THE

PRINCETON REVIEW.

By Whom, all things; for Whom, all things.

FIFTY-SIXTH YEAR.

JULY—DECEMBER.

NEW YORK
1880.

CRITERIA OF THE VARIOUS KINDS OF TRUTH.

IN respect of religious opinion the educated young men of this age may be described as *unsettled*. They cannot be represented as having deep convictions, yet they are not unwilling to listen to the claims of religion and of all kinds of it. They cannot be designated sceptics; the most of them resent it as a calumny when they are charged with being atheists or materialists, tho numbers are cherishing views which are hurrying them on in this downward direction. They are not satisfied with the past, with its opinions or practices. They do not show any partiality for old creeds and confessions. Authority is not worshipped by them. They are bent on searching into the foundation of every belief, and therefore they would dig down deep, and are stirring up the rubbish and dust that stand in their way. They will not accept without first doubting and sifting even such truths, supposed to be long ago established, as the existence of God and the immortality of the soul and the essential distinction between good and evil. It is an age out of which good and evil, either or both, may come according as it is guided. We may cherish hope, for it is an inquiring age. We may entertain fears, for it is dancing on the edge of a precipice down which it may fall.

This age, like every other, is a transition one. Nothing here is abiding: the stream is ever flowing on; the present is hastening on to the future. The generation that now is will soon divide into two: one abiding in, or going back to, what will be very much the old faith, the other going on to a scepticism exceeding in boldness anything that has ever gone before. Somehow or other an old fisherman who lived eighteen hundred years ago, the same who anticipated the modern scientific doctrine

that the earth is to be burned up, had a fore-glimpse of this state of things: "There shall come in the last days scoffers walking after their own lusts, and saying, Where is the promise of his coming? for since the fathers fell asleep, all things continue as they were from the beginning of the creation." Meanwhile Pilate's question is being put—'What is truth?' Philosophers tell us that we have truth when our ideas are conformed to things. But can truth in this sense be found? This is the question eagerly put. Are there things to be known? or are our minds capable of knowing them? The extreme form in which this spirit embodies itself is Agnosticism—it used to be called Nescience, and the issue in which it lands us, Nihilism—and many are following it without knowing that they do so. It acknowledges with Hume that there are impressions and ideas, but without a mind impressed or entertaining the ideas; it admits with Kant phenomena in the sense of appearances; it believes in pleasures to be eagerly sought and avoided, but can find behind or beyond (or where it is to be found) in these no proof of a reality natural or supernatural. In such an age it may serve some good purpose to show that a certain amount of truth can be found, and that there are criteria which determine when we have found it.

Kant and the German metaphysicians have shown again and again that there is no one absolute criterion of truth to settle all truth for us; that will determine, for example, at one and the same time whether there is a fourth dimension of space, whether the planet Jupiter is inhabited, who is to be the next President of the United States, and what is to be the price of coal a year hence. But it can be shown that there are truths which can be ascertained, and that there are criteria which show when they are so, and these clear, sure, and capable of being definitely expressed. But the test which settles one truth does not necessarily settle all others or any others. It will be necessary to distinguish between different kinds of truth (and this is the merit of this article, if it has any); and we should be satisfied if we can find a criterion of each kind. It will be found that there are three kinds of truth, each of which has its own tests. The primary aim of the criteria, it should be noticed, is not to help us to discover truth, but to determine when we have discovered it.

I.—CRITERIA OF FIRST TRUTHS.

The mind must start with something. There are things which it knows at once. I know pleasure and pain. I do more: I know myself as feeling pleasure and pain. I know that I am surrounded with material objects extended and exercising properties. I know by barely contemplating them that these two straight lines cannot contain a space. These are called first truths. There must be first truths before there can be secondary ones; original before there can be derivative ones. Can we discover and enunciate these? I believe we can.

We are not at liberty, indeed, to appeal to a first principle when we please, or because it suits our purpose. When we are left without evidence, we are not therefore at liberty to allege that we need no evidence. When we are defeated in argument, we are not therefore to be permitted to escape by falling back on what is unproved and unprovable. It is true that we cannot prove everything, for this would imply an infinite chain of proofs every link of which would hang on another, while the whole would hang on nothing—that is, be incapable of proof. We cannot prove everything by mediate evidence, but we can show that we are justified in assuming certain things. We cannot prove that two straight lines cannot enclose a space, but we can show that we are justified in saying so. We can do so by the application of certain tests.

SELF-EVIDENCE is the primary test of that kind of truth which we are entitled to assume without mediate proof. We perceive the object to exist by simply looking at it. The truth shines in its own light, and in order to see we do not require light to shine upon it from any other quarter. We are conscious directly of self as understanding, as thinking, or as feeling, and we need no indirect evidence. Thus, too, we perceive by the eye a colored surface, and by the muscular touch a resisting object, and by the moral sense the evil of hypocrisy. The proof is seen by the contemplative mind in the things themselves. We are convinced that we need no other proof. A proffered probation from any other quarter would not add to the strength of our conviction. We do not seek any external proof, and if any

were pressed upon us we would feel it to be unnecessary—nay, to be an incumbrance, and almost an insult to our understanding.

But let us properly understand the nature of this self-evidence. It has constantly been misunderstood and misrepresented. It is not a mere feeling or an emotion belonging to the sensitive part of our nature. It is not a blind instinct or a belief in what we cannot see. It is not above reason or below reason; it is an exercise of primary reason prior, in the nature of things, to any derivative exercises. It is not, as Kant represents it, of the nature of a form in the mind imposed on objects contemplated and giving them a shape and color. It is a perception, it is an intuition of the object. We inspect these two straight lines, and perceive them to be such in their nature that they cannot enclose a space. If two straight lines go on for an inch without coming nearer each other, we are sure they will be no nearer if lengthened millions of miles as straight lines. On contemplating deceit we perceive the act to be wrong in its very nature. It is not a mere sentiment, such as we feel on the contemplation of pleasure and pain; it is a knowledge of an object. It is not the mind imposing or superinducing on the thing what is not in the thing; it is simply the mind perceiving what is in the thing. It is not merely subjective, it is also objective—to use phrases very liable to be misunderstood; or, to speak clearly, the perceiving mind (subject) perceives the thing (object). This is the most satisfactory of all evidence; and this because in it we are immediately cognizant of the thing. There is no evidence so ready to carry conviction. We cannot so much as conceive or imagine any evidence stronger.

NECESSITY is a secondary criterion. It has been represented by Leibnitz and many metaphysicians as the first and the essential test. This I regard as a mistake. Self-evidence comes first, and the other follows and is derived from it. We perceive an object before us and we know so much of its nature; and we cannot be made to believe that there is no such object, or that it is not what we believe it to be. I demur to the idea so often pressed upon us that we are to believe a certain proposition because we are necessitated to believe in it. This sounds too much like fatality to be agreeable to the free spirit of man. It is because we are conscious of self that we cannot be made to

believe that we do not exist. The account given of the principle by Herbert Spencer is a perverted and a vague one: all propositions are to be accepted as unquestionable whose negative is inconceivable. This does not give us a direct criterion, as self-evidence does, and the word inconceivable is very ambiguous. But necessity, while it is not the primary, is a potent secondary test. The self-evidence convinces us; the necessity prevents us from holding any different conviction.

UNIVERSALITY is the tertiary test. By this is meant that it is believed by all men. It is the argument from catholicity, or common consent—the *sensus communis*. All men are found to assent to the particular truth when it is fairly laid before them, as, for instance, that the shortest distance between two points is a straight line. It would not be wise nor safe to make this the primary test, as some of the ancients did. For, in the complexity of thought, in the constant actual mixing up of experiential with immediate evidence, it is difficult to determine what all men believe. It is even conceivable that all men might be deceived by reason of the deceitfulness of the faculties and the illusive nature of things. But this tertiary comes in to corroborate the primary test, or rather to show that the proposition can stand the primary test which proceeds on the observation of the very thing, in which it is satisfactory to find that all men are agreed.

Combine these and we have a perfect means of determining what are first truths. The first gives us a personal assurance of which we can never be deprived; the second secures that we cannot conquer it; the third that we can appeal to all men as having the same conviction. The first makes known realities; the second restrains us from breaking off from them; the third shows that we are surrounded with a community of beings to whom we can address ourselves in the assurance of meeting with a response.

But in order to be able to apply these criteria properly we must carry along with us certain explanations and limitations.

1. It should be noticed of intuitive truths that they are in the first instance *individual* or *singular*, and that we need to generalize the single perceptions in order to reach general maxims. In them we begin with contemplating a single object, say an external object and know it to be extended and solid, or an act

of benevolence and know it to be good, or an act of cruelty and proclaim it to be evil. But we can generalize the individual perceptions, and then we have general maxims or axioms, which we can apply to an infinite number of cases. We perceive that these two parallel lines will never meet; and we are sure that we should affirm the same of every other set of parallel lines, and hence we reach the general maxim that parallel lines will never meet. We perceive on the bare contemplation of this deed of deceit that it is base, but we would feel the same of every other deed of deceit, and hence the maxim deceit is evil. But it should be observed that in the formation of these general principles there is a discursive act in the shape of a generalizing process involved. It is here that there may creep in error, which is not in the intuitive but in the discursive process; for we may form a partial, a one-sided, or exaggerated generalization. Thus, on discovering a particular effect we at once judge or decide that it has a cause. But when we would make the principle universal we may fall into a mistake, and declare that "everything has a cause," which would require an infinite series of causes and make it necessary to hold that God himself has a cause. In such a case our generalization is wrong. But let the maxim take the form that "everything which begins to be has a cause," and we perceive that on a thing presenting itself to us as beginning we should proclaim it to have had a producing power. We thus see that there may be both truth and error in our metaphysical or moral maxims: truth in the primitive perception at the basis of the whole, but it may be hastiness leading to mutilation in the expression. Hence the wrangling in metaphysics. Thus, everybody acknowledges that two parallel lines can never meet, but there may be disputes as to the fit form in which to put the axiom. So, in regard to the generalized principles that every effect has a cause, that every quality implies a substance, that virtue is commendable; there may be a difficulty in expressing exactly what is meant by cause and effect, what by substance and quality, and what by virtue and moral good; and we may find that when we would make the expressions definite we fall into grievous mistakes, and this while we are certain that there is a self-evident, necessary, and universal truth if only we can seize it.

2. First truths are of various kinds, which we should endeavor to classify. Some of them are

Primitive Cognitions. In these the object is now before us, and is perceived by us. We perceive that this body has three dimensions in space, and cannot be made to believe otherwise. We decide that this thing, material or mental, cannot be and not be at the same time; that these two things, being each equal to the same thing, are equal to one another. In these cases the object is perceived at once and immediately. But there are others in which the object is not present, and the convictions may be regarded as

Primitive Beliefs. Here there is still an object. It is not present, but still it is contemplated. We have known the object somehow, and on conceiving it beliefs become attached to us. Thus, we know time in the concrete, and in regarding it we believe that time is continuous, that time past has run into time present, and that time present will run into time to come. A number of such faiths gather round our primitive cognitions and widen them indefinitely. We see two points in space; we are sure that there is space between, and that the shortest line between the two is a straight line. We can rise to still higher faiths. We believe of certain objects, say space and time, and God—when we come to know him as being infinite, that is—that they are always beyond our widest image or concept, and such that nothing can be added to or taken from them. The senses cannot give us these beliefs, nor can the understanding construct them out of the materials supplied by the senses. Some of them, such as the idea of the infinite, the perfect, lift us above our immediate experience into a higher sphere. We begin in all such cases with realities perceived or apprehended; and we are sure, if we proceed legitimately, that we end with realities. It should be remarked that in order to our having these cognitions and beliefs it is not necessary to express them or even put them in the shape of propositions. It is necessary first to have cognitions or beliefs regarding them before we form comparisons of them or affirm that they exist or possess certain properties. But out of these we can form

Primitive Judgments, in which we predicate—that is, make affirmations or denials—or discover certain properties or rela-

tions, as when we say space and time are without bounds and exist independent of the contemplative mind. In order that these judgments may be primitive they must be pronounced as to objects which have been perceived by intuition.

I ought here to add that the mind is capable of perceiving at once certain moral qualities, and we have

Moral Cognitions, Beliefs, and Judgments. On contemplating an act of self-sacrifice done for a friend or a good cause we know it at once to be good, or an act of selfishness we perceive it to be evil. When these acts are done by our neighbors we cannot notice them directly, but we are sure that they are good or evil; and these may be regarded as beliefs. When we put them in propositions we exercise judgment, as when we declare that sin deserves punishment.

3. The complexity of our mental states places difficulties in the way of our applying the criteria. There are opinions which have been acquired by a lengthened and constant observation, which association has wrought into our very nature, so that we feel as if they are native and necessary; and yet some of them may be mere hereditary or popular prejudices which have no warrant in reason. In particular, experiential truths or even fancies and prejudices may so mingle with our intuitions that it seems impossible to separate them and determine which is the self-evident principle in the complex notion. These circumstances, it should be admitted, do throw difficulties in the way of the application of our criteria. But these are not greater, after all, than the application of tests in any other department of knowledge, as, for example, chemical tests to determine the existence of poisons in very complex mixtures, and generally the verification of scientific discoveries of every description. But, in spite of these difficulties, the tests can be applied if only pains be taken to distinguish the things that differ, and to lay aside the things that are irrelevant. It is possible by a careful discrimination to separate the associated from the primitive judgment, and thus seize the conviction that is native and necessary and apply the tests to it.

4. In many instances it is essential to apply the tests to alleged intuitive truths before we put trust in them. In some cases, indeed, the spontaneous belief is so clear and assured that

we may follow it without instituting any reflex examination. But in other cases the supposed necessary truth may be mixed with extraneous matter which adulterates it. Every one acknowledges that for the purposes of accurate science it is of importance to have the axioms of mathematics and mechanics so enunciated that no empirical element has entered. In morals and jurisprudence evil consequences might arise from mixing up doubtful principles with true ones, from assuming, for instance, that the promotion of happiness is the sole and essential quality of virtue. Without a sifting we might often be tempted by indolence or prejudice to assume as true what ought to be proven, or what in fact cannot be proven. It is of special importance to apply these tests to all those higher faiths which perform so important a part in mystic philosophy and theology. In these there is commonly a real intuition, and this possibly of an elevating, inspiring order as a nucleus; but around this there may gather a halo consisting merely of mist irradiated by the light in the centre. All high minds have felt the influence of these faiths, and some have been transported by them. But earthly ingredients are apt to mingle with the ethereal and heavenward aspirations, and claim all the authority which these have. The gilding gold is made to give currency to the coin. Truth and error thus come to be hopelessly intermixed, and visions of fancy come to be regarded as revelations of heaven. The sceptic detects this, and in pulling up the tares he uproots the wheat; to vary our illustration, in tearing down the creepers he pulls asunder the wall on which they grow. These results are to be avoided by a reflex examination of the whole mental exercise. The idea of Plato, the ecstasy of the Alexandrians, the perfect of Descartes, Malebranche's vision of all things in God, the absolute of Kant, Schelling, and Hegel, the supposed inspirations of poets and the revelations to prophets who utter grand truths—all these point to and imply high realities. But they are liable to run into fancies and extravagances, into follies and deceptions, which delude and mislead those who believe in them, pervert their judgments, and render them ridiculous in the view of the world. There is gold in the mine, and all we have to do is by crucial tests to separate it from the dross that we may have the true metal.

Had our limits allowed I should have liked much to apply these tests to two works of ability recently published—Caird's "Philosophy of Religion" and Balfour's "Defence of Philosophic Doubt." The first of these is a Hegelian defence and exposition of religion. It is elevated both in style and thought, and will recommend Hegelianism (which has run and finished its course in Germany) to the British public more effectively than any other book written in the English tongue. The fault of the author is that of Hegel: he denies what he should have assumed, and assumes what he should have denied. Our tests would cut down a vast number of his principles and his reasonings. He represents intuitive or immediate conviction as purely empirical, whereas it is the primary exercise of reason. He asserts after the manner of the old Eleatics the unity of thought and reality, whereas thought affirming its own reality discloses a reality comprehensible by thought, but which is different from thought. He is perpetually assuming an absolute of which he does not condescend to give any intelligent account. He denies the logical validity of the argument from design for the existence of God, and thus undermines the old philosophic faith of Scotland, and gives us an argument from historical development which no shrewd Scotchman or American is likely to adopt. He insists after the manner of Hegel that truth is made up of contradictions. He reaches a refined rationalism different entirely from the evangelism hitherto preached in Scotland.

If Principal Caird errs by excess, Mr. Balfour errs by defect. It is not easy to determine the precise end he has in view. He is not to be regarded as a sceptic, least of all as a religious sceptic. His objections to all kinds of supposed truth are directed far more against boasted scientific certainty than religious faith. He has certainly been successful in showing that the objections taken by scientific men to religion apply with far greater force to their own dogmas. Some religious men are therefore rejoicing in what he has done. But it is somewhat perilous to make men doubt everything in order to shut them into some favorite tenets which they wish them to believe. They may thus be led into a bog from which they have no ability nor inclination to extricate themselves. He and his brother-in-law, Prof. Sidgwick, without being sceptics are the most successful men in our day

in starting doubts and difficulties. Mr. Balfour, whether sincerely or not I cannot say, represents our belief in truth, whether scientific or religious, as a vague and unreasoning instinct which the rising generation will regard as a poor defence against a reasoned scepticism. In this article I have carefully enunciated the canons of first truths, so as not to expose them to the cavils of Mr. Balfour, which are directed against representations of fundamental principles to which I am utterly opposed, and which cannot and should not be defended. By making self-evidence—that is, the perception of the thing—the primary test of fundamental truth we avoid his objections. He maintains that what we mean by ultimate is independent of proof. But we have shown that ultimate truths have their evidence in themselves in the realities perceived. He insists that when we say we believe we feel cold because consciousness tells us, and we believe in cause and effect because it is intuitive or *a priori*, the principle cannot be primitive, as it is represented as depending on something else. But in all such cases there is a mistake committed in the expression, often made, I admit, by metaphysicians, even by Hamilton, bringing in a reason or cause where there is none. We feel cold not *because* we are conscious of it; we believe in cause and effect not *because* it is intuitive or *a priori*. We perceive the cold at once, and believe that the effect has a cause by contemplating the effect; and there is no reason or cause, and the conviction is primitive. We call in the consciousness and intuition merely as criteria of what we have discerned directly.

II.—CRITERIA OF REASONED TRUTHS.

When we have got truth by self-evidence or by observation, we may add indefinitely to it by inference, in which we proceed from something given or allowed to something else derived from it by the mind contemplating it. If we have truth and reality in what we start with, and if we reason properly, we have also truth and reality in what we reach. Of course if what we assume be fictitious, what we arrive at may be the same. These inferences may be of three kinds, each of which has its tests.

IMMEDIATE INFERENCES, or what I am disposed to call *implied judgments*. Here we have a judgment given, and we

derive other judgments merely from contemplating the two notions compared. All general concepts, as logicians know, have both extension and comprehension. The extension has reference to the objects in the class; the comprehension to the qualities which combine them. Now, on the bare contemplation of the extension of the concepts we can draw certain inferences, as when it is granted that "all men have a conscience" we infer that "this man has a conscience" even tho he be a liar. From the same proposition we can draw the inference in comprehension that the possession of a conscience is an attribute of man. The canon is that whatever is involved in the extension and comprehension of a notion may be legitimately inferred.[1]

MEDIATE REASONING.—Here we do not discover the relation of two notions, or as we call them when expressed in language, terms, by directly comparing them, but we can do so by means of a third term which has a connection with both. Reasoning thus consists in comparing two notions by means of a third. The canon of reasoning in its most general form is, "Notions which agree with one and the same notion agree with one another," with a corresponding dictum for negative reasoning. But the word "agree" is vague, and it is necessary to state

[1] From the proposition "men are responsible" the following may be drawn:

In Extension.

Every man is in the Class Responsible;
This man is responsible;
Some men are responsible;
Every tribe of mankind are responsible;
It is not true that some men are not responsible, etc., etc.

In Comprehension.

Man exists;
Responsibility is a real attribute;
Responsibility is an attribute of every man;
Responsibility is an attribute of this man;
Responsibility is an attribute of every tribe of men;
Responsibility is an attribute of some men;
Irresponsibility may be denied of all men;
No man is irresponsible;
Irresponsible beings are not men;
Men of wealth are responsible with their wealth;
To punish men is to punish responsible men.

See "The Laws of Discursive Thought: being a text-book of Formal Logic," by James McCosh, LL.D.

the nature of the agreement. This is done by two formulæ, which act as the criteria of reasoning.

The Dictum of Aristotle.—We have before us a crocodile, and wish to know how it brings forth its young. Our two terms are "crocodiles" and "bringing forth their young." We find that it has been ascertained by science that the crocodile is a reptile, and that reptiles bring forth their young by eggs. We are now prepared to reason: "The crocodile, being a reptile, must bring forth its young by eggs." Here we have three terms: two called the extremes, the original ones which we wish to compare, "crocodiles" and "bringing forth their young by eggs," and a middle, "reptile," by which we compare them. The process when expanded takes the form of two propositions, called the premises, and the conclusion drawn from them.

> All reptiles bring forth their young by eggs;
> The crocodile is a reptile;
> Therefore it brings forth its young by eggs.

The conclusion is reached by the bare contemplation of the premises. The premises being true, the conclusion is true.

But this reasoning proceeds on a principle which it is desirable to have expressed and announced when it becomes the test of this kind of reasoning. It is, "Whatever is true of a class is true of all the members of the class." What is true of reptiles generally is true of the reptiles called crocodiles, and of every individual crocodile. If we have not something that can be predicated—that is, affirmed or denied—of a class to constitute a premise, no conclusion can be drawn. Thus, if only some reptiles are oviparous, if only the greater number are so, we are not entitled to conclude that the crocodiles must be so. We have thus a very decisive and easily applicable test of reasoning.

In formal logic this governing principle is spread out in various forms, so as to enable us to apply the test to every case of ratiocination. First, the syllogism is found to be the universal form of mediate reasoning. Then logicians divide reasoning according to the position of the middle term, which is the nexus of the argument, and this gives four figures. I do not mean to unfold these; they are to be found in every treatise on elementary logic. All that I have to do is to show that thereby we have a criterion of ratiocination.

All this was established by Aristotle in his "Prior Analytics." A number of attempts have been made since his day to set aside his analysis or to improve upon it. None of these have met with anything more than a temporary success. But I am not convinced that the dictum of Aristotle is the regulating principle of all reasoning; it regulates only that reasoning which involves a general notion—that is, a class notion. It can be shown, I think, that there is a ratiocination which does not proceed on the principle of classes, but of identity or equivalence. Thus, we find that the stick A is equal to the stick B, and the stick B is equal to the stick C, and we conclude that the stick A is equal to the stick C. Here we have no classes or members of a class. The canon is, "Notions which are equivalent to one and the same third notion are equivalent to one another." In ratiocination of this description the subject of the propositions may be made the predicate, and the predicate the subject:

> Shakespeare wrote "Hamlet;"
> The writer of "Hamlet" is the greatest English poet:
> Shakespeare was the greatest English poet.

All reasoning, in order to be valid, must fall under one or other of these rules, which are therefore the criteria of legitimate inference. When a professed argument cannot be brought under either of them, it is a proof that it is not reasoning. When, on endeavoring to bring it under them, we find that it is not in accordance with them, we may conclude that the inference is not valid.

Reasoning may take several forms, which are legitimate provided they are in conformity with the dictum of Aristotle or the principle of equivalents. The natural form in ordinary circumstances is the categorical, in which we lay down a general principle and bring a particular under it; as when we say, "Consumption is a fatal disease, and as this man has consumption he has a fatal disease;" or, not being sure of the fact, we say, "If this man has consumption he has a fatal disease." This reasoning is hypothetical, and is quite as valid as the categorical. Or the reasoning may take the disjunctive form: "This disease is either a severe cold or consumption. It is not a severe cold; therefore it is consumption."

The greater portion of the reasoning in mathematics is regu-

lated not by the dictum of Aristotle relating to classes, but the dictum of equivalence or equipollence.

III.—CRITERIA OF INDUCTIVE TRUTHS.

My purpose in the present article is not to show how truth is to be discovered, a subject which may be profitably discussed in the *Prolegomena* prefaced to the several sciences. I am simply to show that truth can be reached, and to give the marks which certify that it has been attained. I have given a brief exposition of the tests of intuitive truths and of reasoned truths. But there are branches of knowledge which have to deal from first to last and throughout with scattered facts. These become known in the first instance by the senses, external and internal. In the case of the bodily senses our observations are aided by such instruments as the telescope, the microscope, and the blowpipe. The affections of the mind are revealed by consciousness aided by attention and analysis. The criterion in such cases is

The Testimony of the Bodily Senses and Self-Consciousness.—This is primarily of the nature of an intuition, the criteria of which have already been given. But it is to be remembered, what we have previously noticed when treating of first truths, that reasonings and even fancies are apt to mingle with our intuitions proper, and may perplex and mislead. In such cases we are carefully to separate all additions, illegitimate and legitimate, from the immediate perceptions of sense and consciousness. So far as they are fancies, they are simply to be cast aside. In some cases this is difficult, as there may be illusions to which we are naturally inclined by the laws of association. It is not easy in the multitude of our thoughts within us to specify our precise experience at any given time, and in the attempted description we may subtract or we may exaggerate. So far as the additions, or rather concomitants, are inferences, they may be tried by the tests of reasoning as given above. In viewing along the surface of the ocean a rock which actual measurement tells us is two miles off, we regard it as only a mile away: but in this we are drawing a wrong inference. By the eye we intuitively know only a colored surface; but we can come by experience to know distance, and we lay it down as a rule that when there are few things between us and an object that the object

must be near—a rule correct enough for ordinary use, but which may fail us in extraordinary circumstances. It is always possible with the proper pains to separate the perceptions of the senses from all adventitious circumstances, and to discover the truth pure and simple in the midst of the accretions.

But in all this we have only individual facts, which inform us of nothing beyond themselves. We have not as yet any means of anticipating the future from the past, or gathering wisdom from experience. In particular we have not as yet any science, which consists, not of individual and scattered and isolated facts, but of systematized knowledge. In order to have science we must co-ordinate the facts. We do so in order to discover *laws*—that is, the order that is in nature. In doing so we can discover truths of which we can now give the criteria. These are called the

Canons of Induction.

It should be observed that these do not guarantee to us absolute certainty, what is called apodictive truth or demonstration. None of these are certified, as first truths are, by the law of necessity; we can easily conceive any one of the ordinary physical laws not to be true universally, and we might believe so provided we have evidence. The evidence, after all, is merely a probability of a lower or higher degree, but may rise to a certainty only a little short of being absolute, and quite sufficient to justify us to put trust in it and act upon it in ordinary, indeed in all, circumstances. Such, for instance, is the proof which we have in favor of the law of gravitation. It is not demonstrative like a mathematical truth, but it satisfies the mind and is verified by constant observation. The doubts raised by Mr. Balfour in regard to scientific truths almost all derive their force from the circumstance that observation cannot reach all the facts and give us absolute certainty.

But the question arises, How from scattered facts do we reach a law which we may regard as universal? Most people, on the question being first put to them, would answer, By observing *all* the facts. But a moment's reflection suffices to show that in most cases, I believe in all, we cannot find out all the facts. Take the law, all mammals are warm-blooded, or that all matter attracts other matter inversely according to the square of the

distance; nobody has gone the round of the universe and noticed every mammal and every particle of matter, so as to be able from his own observation to say that no mammal is cold-blooded, and no particle of matter is without the power of attraction. But we can, notwithstanding, from a limited number of observations rise to a law which seems to be universal. The canons of induction determine for us when we have reached a law of nature.

There seem to be three grand ends which men of science have in view in their investigations. One is to discover the composition of the objects around us; the second is to discover natural classes; the third is to discover causes. There are canons which guide and guard us in each of these investigations.

I. *Canons of Decomposition.*—Almost all the objects we meet with in the world, whether material or mental, are composite. It is the aim of many departments of science, in particular of chemistry and psychology, to analyze them. This can so far be effectively done. There are certain rules to guide us, and these may be made more and more specific as the analytic sciences advance.

A. We must separate the object we wish to decompose from all other objects. If we wish to analyze water, we must have pure water separate from all other ingredients. If we wish to analyze intuition or reasoning we must separate it from all associated observations and fancies.

B. When we have found the composition of any piece or portion of a substance, we have determined the composition of every other part, and indeed of the whole. When we have ascertained that a pint of water is formed of hydrogen and oxygen, we have settled that water everywhere is composed of the same elements. This arises from the circumstance that every substance in nature has its properties which it retains. Having detected these properties in one case, we have found what they are in all.

C. The elements reached are to be regarded as being so only provisionally. We are not sure that in any cases we have found the ultimate elements of bodies. At present it is supposed that there are sixty-four elements, but we are not sure of any one of these that it will never be resolved into simpler substances. Meanwhile the chemical analysis is correct so far as it goes. It will always hold true that water is composed of oxygen and hydrogen, tho it is possible that oxygen or hydrogen, one or both, may be resolved into something simpler.

II. *Canons of Natural Classes.*—There are certain sciences which are called by Whewell classificatory. They are such as botany, zoology, and mineralogy. In these our aim is to arrange the objects in nature in classes lower and higher, such as species, genera, orders, and kingdoms. They are so arranged by their points of resemblance. There are canons which may assist us in determining when we have reached these classes.

A. We must have observed the resemblance in many and varied cases, say in different countries and at different times.

B. We must be in a position to say that if there had been exceptions we must have met them. These two rules guard against forming a law from a limited class of facts.

C. There are classes in nature called Kinds, in which the possession of one quality is a mark of a number of others. All classes entitled to be called natural are more or less of this description. Thus, mammals are so designated because they suckle their young, but this characteristic is a mark of a number of others: that the animals are warm-blooded and have four compartments in their hearts. Reptiles are recognized as producing their young by eggs, but they are also marked as having three compartments in the heart and being cold-blooded.

These canons guarantee truth. When we are able to place objects in a class we know that they possess the properties of the class.

III. *Canons of Causes.*—These determine for us when we have discovered the cause of any given phenomena. This subject was first systematically taken up by Bacon. He insisted on the careful observation of instances. But he knew that all instances are not of like value, and he found it needful to specify certain instances as of greater significance than others. These he called *prerogativæ instantiarum*, and enumerates twenty-seven species of them, most of which are not applicable in the advanced stage of science we have now reached. It may be enough to give only one example, that of *instantia crucis*, the phrase being derived from the custom of placing a cross where two ways meet to guide the traveller. There are cases in which it is alleged that there may be one or other of two causes of the phenomenon. In these we should seek for a phenomenon which can be explained by the one and not by the other. Sir John Herschel has taken up the subject in his "Discourse on Natural Philosophy." But

the most lucid and upon the whole the clearest and most satisfactory exposition of these methods is by Mr. John S. Mill in his "Logic." It should be noticed that his methods relate to causes, and we have not had from him an exposition of the canons of decomposition and classes as given above. He mentions four or five methods.

A. The Method of Agreement.—In the spring season we see innumerable buds, leaves, and blossoms appearing upon the plants, and we find the common cause to be the heat of the sun shining more directly upon the earth. The canon is, "If two or more effects have only one antecedent in common, that antecedent is the cause, or at least part of the cause." That canon is too loose to admit of a universal application, as we may not be sure that the point of agreement we have fixed on is the only one.

B. The Method of Difference.—In the very middle of the day I find the scene around me on the earth suddenly darkened. There must be a cause. I find that the moon has come between us and the sun, and this seems the only difference between the two states — the one in which everything was bright, and the other in which it is in gloom. The canon is, "If in comparing one case in which the effect takes place and another in which it does not take place, we find the latter to have every antecedent in common with the former except one; that one circumstance is the cause of the former, or at least part of the cause." This method is the one employed in cases in which experiment with its separating power is available. It is the most decisive of all tests when the circumstances admit of its application. There are cases in which this method is not applicable, when a sort of intermediate one may come to our aid:

C. The Indirect Method of Difference, or the Joint Method of Agreement and Difference.—The canon is, "If two or more cases in which the phenomenon occurs have only one antecedent in common, while two or more instances in which it does not occur have nothing in common but the absence of that antecedent, the circumstance in which alone the two sets of cases differ is the cause, or part of the cause, of the phenomenon." The illustration given by Mr. Mill is: "All animals which have a well-developed respiratory system, and therefore aërate the blood, perfectly agree in being warm-blooded, while those whose res-

piratory system is imperfect do not maintain a temperature much exceeding that of the surrounding medium; we may argue from the two-fold experience that the change which takes place in the blood by respiration is the cause of animal heat."

D. The Method of Concomitant Variations.—We want to know the cause of the rise of water in a pump or of mercury in a barometer. The ancients accounted for this by nature's horror of a vacuum, which is inconsistent with the fact that water will not rise above a certain number of feet in the pump. Torricelli and Pascal gave a better explanation when they referred the rising of the water or mercury to the weight of the incumbent atmosphere, which Pascal proved by ascending a mountain with a barometer and finding that as he rose higher and higher the mercury fell lower and lower in the tube. Here we have the effect varying with its alleged cause, which is an evidence that the alleged cause is the true one. The canon is, "Whenever an effect varies according as its alleged cause varies, that alleged cause may be regarded as the true cause, or at least as proceeding from the true cause."

E. The Method of Residues.—A farmer knows how much grain a particular field has yielded in the past. He mixes manure with the earth on the field, and finds he has a larger crop, and he ascribes the increase to the manure. He knows what the previously existing antecedents will produce, and after subtracting this he ascribes the residue to the new antecedent. The canon is, "Subtract from an effect whatever is known to proceed from certain antecedents, and the residue must be the effect of the remaining antecedents."

I do not need here to give anything more than the above general account of these canons, which are fully unfolded by Mr. Mill. I mention them simply to show that when they are applied they settle for us what is truth.

Prof. Jevons, I am aware, has made a determined attack on them (*Contemporary Review*, vol. xxxi.). For fourteen years he had used Mr. Mill's works as partially his text-books in teaching, but now he has discovered that his philosophy is sophistical and false and doing immense injury; and in the reaction he has expressed himself strongly and passionately. I do not wonder that Mr. Jevons should speak thus of the metaphysics which underlies Mill's theory of induction. But his canons of causes

(he does not mention decomposition and classes) seem to me to be the best that have yet been expounded. Certainly Mr. Jevons has not given nearly so satisfactory an exposition of the methods of science in his elaborate work "The Principles of Science." I am not disposed to argue that Mr. Mill's version is perfect, or that it will never be modified as science enters new fields. I am inclined to think that there is special need of a logic adapted to those sciences in which there is a union of induction and deduction, particularly where there is the application of mathematics to laws discovered by observation. This is a field in which Prof. Jevons is fitted to labor with great success. The sciences which begin with induction and which, I believe, shall have to end with induction in the verification of the previous inductions, are becoming more and more deductive, and we have need of a theory and canons of what I call the Joint Inductive and Deductive Method, as practised in the social sciences and in the more recondite branches of physical sciences, in which mathematics have to be used as an instrument.

The canons of induction admit of an application to all the sciences which deal with scattered facts. Subsidiary rules, however, require to be added for each department of knowledge. There are, for instance, *Canons of Testimony.* In order to believe the report of a witness I must have reason to believe that he has means of knowing what he relates to be true. I must also have reason to believe that he is honest. Or, alternately, if I do not know him to be honest I must have reason to believe that he has no motive to deceive. Some other rules will also be followed: such as it is a good thing when the narrative is easy and natural; it is a good sign when it is consistent. Again, it is a bad sign when it is artificial, or when its consistency is a labored one. We use such guides as these in the common affairs of life, and we employ them in historical criticism.

These canons, as they determine what truth we can reach, also show how stringent are the limits laid on our researches and discoveries. Much as we know, there is evidently vastly more that we do not know, and probably infinitely more that we never can know in this world. "We know in part." Yes, we know, but we know only in part. We who dwell in a world "where day and night alternate," we who go everywhere accompanied by our own shadow—a shadow produced by our dark

body, but produced because there is light—cannot expect to be absolutely delivered from the darkness. Man's faculties, exquisitely adapted to the sphere in which he moves, were never intended to enable him to comprehend all truth. The mind is in this respect like the eye. The eye is so constituted as to perceive things within a certain range, but as objects are removed farther and farther from us they become more indistinct, and at length are lost sight of altogether. It is the same with the intellect of man. It can penetrate a certain distance and understand certain subjects, but as they stretch away farther they look more and more confused, and at length they disappear from the view. And if the human spirit attempts to mount higher than its limited range, it will find all its flights fruitless. The dove, to use a well-known illustration of Kant's, may mount to a certain hight in the heavens; but as she rises the air becomes lighter, and at length she finds that she can no longer float upon its bosom, and should she attempt to soar higher her pinions flutter in emptiness, and she falters and falls. So it is with the spirit of man: it can wing its way a very considerable distance into the expanse above it, but there is a boundary which if it attempts to pass, it will find all its conceptions void and its ratiocinations unconnected.

Placed as we are in the centre of boundless space and in the middle of eternal ages, we can see only a few objects immediately around us, and all others fade in outline as they are removed from us by distance, till at length they lie altogether beyond our vision. And this remark holds true not only of the more ignorant, of those whose eye can penetrate the least distance; it is true also of the learned; it is perhaps true of all created beings that there is a bounding sphere of darkness surrounding the space rendered clear by the torch of science. Nay, it almost looks as if the wider the boundaries of science are pushed, and the greater the space illuminated by it, the greater in proportion the bounding sphere of darkness into which no rays penetrate, just as (to use a very old comparison) when we strike up a light in the midst of darkness, in very proportion as the light becomes stronger so does also that surface dark and black which is rendered visible.

JAMES MCCOSH.