportepw.
of man. Here is the cause and the proof. It is this abstract law which, present in nature, will cause the death of the prince, and which, being present to my mind, shows me that he will die. It is this abstract proposition which is demonstrative; it is neither the particular nor the general propositions. In fact, the abstract proposition proves the others. If John, Peter, and others are dead, it is because mortality is added to the quality of man. If all men are dead, or will die, it is still because mortality is added to the quality of man. Here, again, the part played by Abstraction has been overlooked. Mill has confounded it with Experience; he has not distinguished the proof from the materials of the proof, the abstract law from the finite or indefinite number of its applications. The applications contain the law and the proof, but are themselves neither law nor proof. The examples of Peter, John, and others, contain the cause, but they are not the cause. It is not sufficient to add up the cases, we must extract from them the law. It is not enough to experimentalise, we must abstract. This is the great scientific operation. Syllogism does not proceed from the particular to the particular, as Mill says, nor from the general to the particular, as the ordinary logicians teach, but from the abstract to the concrete; that is to say, from cause to effect. It is on this ground that it forms part of science, the links of which it makes and marks out; it connects principles with effects; it brings together definitions and phenomena. It diffuses through the whole range of science that Abstraction which definition has carried to its summit.
V.

Abstraction explains also axioms. According to Mill, if we know that when equal magnitudes are added to equal magnitudes the wholes are equal, or that two straight lines cannot enclose a space, it is by external ocular experiment, or by an internal experiment by the aid of imagination. Doubtless we may thus arrive at the conclusion that two straight lines cannot enclose a space, but we might recognise it also in another manner. We might represent a straight line in imagination, and we may also form a conception of it by reason. We may either study its form or its definition. We can observe it in itself, or in its generating elements. I can represent to myself a line ready drawn, but I can also resolve it into its elements. I can go back to its formation, and discover the abstract elements which produce it, as I have watched the formation of the cylinder and discover the revolution of the rectangle which generated it. It will not do to say that a straight line is the shortest from one point to another, for that is a derived property; but I may say that it is the line described by a point, tending to approach towards another point, and towards that point only: which amounts to saying that two points suffice to determine a straight line; in other words, that two straight lines, having two points in common, coincide in their entire length; from which we see that if two straight lines approach to enclose a space, they would form but one straight line, and enclose nothing at all. Here is a second method of arriving at a knowledge of the axiom, and it is clear that it differs much from the first. In the first we verify; in the second we deduce
it. In the first we find by experience that it is true; in the second we prove it to be true. In the first we admit the truth; in the second we explain it. In the first we merely remark that the contrary of the axiom is inconceivable; in the second we discover in addition that the contrary of the axiom is contradictory. Having given the definition of the straight line, we find that the axiom that two straight lines cannot enclose a space is comprised in it, and may be derived from it, as a consequent from a principle. In fact, it is nothing more than an identical proposition, which means that the subject contains its attribute; it does not connect two separate terms, irreducible one to the other; it unites two terms, of which the second is a part of the first. It is a simple analysis, and so are all axioms. We have only to decompose them, in order to see that they do not proceed from one object to a different one, but are concerned with one object only. We have but to resolve the notions of equality, cause, substance, time, and space into their abstracts, in order to demonstrate the axioms of equality, substance, cause, time, and space. There is but one axiom, that of identity. The others are only its applications or its consequences. When this is admitted, we at once see that the range of our mind is altered. We are no longer merely capable of relative and limited knowledge, but also of absolute and infinite knowledge; we possess in axioms facts which not only accompany one another, but one of which includes the other. If, as Mill says, they merely accompanied one another, we should be obliged to conclude with him, that perhaps this might not always be the case. We should not see the inner necessity for their connection, and should only admit it as far as our
experience went; we should say that, the two facts being isolated in their nature, circumstances might arise in which they would be separate; we should affirm the truth of axioms only in reference to our world and mind. If, on the contrary, the two facts are such that the first contains the second, we should establish on this very ground the necessity of their connection; wheresoever the first may be found, it will carry the second with it, since the second is a part of it, and cannot be separated from it. Nothing can exist between them and divide them, for they are but one thing under different aspects. Their connection is therefore absolute and universal; and we possess truths which admit neither doubt nor limitation, nor condition, nor restriction. Abstraction restores to axioms their value, whilst it shows their origin; and we restore to science her dispossessed dominion, by restoring to the mind the faculty of which it had been deprived.

VI.

Induction remains to be considered, which seems to be the triumph of pure experience, while it is, in reality, the triumph of abstraction. When I discover by induction that cold produces dew, or that the passage from the liquid to the solid state produces crystallisation, I establish a connection between two abstract facts. Neither cold, nor dew, nor the passage from the liquid to the solid state, nor crystallisation, exist in themselves. They are parts of phenomena, extracts from complex cases, simple elements included in compound aggregates. I withdraw and isolate them; I isolate dew in general from all local, temporary, special dews which I observe; I isolate cold in general from
all special, various distinct colds which may be produced by all varieties of texture, all diversities of substance, all inequalities of temperature, all complications of circumstances. I join an abstract antecedent to an abstract consequent, and I connect them, as Mill himself shows, by subtractions, suppressions, eliminations; I expel from the two groups, containing them, all the proximate circumstances; I discover the couple under the surroundings which obscure it; I detach, by a series of comparisons and experiments, all the subsidiary accidental circumstances which have clung to it, and thus I end by laying it bare. I seem to be considering twenty different cases, and in reality I only consider one; I appear to proceed by addition, and in fact I am performing subtraction. All the methods of Induction, therefore, are methods of Abstraction, and all the work of Induction is the connection of abstract facts.

VII.

We see now the two great moving powers of science, and the two great manifestations of nature. There are two operations, experience and abstraction; there are two kingdoms, that of complex facts, and that of simple elements. The first is the effect, the second the cause. The first is contained in the second, and is deduced from it, as a consequent from its principle. The two are equivalent, they are one and the same thing considered under two aspects. This magnificent moving universe, this tumultuous chaos of mutually dependent events, this incessant life, infinitely varied and multiplied, may be all reduced to a few elements and their relations. Our whole efforts result in passing
from one to the other, from the complex to the simple, from facts to laws, from experiences to formulæ. And the reason of this is evident; for this fact which I perceive by the senses or the consciousness is but a fragment arbitrarily severed by my senses or my consciousness from the infinite and continuous woof of existence. If they were differently constituted, they would intercept other fragments; it is the chance of their structure which determines what is actually perceived. They are like open compasses, which might be more or less extended; and the area of the circle which they describe is not natural, but artificial. It is so in two ways, both externally and internally. For, when I consider an event, I isolate it artificially from its natural surroundings, and I compose it artificially of elements which do not form a natural group. When I see a falling stone, I separate the fall from the anterior circumstances which are really connected with it; and I put together the fall, the form, the structure, the colour, the sound, and twenty other circumstances which are really not connected with it. A fact, then, is an arbitrary aggregate, and at the same time an arbitrary severing;¹ that is to say, a factitious group, which separates things connected, and connects things that are separate. Thus, so long as we only regard nature by observation, we do not see it as it is: we have only a provisional and illusory idea of it. Nature is, in reality, a tapestry, of which we only see the reverse; this is why we try to turn it. We strive to discover laws; that is, the natural groups which are really distinct from their surroundings, and composed

¹ An eminent student of physical science said to me: "A fact is a superposition of laws."
of elements really connected. We discover couples; that is to say, real compounds and real connections. We pass from the accidental to the necessary, from the relative to the absolute, from the appearance to the reality; and having found these first couples, we practise upon them the same operation as we did upon facts, for, though in a less degree, they are of the same nature. Though more abstract, they are still complex. They may be decomposed and explained. There is some ulterior reason for their existence. There is some cause or other which constructs and unites them. In their case, as well as for facts, we can search for generating elements into which they may be resolved, and from which they may be deduced. And this operation may be continued until we have arrived at elements wholly simple; that is to say, such that their decomposition would involve a contradiction. Whether we can find them or not, they exist; the axiom of causation would be falsified if they were absent. There are, then, indecomposable elements, from which are derived more general laws; and from these, again, more special laws; and from these the facts which we observe; just as in geometry there are two or three primitive notions, from which are deduced the properties of lines, and from these the properties of surfaces, solids, and the numberless forms which nature can produce or the mind imagine. We can now comprehend the value and meaning of that axiom of causation which governs all things, and which Mill has mutilated. There is an inner constraining force which gives rise to every event, which unites every compound, which engenders every actual fact. This signifies, on the one hand, that there is a reason for everything; that every fact has its law;
that every compound can be reduced to simple elements; that every product implies factors; that every quality and every being must be reducible from some superior and anterior term. And it signifies, on the other hand, that the product is equivalent to the factors, that both are but the same thing under different aspects; that the cause does not differ in nature from the effect; that the generating powers are but elementary properties; that the active force by which we represent Nature to our minds is but the logical necessity which mutually transforms the compound and the simple, the fact and the law. Thus we determine beforehand the limits of every science; and we possess the potent formula, which, establishing the invincible connection and the spontaneous production of existences, places in Nature the moving spring of Nature, whilst it drives home and fixes in the heart of every living thing the iron fangs of necessity.

VIII.

Can we arrive at a knowledge of these primary elements? For my part, I think we can; and the reason is, that, being abstractions, they are not beyond the region of facts, but are comprised in them, so that we have only to extract them from the facts. Besides, being the most abstract, that is, the most general of all things, there are no facts which do not comprise them, and from which we cannot extract them. However limited our experience may be, we can arrive at these primary notions; and it is from this observation that the modern German metaphysicians have started in attempting their vast constructions. They understood that there are simple notions, that is to say, indecom-
posable abstract facts, that the combinations of these engender all others, and that the laws for their mutual union or contrarieties, are the primary laws of the universe. They tried to attain to these ideas, and to evolve by pure reason the world as observation shows it to us. They have partly failed; and their gigantic edifice, factitious and fragile, hangs in ruins, reminding one of those temporary scaffoldings which only serve to mark out the plan of a future building. The reason is, that with a high notion of our powers, they had no exact view of their limits. For we are outflanked on all sides by the infinity of time and space; we find ourselves thrown in the midst of this monstrous universe like a shell on the beach, or an ant at the foot of a steep slope. Here Mill is right. Chance is at the end of all our knowledge, as on the threshold of all our postulates: we vainly try to rise, and that by conjecture, to an initial state; but this state depends on the preceding one, which depends on another, and so on; and thus we are forced to accept it as a pure postulate, and to give up the hope of deducing it, though we know that it ought to be deduced. It is so in all sciences, in geology, natural history, physics, chemistry, psychology, history; and the primitive accidental fact extends its effects into all parts of the sphere in which it is comprised. If it had been otherwise, we should have neither the same planets, nor the same chemical compounds, nor the same vegetables, nor the same animals, nor the same races of men, nor, perhaps, any of these kinds of beings. If an ant were taken into another country, it would see neither the same trees, nor insects, nor dispositions of the soil, nor changes of the atmosphere, nor perhaps any of these forms of existence. There is, then, in
every fact and in every object, an accidental and local part, a vast portion, which, like the rest, depends on primitive laws, but not directly, only through an infinite circuit of consequences, in such a way that between it and the primitive laws there is an infinite hiatus, which can only be bridged over by an infinite series of deductions.

Such is the inexplicable part of phenomena, and this is what the German metaphysicians tried to explain. They wished to deduce from their elementary theorems the form of the planetary system, the various laws of physics and chemistry, the main types of life, the progress of human civilisations and thought. They contorted their universal formulae with the view of deriving from them particular cases; they took indirect and remote consequences as direct and proximate ones; they omitted or suppressed the great work which is interposed between the first laws and the final consequences; they discarded Chance from their construction, as a basis unworthy of science; and the void so left, badly filled up by deceptive materials, caused the whole edifice to fall to ruins.

Does this amount to saying, that in the facts with which this little corner of the universe furnishes us, everything is local? By no means. If an ant were capable of making experiments, it might attain to the idea of a physical law, a living form, a representative sensation, an abstract thought; for a foot of ground, on which there is a thinking brain, includes all these. Therefore, however limited be the field of the mind, it contains general facts; that is, facts spread over very vast external territories, into which its limitation prevents it from penetrating. If the ant were capable of
reasoning, it might construct arithmetic, algebra, geometry, mechanics; for a movement of half an inch contains in the abstract, time, space, number, and force, all the materials of mathematics: therefore, however limited the field of a mind’s researches be, it includes universal data; that is, facts spread over the whole region of time and space. Again, if the ant were a philosopher, it might evolve the ideas of existence, of nothingness, and all the materials of metaphysics; for any phenomenon, interior or exterior, suffices to present these materials: therefore, however limited the field of a mind be, it contains absolute truths; that is, such that there is no object from which they could be absent. And this must necessarily be so; for the more general a fact is, the fewer objects need we examine to meet with it. If it is universal, we meet with it everywhere; if it is absolute, we cannot escape meeting it. This is why, in spite of the narrowness of our experience, metaphysics, I mean the search for first causes, is possible, but on condition that we remain at a great height, that we do not descend into details, that we consider only the most simple elements of existence, and the most general tendencies of nature. If any one were to collect the three or four great ideas in which our sciences result, and the three or four kinds of existence which make up our universe; if he were to compare those two strange quantities which we call duration and extension, those principle forms or determinations of quantity which we call physical laws, chemical types, and living species, and that marvellous representative power, the Mind, which, without falling into quantity, reproduces the other two and itself; if he discovered among these three terms—the pure quantity, the determined quan-
tity, and the suppressed quantity\(^1\)--such an order that
the first must require the second, and the second the
third; if he thus established that the pure quantity is
the necessary commencement of Nature, and that
Thought is the extreme term at which Nature is wholly
suspended; if, again, isolating the elements of these
data, he showed that they must be combined just as
they are combined, and not otherwise: If he proved,
moreover, that there are no other elements, and that
there can be no other, he would have sketched out a
system of metaphysics without encroaching on the
positive sciences, and have attained the source without
being obliged to descend to trace the various streams.

In my opinion, these two great operations, Experience
as you have described it, and Abstraction, as I have tried
to define it, comprise in themselves all the resources of
the human mind, the one in its practical, the other in
its speculative direction. The first leads us to consider
nature as an assemblage of facts, the second as a system
of laws: the exclusive employment of the first is
English; that of the second, German. If there is a
place between these two nations, it is ours. We have
extended the English ideas in the eighteenth century;
and now we can, in the nineteenth, add precision to
German ideas. Our business is to restrain, to correct,
to complete the two types of mind, one by the other, to
combine them together, to express their ideas in a style
generally understood, and thus to produce from them
the universal mind.

IX.

We went out. As it ever happens in similar cir-

\(^1\) Die aufgehobene Quantität.
cumstances, each had caused the other to reflect, and neither had convinced the other. But our reflections were short: in the presence of a lovely August morning, all arguments fall to the ground. The old walls, the rain-worn stones, smiled in the rising sun. A fresh light rested on their embrasures, on the keystones of the cloisters, on the glossy ivy leaves. Roses and honeysuckles climbed the walls, and their flowers quivered and sparkled in the light breeze. The fountains murmured in the vast lonely courts. The beautiful town stood out from the morning's mist, as adorned and tranquil as a fairy palace, and its robe of soft rosy vapour was indented, as an embroidery of the Renaissance, by a border of towers, cloisters, and palaces, each enclosed in verdure and decked with flowers. The architecture of all ages had mingled their arches, trefoils, statues, and columns; time had softened their tints; the sun united them in its light, and the old city seemed a shrine to which every age and every genius had successively added a jewel. Beyond this, the river rolled its broad sheets of silver: the mowers stood up to the knee in the high grass of the meadows. Myriads of buttercups and meadow-sweets; grasses, bending under the weight of their grey heads, plants sated with the dew of the night, swarmed in the rich soil. Words cannot express this freshness of tints, this luxuriance of vegetation. The more the long line of shade receded, the more brilliant and full of life the flowers appeared. On seeing them, virgin and timid in their gilded veil, I thought of the blushing cheeks and fine modest eyes of a young girl who puts on for the first time her necklace of jewels. Around, as though to guard them, enormous trees, four centuries old, ex-
tended in regular lines; and I found in them a new trace of that practical good sense which has effected revolutions without committing ravages; which, while reforming in all directions, has destroyed pothing; which has preserved both its trees and its constitution, which has lopped off the dead branches without levelling the trunk; which alone, in our days, among all nations, is in the enjoyment not only of the present, but of the past.