Asa Gray - 1865

theological class-room. You ask a layman to speak from this desk because you would have a layman's thoughts, expressed from a layman's point of view; because you would know what a naturalist comes to think upon matters of common interest. And you would have him liberate his mind frankly, unconventionally, and with as little as may be of the technicalities of our several professions. Frankness is always commendable; but outspokenness upon delicate and unsettled problems, in the ground of which, cherished convictions are rooted, ought to be tempered with consideration. Now I, as a lay-man, may claim a certain license in this regard; and any over-free handling of sensitive themes should compromise no one but myself. As a student who has devoted an ordinary lifetime to one branch of natural history, in which he is supposed to have accumulated a fair amount of particular experience and to have gained a general acquaintance with scientific methods and aims, -as one, moreover, who has taken kindly to the new turn of biological study in these latter years, but is free from partisanship, - I am asked to confer with other and younger students, of another kind of science, in respect to the tendencies of certain recently developed doctrines, which in schools of theology are almost everywhere spoken against, but which are everywhere permeating the lay mind- whether for good or for evil- and are raising questions more or less perplexing to all of us. But our younger and middle-aged men must not think that such perplexities and antagonisms have only recently begun. Some of them are very old; some are old questions transferred to new ground, in which they spring to rankness of growth, or sink their roots till they touch deeper issues than before, -issues of philosophy rather than of science, upon which the momentous question of theism or non-theism eventually turns. Some on the other hand are mere survivals, now troublesome only to those who are holding fast to theological positions, which the advance of actual knowledge has rendered un- tenable, but which they do not well know how to abandon; yet which, in principle, have mostly been abandoned already. To begin with trite examples. Among the questions which disquieted pious souls in my younger days, but which have ceased to disquiet any of us, are those respecting the age and gradual

may honorably, edifyingly, and wisely use that which we should not have formulated, but may on due occasion qualify,- statements, for instance, dogmatically pronouncing upon the essential nature of the Supreme Being (of which nothing' can be known and nothing is revealed), instead of the Divine manifestation. We may add more to our confession: we all of us draw more from the exhaustless revelation of Christ in the gospels; but this should suffice for the profession of Christianity. If you ask, must we require that, I reply that I am merely stating what I accept. Whoever else will accept Him who is himself the substance of Christianity, let him do it in his own way.. In conclusion, we students of natural science and of theology have very similar tasks. Nature is a complex, of which the human race through investigation is learning more and more the meaning and the uses. The Scriptures are complex, an accumulation of a long series of records, which are to be well understood only by investigation. It cannot be that in all these years we have learned nothing new of their meaning and uses to us, and have nothing still to learn. Nor can it be that we are not free to use what we learn in one line of study to limit, correct, or remodel the ideas which we obtain from another. Gentlemen of the Theological School, about to become ministers of the gospel, receive this discourse with full allowance for the different point of view from which we survey the field. If I, in my solicitude to attract scientific men to religion, be thought to have minimized the divergence of certain scientific from religious beliefs, I pray that you on the other hand will never needlessly exaggerate them; for that may be more harmful. I am persuaded that you, in 'I your day, will enjoy the comfort of a much better understanding between the scientific and the religious mind than has prevailed. Yet without doubt a full share of intellectual and traditional difficulties will fall to your lot. Discreetly to deal with them, as well for your- selves as for those who may look to you for guidance, rightly to present sensible and sound doctrine both to the learned and the ignorant, the lowly and the lofty-minded, the simple believer and the astute speculatist, you will need all the knowledge and judgment you can acquire from science and philosophy, and all the superior wisdom your supplications may draw from the Infinite Source of
knowledge, wisdom, and grace.

truly teach such natural science as it had occasion to refer to, or at least could never contradict it; while the most that is now intelligently claimed is, that the teachings of the, two, properly understood, are not incompatible. We may take it to be the accepted idea that the Mosaic books were not handed down to us for our instruction in scientific knowledge, and that it is our duty to ground our scientific beliefs upon observation and inference, unmixed with considerations of a different order. Then, when fundamental principles of the cosmogony in Genesis are found to coincide with established facts and probable inferences, the coincidence has its value; and wherever the particulars are incongruous, the discrepancy does not distress us, I may add, does not concern us. I trust that the veneration rightly due to the Old Testament is not impaired by the ascertaining that the Mosaic is not an original but a compiled cosmogony. Its glory is, that while its materials were the earlier property of the race, they were in this record purged of polytheism and Nature- worship, and impregnated with ideas which we w suppose the world will never outgrow. For its fundamental note is, the declaration of one God, maker of heaven and earth, and of all things, visible and invisible, -a declaration which, if physical science is unable to establish, it is equally unable to overthrow. But, leaving aside for the present all questions of this sort, I proceed with the proper subject of this discourse; namely, the further changes in scientific belief, which have occurred within my own recollection, even since the time when I first aspired to authorship, now forty-five years ago. There will be no need to go much beyond the line of subjects which it has been my business to study, in order to bring before you, in a cursory review, not indeed all the disturbing topics of the time, but quite enough of them for our purpose. For the changes which we have to consider are all more or less connected I with the evolutionary theories which are now uppermost in the popular mind. In this presentation, it is best to set them forth in their in their simplest or most general form, divested of all theological or philosophical considerations, which have been or may be attached to them. I should rather say, to some of them. For the foundations, or at least the buttresses, of the now prevalent doctrine of the

of desire and affection, of even the feeblest vital response to external impressions, of simplest life. The duality runs through the whole. You cannot reasonably give over any part of the field to the monist, and retain the rest. Ii. Now see how evolution may help you; -in its conception that, while all the lower serves its purpose for the time being, and is a stage toward better and higher, the lower sooner or later perish, the higher, the consummate, survive. The soul in its bodily tenement is the final outcome of Nature. May it not well be that the perfected soul alone survives the final struggle of life, and indeed "then chiefly lives," -because in it all worths and ends inhere; because it only is worth immortality, because it alone carries in itself the promise and potentiality of eternal life! Certainly in it only is the potentiality of religion, or that which aspires' to immortality. Here I should close; but, in justice to myself and to you, a word must still be added. You rightly will say that, although theism is at the foundation of religion, the foundation is of small practical value without the, superstructure. Your supreme interest is Christianity; and you ask me if I maintain that the doc- trine of evolution is compatible with this. I am bound to do so. Yet I have left myself no time in which to vindicate my claim; which I should wish to do most earnestly, yet very deferentially, considering where and to whom I speak. Here we reverse positions: you are the professional experts; I am the unskilled Inquirer. I accept Christianity on its own evidence, which I am not here to specify or to justify; and I am yet to learn how physical or any other science conflicts with it any more than it conflicts with simple theism. I take it that religion is based on the idea of a Divine Mind revealing himself to intelligent creatures for moral ends. We shall perhaps agree that the revelation on which our religion is based is an example of evolution; that it has been developed by degrees and in stages, much of it in connection with second causes and human actions; and that the current of revelation has been mingled with the course of events. I suppose that the Old Testament carried the earlier revelation and the germs of Christianity, as the apostles carried the treasures of the gospel, in earthen vessels. I trust it is reverent, I am confident it is safe and wise, to consider that revelation in its essence concerns things

essential oneness of the two kingdoms of organic nature. I crave your patience while I enter somewhat into particulars. Not many years ago it was taught that plants and animals were composed of different materials: plants, of a chemical substance of three elements,- carbon, hydrogen, and oxygen; animals of one of four elements, nitrogen being added to the other three. .The plant substance, named cellulose, because it formed the cell-walls, was supposed to constitute the whole vegetable fabric. It was known that all plants produced nitrogenous matter in the form of a compound of four elements; but this was thought to be merely a contained product, in a structureless condition, and to be not so much essential to the plant's life as to that of the animals which the plants nourished. It was known to be structure-building material for animals: it was not known to be essential plant-structure also. But it was soon ascertained that this quaternary matter of the animal body was chemically the same in the plant, was elaborated there, and only appropriated by the animal. Next it was found that it was physiologically and structurally the same in the plant, that it was the living part of the plant, that which manifested the life and did the work in vegetable as well as in animal organisms. This substance, which is manifold in its forms and protean in its transformations, has, in its state of living matter, one physiological name which has become familiar, that of protoplasm. The statement that "protoplasm is the physical basis of life" must be accepted as true. As Professor Allman puts it, "wherever there is life, from its lowest to its highest manifestations, there is protoplasm; wherever there is protoplasm, there too is life," or has been. The cellulose or solid material which composes the bulk of a tree or herb did not produce the protoplasm contained in its living parts, as was formerly supposed, but the protoplasm produced the cellulose: the semi- liquid and mobile matter within produced the cell-walls which enclose it. The walls or solid parts are to the protoplasm what the shell is to he oyster. The contents not only preceded he protective, investment, but can exist and prosper apart from it, as many a mollusk does, as many a simple plant does throughout the earlier and most active period of its life. Indeed this slimy matter lives before and apart from any thing which can be

which evolution traces human descent. Sober evolutionists do not suppose that man has descended from monkeys. The stream must have branched too early for that. The resemblances, which are the same in fact under any theory, are supposed to denote collateral relationship. The psychological differences between man and the higher brute animals you do not expect me now to discuss. Here, too, we may say that, although gradations abridge the wide interval, the transcendent character of the superadded must count for more than a host of lower similarities and identities; for, surely, what difference there is between the man arid the animal in this respect is supremely important. If we cannot reasonably solve the problems even of inorganic nature without assuming initial causation, and if we assume for that supreme intelligence, shall we not more freely assume it, and with all the directness the case may require, in the field where intelligence at length develops intelligences? But while, on the one hand, we rise in thought into the supernatural, on the other we need not forget that one of the three old orthodox opinions,- the one held to be tenable if not directly favored by Augustine, and most accordant to his theology, as it is to observation, -is that souls as well as lives are propagated in the order of Nature. Here we may note, in passing, that since the "theologians are as much puzzled to form a satisfactory conception of the origin of each individual- soul as naturalists are to conceive of the origin of species," and since the Darwinian and the theologian (at least the Traducian) take similar courses to find a way out of their difficulties, they might have a little more sympathy for each other. The high Calvinist and the Darwinian have a goodly number of points in common. View these high matters as you will, the out-come, as concerns us, of the vast and partly comprehensible system, which under one aspect we call Nature, and under another Providence, and in part under another: Creation, is seen in the emergence of a free and self-determining personality, which, being capable of 'conceiving , it, may hope for immortality. "May hope for immortality." You ask for the reasons of this hope upon these lines of thought. I suppose that they are the same as your own, so far as natural reasons go. A being who has the faculty -however bestowed -of reflective, abstract thought

vegetable than chlorophyll, the green of herbage; for in it the special work of the plant is done, -namely, the transformation of mineral matter into organic, under the light of the sun, this being the prerogative of vegetation. Now, not only does chlorophyll abound in many ambiguous microscopical organisms of fresh and salt water, which except for this would be taken for animals, but it has recently been detected in hydras and sea-anemones and planarias, which are as certainly animals as are oysters and clams. Nor can it be thought that they possess something merely resembling chlorophyll; for it performs the characteristic work of that peculiar substance, which, as I have said, is the characteristic work of vegetation. For the index and essential accompaniment of this work (i. e., of the conversion of mineral into organic matter) is the evolution of oxygen gas from the decomposition of carbonic acid, water, &c., in which, if in any thing, vegetation consists. Now, the proof that what these animals possess is chlorophyll itself is demonstrated by their performance of the same function. They decompose carbonic acid and evolve oxygen gas, just as a green leaf does. Moreover, the chlorophyll has been extracted and identified by the spectroscopic test. Here, then, animals, undoubted animals, in addition to their own proper functions, talce on the essential function of plants. There is no avoiding the conclusion that such animals are doing the duty of vegetables. Although I make little account of it, I should not overlook a more empirical distinction between the two kingdoms which has also failed. The characteristic features of an animal were mouth and stomach. This is the normal correlation of an animal with its conditions. Having to feed on vegetable matter, or what has been vegetable matter, in solid as well as liquid form, a mouth opening into an internal cavity of some sort was the natural pattern, to which all animals were supposed to conform. But Nature, with all her fondness for patterns, will not be arbitrarily held to them. Entozoa feed like rhizophytes; and turbellarias and their relatives have no alimentary canal, -the food taken by what answers to mouth passing as directly into the general tissue as does the material which a parasitic root imbibes from its host, or an ordinary root from the soil. While animals are thus overpassing the boundary in one

to say, except to admit that so much of choice is determined by antecedent conditions and the surroundings, by hereditary bias, by what has been made for the individual and inwrought into his nature, that, granting the will has an element of freedom, it may be in effect a small factor. I can only urge that it is not an insignificant factor. As to this, a pertinent although homely suggestion came to me in the remark of a humble but shrewd neighbor, to the effect that he found the difference between people and people he dealt with was really very little, but that what there is was very important. So facts and reasonings may shut us up to the conclusion that the will, sovereign as it seems to the user, is practically a small factor in the determination of events. But what there is makes all the difference in the world in man! And now, as to man himself in relation to evolution. I have no time left for the discussion of questions which naturally interest you more than any other, but which, even with time at disposal, are not easy to treat. I will not undertake I to consider what your attitude should be upon a matter which connects itself with grave ulterior considerations; but I will very briefly and frankly intimate what views I think a scientific man, religiously disposed, is likely to entertain. To pursue the illustration just ventured upon: The anatomical and physiological difference between man and the higher brutes is not great from a natural-history point of view, compared with the difference between these and lower grades of animals; but we may justly say that what corporeal difference there is extremely important. The series of considerations which suggest evolution up to man, suggest man's evolution also. We may, indeed, fall back upon Mr. Darwin's declaration, in a case germane to this, that "analogy may be a deceitful guide." Yet here it is the only guide we have. If the alternative be the immediate origination out of nothing, or out of the soil, of the human form with all its actual marks, there can be no doubt which side a scientific man will take. Mediate J creation, derivative origination will at once be I accepted; and the mooted question comes to be narrowed down to this: Can the corporeal differences between man and the rest of the animal kingdom be accounted for by known natural causes, or must they be attributed to unknown causes? And shall we assume

with faculties of which no other plants were sharers. The thoughtful naturalist of our day is in a different frame of mind. He expects to find that the extraordinary is only an extreme case of the ordinary; and he looks for instances leading up from the one to the other. I cannot tarry to explain how this expectation has directed observation and stimulated research in this particular field, and reached the result that these wonderful plants are distinguished only by higher degrees and more prominent manifestations of a power which is in some sort common to many or to all their brethren. We learn, even, that the germinating embryo of a grain of corn feeds upon and digests the solid maternal nourishment which surrounds it, and the humblest mould appropriates the organic matter which it attacks, by the aid of a peptone or inversive ferment, not different in nature and -office from the gastric and other juices by aid of which we appropriate our daily meals. It does appear also that the lowest organisms, which live a kind of scavenger life, by using over again dead or effete organic matter running to decay - but to some of which living juices come not amiss -have also the power, certain salts being given, of creating organic matter, and building up a fabric without sun-light and without chlorophyll. Here, then, is the simplest organic life, -in which, germs being given, i. e. first individuals of the sort supplied and placed in favorable surroundings, they increase and multiply into more, each to multiply again, and so on, in geometrical progression. From such lowly basis the two kingdoms may be conceived to rise, diverging as they ascend in separate lines, -the one developing close relations with sunlight and becoming the food-producing vegetable realm; the other, the food-consuming animal realm, which, dispensed from the labor of assimilation, and from the fixity of position which generally attends it, may rise to higher and freer manifestations of life. Such, at least, appear to be the relations of the two kingdoms to each other and to their common base; and such is the conception through which we may attain to an explanation of how it may be that members of each line possess so many characteristics of the other. I have said, "germs being given," the forms increase and multiply. If asked, Whence the germs, and were they everywhere and always prerequisite? the

assert themselves in increasing distinctness, variety, and dignity. Vegetables and animals have paved the earth with intentions. The study and the estimate of these is quite the same, under whatever 'view of the mode in which the structures and beings that exemplify them came to be. The highest of these exemplars is himself conscious of ends. He pronounces that critical monosyllable I. I am, I will, I accomplish ends. I modify the outcome of Nature. Here, at length, is something "on the planets" it which "has been concerned in events;" and in my opinion it is just now a good and useful theistic view which connects this something with all the lower psychological phenomena that preceded and accompany it. Our wills, in their limited degree, modify the course of Nature, subservient though that be to fixed laws. By our will we make these laws sub serve our ends. We momently violate the uniformity of Nature. But we do not violate the law of the uniformity of Nature. Is it not legitimate, is it not inevitable, that a being who knows that he is a will, and a power, and a successful contriver, should explain what he sees around and above him by the hypothesis of a higher and supreme will? A will which has disposed things in view of ends in establishing Nature, and which may, it Deed be, dispose to particular and timed ends, either with or without perceptible suspension of the law of the uniformity of Nature, The question I ask has "been adversely answered, substantially as follows: It may be that in the first instance men can hardly avoid predicating a being who has done and is doing all this. Nevertheless a trained mind soon reaches the incongruity of it, at least "as concerns any events which have happened within the range of the solar system." For the belief that a supernatural power has so acted contradicts that very belief in the uniformity of Nature upon which all scientific reasoning and practical judgments rest. To this it is well rejoined, that the ultimate scientific belief on which our reason reposes "is that belief in the uniformity of Nature which is equivalent to a belief in the law of universal causation; which again is equivalent to a belief that similar antecedents are always followed by similar consequents. But this belief is in no way inconsistent with a belief in supernatural interference. If the principle of the uniformity of Nature asserted that every natural

by it, and then rapidly resumes its horizontal sweep, to result in reaching a distant support,-is it possible to think that these are not movements in reference to ends? You may say that all such movements are capable of explanation, or in time will be so; are the result of mechanism, and adjustments, and of common physical forces. No doubt; and this is equally true of every animal movement, not excepting. those instigated by volition. "Still it moves," as the humbled Galileo said of the earth; and the idea that such movements are in reference to ends is not superseded by any yet devised explanation of the mechanism. A remaining distinction between plants and animals was based on the relations they respectively sustain to the air we breathe. This has already been stated, and the exceptions noted; but the topic is resumed in order to bring to view the substantially different relations of the two kingdoms to physical force. Plants give out oxygen gas, and thus purify the air or the respiration of animals. Animals, consuming this oxygen, breathe it back to the air in the form of carbonic acid. But the putting of this contrast is only another way of saying that plants produce organic matter and animals decompose it. The oxygen gas given out by sun-lit foliage is just what is left over when carbonic acid is decomposed and the carbon enters into the composition of the vegetable matter then produced. This elaborated matter, more complex and unstable than the materials of which it was made, is the food of animals, is first appropriated, then decomposed by them, and in the decomposition the carbon is given back to the air recombined with the oxygen they inhale, the carbon again taking the oxygen which was separated from it by the plant. So respiration means decomposition; and this decomposition in the animal economy means organic material used up, work done, energy degraded. It means that the clock-weight which was wound up by the sun in the plant has run down. It means that, very much as the sun, shining on the earth and ocean, converts water into vapor and lifts it into the upper air, so the same luminary, shining upon the plant, there raises mineral matter to a higher and unstable state, in what we call organic products, -in both cases endowing the affected matter with a certain energy. The exalted matter in the one case falls at length as rain, perhaps directly into

brought old ones into prominence. It must be reasonably clear to all who have taken pains to understand the matter that the true issue as regards design is not between Darwinism and direct Creationism, but between design and fortuity, between any intention or intellectual cause and no intention nor predicable first cause. It is really narrowed down to this, and on this line all maintainers of the affirmative may present an unbroken front. The holding of this line secures all; the weakening of it in the attempted defence of unessential and now untenable outposts endangers all. I have only to add a few observations and exhortations addressed to Christian theists. If intention must pervade every theistic system of Nature, if we give credit to Mr. Darwin when in this regard he likens his divergence from the orthodox view to the difference between general and particular Providence, is it safe to declare that his theory, and his denial that particular forms were specially created, are practically atheistical? I might complain of this as unfair: it is more to my purpose to complain of it as suicidal. It is in effect holding a theistic conception of Nature for our private use, but acting on the opposite when we would discredit an unwelcome theory. Or else it is trusting so little to our own belief that we abandon it as soon as any weight is laid upon it. As soon as you do this, by conceding that the evolution of forms under natural laws militates against design in Nature, you are at the mercy of those reasoners, who, looking at the probabilities of the case from their own point of view, coolly remark that:- "On the whole, therefore, we seem entitled to conclude that, during such time as we have evidence of, no intelligence or volition has been concerned in events happening within the range of the solar system, except that of animals living on the planets." You may say that implicit belief of intention in Nature affords an insufficient foundation for theism. But you are not asked to ground your theism upon it, nor upon the whole world of external phenomena. You may reiterate that you cannot believe that all these events have occurred under natural laws. Nothing hinders your assuming what you need from the supernatural; but allow that the need of other minds may not be identical with yours. As I have said before, what you want is, not a system which may be adjusted to theism, nor even one which finds

with my finger, will coil again only after an interval of rest, and upon the third or fourth excitation, or after a certain number of spontaneous revolutions, it falls exhausted. But material endowed with energy in the plant is largely transferred as food to animals. It brings to them an energy which they may use, but did not originate. Not many years ago, it was taken for granted that living things moved and had their being, and did their work, by strength of their own; that the power by which I strike a blow, or write on my paper, or move my lips in articulate speech, was somehow an original contribution to, rather than a directed use of, the common forces of physical nature. To all who have familiarized themselves with the facts of the case, the contrary is now substantially certain. The sun is the source of all motion and force manifested in life on the earth, and plants are the medium in which energy is exalted to the most serviceable state. The work done by living beings is at the expense of, and is measured by, the passage of so much matter from an unstable to a relatively stable equilibrium, by the coming together of molecules in to closer and; firmer positions, and by the attendant fall of so much energy from an exalted to a relatively degraded condition. So plants, animals, men, in all their doings, add nothing to and take nothing from the sum of physical force. Their prerogative is, each in its measure, to direct the application of physical force, and to direct it to ends. The idea of ends involves that of individuality. The higher animals, and men among them, are complete individuals. We cannot make the idea of individuality any clearer than by adducing them as examples of it. In the lowest form of life, in those amorphous or indefinitely polymorphous "little lumps of protoplasm" which the biologists h6ve made known to us, and even, perhaps, in a stratum or mass which takes the form of whatever bounds it, it is said that we may contemplate the phenomena of life in that which has no manifest individuality. What have we between these two extremes? The first and simplest individuality is that of cells. Cell-doctrine, or the cellular composition of plants and animals, belongs wholly to the biological science of the last half-century, although the name is older, and some knowledge of the structure in plants is as old as the micro-scope. The homologizing of animals with plants in this

contradictory sounds are sometimes given back to us; yet as we listen to and ponder them, they mainly harmonize with our inner idea, and give us reasonable assurance that the God of our religion is the author of Nature. But what of those- you will say -who are not already convinced of His existence? We thought that we had an independent demonstration of His existence, Ii and that we could go out into the highways of unbelief and "compel them to come in;" that "the invisible things of Him from the creation of the world were clearly seen, being understood by the things that are made," "so that they are without excuse." We could shut them up to the strict alternative of Divinity or Chance, with the odds incalculably against Chance. But now Darwinism has given them an excuse and placed us on the defensive. Now we have as much as we can do, and some think more, to reshape the argument in such wise as " to harmonize our ineradicable belief in design with the fundamental scientific belief of continuity in nature, now extended to organic as well as inorganic forms, to living beings as well as inanimate things. The field which we took to be thickly sown with design seems, under the light of Darwinism, to yield only a crop of accidents. Where we thought to reap the golden grain, we find only tares. The outlook is certainly serious, yet not altogether disheartening. Perhaps we cannot now safely separate the wheat from the tares, but must let them grow together unto the harvest. Nobody expects in this world to ascertain the limits between design and contingency. Nobody expects to demonstrate any design, except his own to himself by consciousness; he cannot really prove his own to his bosom friend; though his assertion may give his friend, and his actions may give his enemy, convincing reasons for inferring it. But we are sure that every intellectual being has designs, that the reach and pervasiveness of design must be in proportion to the wisdom; and that the designs of the Author of Nature, if any there be, must be all-pervading and fathomless. Yet if they be wrought into a system of adaptations, some of the adaptations themselves may be such as irresistibly to suggest their reason to our minds. At least they suggest reason, even if we fail to apprehend, or wrongly apprehend, the reason. The sense that there is reason why is as innate in man, as that there is cause

common weal, -some by this function, some by that; but in the higher forms all are somehow controlled by a pervasive life and directed to common ends, -ends the more various, complex, and special, in proportion to the rank of the organism in the scale of being. So, too, the component cells become effete and die, while the aggregate life continues; and the continued structure, which is nothing but an aggregate, is somehow informed, animated, and operated by a common life of higher grade than that of any or all its components. In numerous lower plants and animals we cannot definitely determine what are organisms and what are organs; in the herb or tree, and in the coral polypidom, organ, individual, colony are inextricably blended; in the higher animals subordination of parts to a whole is completely attained. All along the ascent that which controls and subordinates parts aggrandizes its manifestations. The lowest animals add very little to merely vegetative life, except greater sensitiveness to external impressions and more free and varied response; a step higher brings in a greater range of unconscious feeling; the higher brute animals have attained unto specific desires, affections, imagination, and the elements of simple thought; the highest, gifted with reflective reason, may make their own thoughts the subject of thought. So, our conception of individuality is from ourselves, conscious beings: it is carried down unqualified to the brute animals with which we are associated; it becomes vague and shadowy in plants, but still, somehow, the idea inheres throughout all organisms. The beginning of organization is individuation or tendency to individualize. The completed self is man. Here let me interject a remark in correction of a common misapprehension as regards the nature of the simplicity of the lowest organisms. An animalclue and a unicellular plant, or the cellular components of common plants or animals, are simple indeed, comparatively. But the recent science which has brought out the close connection of the lower with the higher forms (and showed that through all “one increasing purpose runs ") is also showing, in all the latest microscopic work, that the plant-cell and the animal-cell are really very complex structures, and the processes through which one cell becomes two, instead of being a simple bisection, prove to be very elaborate and

between pure Darwinism and a more theistically expressed evolution is not so great as it seemed. Both agree in the opinion that species are evolved from species, and that evolution somehow occurs in the course of Nature. Darwinism opines that the whole is a natural result of general causes such as we know of and in a degree understand, such as we recognize under the concrete terms of variability, heredity, and the like, -terms which we can estimate and limit only by reference to what we see coming to pass, -along with complex physical interactions which are more measurable and predictable. The very much that it has not accounted for by these causes and processes, it assumes may be in time accounted for by them, or by as yet unrecognized general causes like them. The specially theistic evolution referred to judges that these general causes cannot account for the whole work, and that the unknown causes are of a more special character and higher order. I think it does not declare that these are not secondary causes, and whether they would be ranked as natural causes would depend upon the sense in which the term Nature was at the moment used. Probably such evolutionists, if they had to give form to their conceptions, would vary in all degrees between the direct interposition of a supernatural hand at certain stages or crises, and that extreme extension of the Supernatural into and through the Natural which Professor Bowen reaches the assertion that each individual living organism, as well as every new species, originated in a special act of creation. This, the complete assimilation of specific to individual origination, is simply Darwinism, expressed in less appropriate language. What the one calls "special act" the other, along with the rest of mankind, calls general process. The common principle of the Divine ordination of Nature, which the philosopher here asserts in a paradoxical way, the Darwinian implies, or even postulates, on appropriate occasions. The Darwinian Naturalist, I mean, not the monistic and agnostic philosopher, -from whom, so far, we have kept as clear as has Mr. Darwin in every volume and every line. Suppose now that we are shut up to Nature for the evolution of the forms of living things. As theists, we are not debarred from the sup- position of supernatural origination, mediate or immediate. But suppose the

that there has been no absolute severance of the present from the nearer past; for while some species have taken the place of other species, not a few have survived unchanged, or almost unchanged. And, it is most probable that this holds throughout; for certain species appear to have bridged the intervals between successive epochs all along the line, surviving from one to another, and justifying the inference that species -however originated -have come in and gone out one by one, and that probably no universal catastrophe has ever blotted out life from the earth. Life seems to have gone on, through many and great vicissitudes, now with losses, now with renewals, and everywhere at length with change; but from first to last it has inhered in one system of nature, one vegetable and one animal kingdom, which themselves show indications of a common starting-point. As respects the vegetation, from which I should naturally draw illustrations, the nature and amount of the likeness between the existing flora and that of a preceding geological period has recently been summed up by Saporta in the statement that there is not a tree nor a shrub in Europe or North America which has not recognizable relatives in the fossil remains of the tertiary period. It is like visiting a country church-yard, where "The rude forefathers of the hamlet sleep," and spelling out, one by one, from mossed and broken gravestones, the names of most of the living inhabitants of the parish, -names differing it may be in orthography from those on the village signs; but, as of the people, so of the trees, it is beyond reasonable doubt that the later are descendants of the earlier., The same holds true of animals; and the facts therefore point toward the conclusion that existing species in general are descended from tertiary ancestors. But if so they have mostly undergone change, and great change as we go farther back with the comparison. And there are many existing forms of which no fossil ancestor is known. What relation, if any, can these sustain to a by-gone flora or fauna? And, with what reason do we predicate change of species in former times if they are not change- able now? This brings up the question of the fixity or variability of species. Scientific opinion upon this point is not what it was thirty or forty years ago. Then it was generally, though not universally, believed that species are perfectly definite

selection does not account for it. That is, we both account for it all, only by assuming as an inexplicable fact that variation does occur to the whole extent of the extreme differences. All appears to have come to pass in the course of Nature, and therefore under second causes; but what these are, or how connected and interfused with first cause, we know not now, perhaps shall never know. Now views like these, when formulated by religious instead of scientific thought, make more of Divine providence and fore-ordination than of Divine intervention; but perhaps they are not the less theistical on that account. Nor are they incompatible with "special creative act," unless natural process generally is incompatible with it, - which no theist can allow. No Christian theist can eliminate the idea of Divine intervention any more than he can that of Divine ordination; neither, on the other hand, can he agree that what science removes from the supernatural to the natural is lost to theism. But, the business of science is with the course of Nature, not with interruptions of it, which must rest on their own special evidence. Still more, it is the business of science to question searchingly all seeming interruptions of it, and its privilege, to refer events and phenomena not at the first but in the last resort to Divine will. Moreover, "special creative act" is not excluded by evolutionists on scientific ground, is not excluded at all on principle, except by those who adopt a philosophy which antecedently rules out all possibility of it. Darwin postulates one creative act and a probability of more, and so in principle is at one with Wallace and with Dana, who insist on more. But it has been said, and indeed is said over and over, even by thoughtful men, that, although Darwinism is not necessarily atheistic, yet, when once started it dispenses with further need of God. "Given [it is said] the laws which we find, then there is no more use for God, and all things have come out as we find them with none of his supervision. There may have been -we do not know -a God once; but law and not God, is the great Creator." A few words should dispose of this. First, by what right is it assumed that the Darwinian differs from the orthodox conception of law? In the next place, this line of argument applies equally to a series of creative acts separated by intervals, during which it could with the same

books one species is as good as another. The absoluteness of species, being the postulate of the science, was taken for granted to begin with; and so all the forms which have been named and admitted into the systematic works as species, are thereby assumed to be completely distinct. All the doubts and uncertainties which may have embarrassed the naturalist when he proposed or admitted a particular species, the nice balancing of the probabilities and the hesitating character of the judgment, either do not appear at all in the record or are overlooked by all but the critical student. Whether the form under consideration should be regarded as a new species, or should be combined with others into a more generalized and variable species, is a question which a naturalist has to decide for the time being, often upon insufficient and always upon incomplete knowledge; and increasing knowledge and wider observation generally raise full as many doubts as they settle. This may not be so decidedly the case in zoology as in botany; but I incline to the opinion that there is no wide difference in this respect. The patient and plodding botanist spends much of his time in the endeavor to draw specific lines between the parts of a series the extremes of which are patently different, while the means seem to fill the interval. When he is addressed by the triumphant popular argument," if one form and f one species has been derived from another, show us the intermediate forms which prove it," he can only ejaculate his wish that this ideal vegetable kingdom was the one he had to deal with. Moreover when he shows the connecting links, he is told, "Then these are all varieties .of one species; species are fixed, only with wider variation than was thought." And when he points to the wide difference between the extremes, as being greater than that between undoubted species, he is met with the rejoinder, "Then here are two or three or more species which undoubtedly have true distinctions, if only you would find them out." That is quite possible, but it is hardly possible that such fine differences are supernatural. Some one when asked if he believed in ghosts, replied, No, he had seen too many of them. So I have been at the making and unmaking of far too many species to retain any overweening confidence in their definiteness and stability. I believe in them, certainly. I do not exactly agree that

determining the survival only of the fittest forms for the time and place. It is therefore a good hypothesis, so far. But is it a sufficient and a complete hypothesis? Does it furnish scientific explanation of (i.e., assign natural causes for) the rise of living forms from low to high, from simple to complex, from protoplasm to simple plant and animal, from fish to flesh, from lower animal to higher animal, from brute to man? Does it scientifically account for the formation of any : organ, show that under given conditions sensitive eye-spot, initial hand or brain, or even a different hue or texture, must then and there be developed as the consequence of assignable conditions? Does it explain how and why so much, or any, sensitiveness, faculty of response by movement, perception, consciousness, intellect, is correlated with such and such an organism? I answer, Not at all! The hypothesis does none of these things. For my own part I can hardly conceive that anyone should think that natural selection scientifically accounts for these phenomena. Let us here discriminate. To account scientifically for phenomena, or for complex series of phenomena, by assigning real and sufficient natural causes, is one thing. To believe that the phenomena have occurred in the course of nature, and have natural causal connection, is another. It is not natural selection which has led Mr. Darwin and many others to believe that life was originally breathed by the Creator into a few forms or into one," and "that the production and extinction of the past and present inhabitants of the world has been due to secondary causes; " but it is the observed fact of likenesses and that of gradation from form to form which suggested the idea of an actual evolution from form to form having somehow taken place. Variation and natural selection are .now assigned as causes or reasons of the evolution. Variation originates all the differences. Natural selection, determining which forms shall survive, reduces their number and intensifies their character. But Darwin may likewise consistently speak of his favorite principle as a cause of the evolution, it being that in the absence of which the evolution could not take effect. A cause of variation it certainly is not, but it is a necessary occasion of it, or of its progress. Because without natural selection to pave the way, the wheels of variation would at once be clogged and all progress be

this conclusion was reached more than sixty years ago, through it observation and experiment, by an English clergyman and naturalist, Herbert, afterward Dean of Manchester. He announced his conviction that "horticultural experiments have established, beyond the possibility of doubt, that botanical species are only a higher and more permanent class of varieties," and, consequently, that the genus is the progenitor of the species belonging to it. Others have reached the same conclusion by more speculative routes, and have deduced the theoretical consequences. But no marked impression was made until the hypothesis of natural selection, or the preservation of favored races in the struggle for life was promulgated, and supplied a scientific reason for the diversification of varieties into species. The principle brought to view is too obvious to have been wholly overlooked. It is interesting to notice: that the earliest known anticipation of that principle which Darwin and Wallace developed almost simultaneously, was published sixty years ago, by Dr. Wells, the sagacious author of the theory of dew, who hit upon the idea of natural selection while resident in America. As abstracted by Mr. Darwin, who evidently takes delight in the discovery of these anticipations, the points which Dr. Wells made were substantially these: - All animals vary more or less: agriculturists improve domesticated animals by selection." What is thus done by art is done with equal efficacy, though more slowly, by Nature, in the formation of varieties of mankind, fitted for the country which they inhabit, and in this way: Negroes and mulattoes enjoy immunity from certain tropical diseases, and white men a comparative immunity from those of cold climates. Under the variation common to all animals, some of the darker would be better adapted than the rest to bear the diseases of a warm country, -say of tropical Africa. This race would consequently multiply, while the others would decrease, directly, because the prevalent diseases would be more fatal to them, and indirectly, by inability to contend with their more vigorous neighbors. Through the continued operation of the same causes, darker and darker races would prevail over the less' dark, and in time would monopolize the region where they originated or into which they

a supernatural creator. Science, in taking this away, leaves us only the assurance that if we bring the idea of God to Nature we may find Nature wholly compatible with that idea. Well, what is lost in directness may perhaps be gained in breadth and depth. It is certain that the whole progress of physical science tends, in respect to Divine action, to consider that mediate, general, and in a sense indirect, which had been thought to be immediate and special. Youth is ever taught by instances, manhood by laws. You go on to say: The evolution of species now, so commended to us by science, not long ago seemed as improbable to scientific as to ordinary minds. What assurance can we unscientific people have that science will not reverse its present judgments? None, perhaps, except -that, while many particular judgments have been reversed or altered, the general course of e thought has run in one direction. And theologians, like naturalists, must be content with the best judgments they can form upon the present showing, and be ready to modify them upon better. Finally, and to reach the present point, you a pertinently commend to scientific men their own saying: "Science asks of every thing how it is a part of the system of Nature, of the chain of cause and effect." An hypothesis must give the how and why, and from its own resources, before it is worth attending to. A credible hypothesis should assign real and known causes, and ascertain their actual operation somewhere before assuming their operation everywhere. A complete hypothesis should assign not only real but sufficient causes for all the effects; and when it assumes them in invisible and intangible forms, such as molecules and molecular movements, it is bound to show that all the observed consequences flow from the assumption. Now to declare that species come through evolution, without either proving it by facts or clearly conceiving the mode and manner how, is only supporting a thesis which was until lately deemed scientifically improbable by hypotheses of a kind which have always been regarded as invalid. Just here Darwinism comes in with a modus operandi, in which lies all its essential value. As the conception of the derivation of one form from another is the only distinctly-pointed alternative to specific supernatural creation, so the principle of natural selection, taken in its fullest sense, is the

whole interplay of living things on the earth with their inorganic surroundings and with each other. The hypothesis asserts that these may account, not for the introduction of life, but for its diversification into the forms and kinds which we now behold. This, I suppose, is tantamount .to asserting that the differences between one species and another now existing, and between these and their predecessors, has come to pass in the course of Nature; that is, without miracle. In these days, all agree that a scientific inquiry whether this may be so -that is, whether there are probable grounds for believing it (no thoughtful person expects to prove it) -is perfectly legitimate; and, so far as it becomes probable, I imagine that you might safely accept it. For the hypothesis, in its normal and simplest form,- when kept close to the facts, and free from extraneous assumptions -is merely this:- Given the observed capacity for variation as an inexhaustible factor, assuming that what has varied is still prone to vary (and there are grounds for the assumption), and natural selection will- so to say-pick out for preservation the fittest forms for particular surroundings, lead on and diversify them, and, by continual elimination of the less fit, segregate the survivors into distinct species. This, you see, assumes, and does not account for, the impulse to variation, assumes that variation is an inherent and universal capacity, and is the efficient cause of all the diversity; while natural selection is the proximate cause of it. So it is the selection, not the creation of forms that is accounted for. Darwinism does not so much explain why we have the actual forms, as it does why we have only these and not all intermediate forms, -in short, why we have species. There is of course a cause for the variation. Nobody supposes that any thing changes without a cause; and there is no reason for thinking that proximate causes of variation may not come to be known; but we hardly know the conditions, still less the causes now. The point I wish to make here is that natural selection -however you expand its meaning -cannot be invoked as the cause of that upon which it operates, i. e., variation. Otherwise, if by natural selection is meant the totality of all the known and unknown causes of whatever comes to pass in organic nature, then the term is no longer an allowable personification, but a sheer

adds any new perplexity to theism. In unfolding my thoughts upon the subject, I wish to keep as close "to the solid ground of Nature " as I possibly can, even where the discourse must rise from the ground of science into the finer air of philosophy. Specially I must heed the injunction: "If thou hast any tidings; prithee, deliver them like a man of this world," and not trouble myself, nor you, with meta- physical refinements and distinctions which, I' however needful in their way and place, are unnecessary to our purpose. I take for granted, "like a man of this world," the objective reality and substantiality of what we see and deal with, though I am told it cannot be proved; and I assume, -although demonstration is impossible, that what I and my fellow-men cannot help believing we ought to believe, or at least must rest content with. I suppose you will agree with me that it is not science, at least not natural science, which raises the most formidable difficulties to Christian theism, but philosophy, and that it is for philosophy to surmount them. The question which science asks of all it meets is, What is the system and course of things, and how is this or that a part of it in the fixed sequence of cause and effect? Philosophy asks whence the system itself, and what are causes and effects. Theology is partly historical science, and partly philosophy. Now I, as a scientific man, might rest in the probability of evolution as a general inference from the facts or a good hypothesis, and relegate the questions you would ask to the philosophers and theologians. But I am not one of those who think that scientific men should not concern themselves with such matters; and having gone so far as to say that the evolution which I accept does not seem to me to add any new perplexity to theism, and well knowing that others are of a contrary opinion, I am bound to further explanation and argument. But I have not the presumption to suppose that I can make any new contribution to this discussion; and what I may suggest must not be expected to cover the ground widely nor penetrate it deeply. I am sure that you will not look to me for the rehandling of insoluble problems and inevitable contradictions, into which the philosophical consideration of the' relations of Nature and man to God ultimately lands us. Certainly they are not peculiar to evolution. So, in so far as we may fairly refer any of its

common impression that Darwinian evolution predicates actual or necessary variation of all existing species, and counts that the variation must be in some de- finite ratio to the time. That is not the idea, nor the fact. "Evolution is not a course of hap-hazard and incessant change, but a continuing re-adjustment, which mayor may not, ac- cording to circumstances, involve considerable changes in a given time." Every form is in a relatively stable equilibrium, else it would not .Ii exist. Forms adjusted to their surroundings ought by the hypothesis to remain unchanged until the circumstances change. Only those of their variations could come to any thing which happened to be equally well adapted to the unchanged circumstances; and this may be' what we have when two or more nearly related species inhabit similar stations in the, same area. From this point of view you see how wide of the mark are those who imagine that Darwinian evolution supposes that the organic world was in early times, or at any time, out of joint or in ill relations to the surroundings. On the contrary, it is of the very nature of natural selection, that, while inducing changes eventually immense, it should preserve throughout all " time a condition of harmonious adaptation. Catastrophes must destroy; but gradual modification, under the long and silent struggle which never hastes and never rests, preserves while it renovates and diversifies the races. I ought here to state that there are eminent naturalists (one of them of Y°l;1rxx own university) who accept the doctrine of evolution, but who think little of natural selection as a modus operandi in the diversification of species; and there are distinguished writers, not naturalists, who, from other points of view are ready to accept "the doctrine of the successive evolution from ancestral germs of higher and higher forms of life and mind," while they profess to have buried the principle of natural selection and with it the Malthusian theory of population in one common grave. These are evolutionists, in their way, because the probability of evolutionary theories springs from the very various lines of facts, otherwise inexplicable, which they harmonize and explain: -in geology, the previous existence of forms more and more like those now existing, and at length coalescing in them; in geography, the actual distribution of species and genera over the earths

surface; in systematic natural history, the reason why species and genera and orders are so variously related, are here connected by transitions and there separated by wide gaps; in morphology why the same functions may be assumed by different organs, or the same kind of organ may perform here one function and there another, or again exist as a vestige, of no service at all; in anatomy and biology, the transition from one element of structure to another, the gradual specialization of organs, and the remarkable coincidence between the order of the development in the individual animal and that of the rise from low to high in the scale of being, and that of the successive appearance of the grades in time; finally in psychology, the gradations between beings endowed with rudimentary sensation and beings endowed with mind. Here, where the "touch of Nature makes the whole world kin," we reach the sensitive point. Man, while on the one side a wholly exceptional being, is on the other an object of natural history, -a part of the animal kingdom. If you agree with Quatrefages that man is a kingdom by himself, you must agree with him that this' kingdom is solely intellectual; that he is as certainly and completely an animal as he is certainly something more. We are sharers not only of animal but of vegetable life, sharers with the higher brute animals in common instincts and feelings and affections. It seems to me that there is a sort of meanness in the wish to ignore the tie. I fancy that human beings may be more humane when they realize that, as their' dependent associates live a life in which man has! a share, so they have rights which man is bound to respect. Man, in short, is a partaker of the natural as well as of the spiritual. And the evolutionist may say with the apostle: "Howbeit that was not first which is spiritual, but that which is natural, and afterward that which is spiritual." Man, "formed of the dust of the ground," endowed with "the breath of life," "became a living soul." Is there any warrant for affirming that these processes were instantaneous? As has just been intimated, the characteristic of that particular theory of evolution which is now in the ascendant is that, by taking advantage of "every creature's best" for bettering conditions, it has made strife work for good, throughout" an immensely long line of adjustments and readjustments, in a series

others have been most valuable. In any case, there is no call to wait on the ground that the disturbing views are only hypotheses. For, in the first place, we should have long to wait for demonstration one way or the other; and one crop of hypotheses is the fertile seed of another. Besides, hypothesis is the proper instrument for dealing with this class of questions; indeed, it is the essential precursor of every fruitful investigation in physical nature. You can seldom sound with the plummet while standing on the shore. To do this to any purpose, you must launch out on the sea, and brave some risks. Nearly all valuable results have been gained in this way. Newton's theory of gravitation was a typical hypothesis, and one which happened to be capable of early and sufficient verification. The undulatory theory of light was another. The nebular hypothesis, or portions of it, and the, kinetic theory -of gases, less verifiable, are accepted willingly because of the success with which they explain the facts. Evolution is a more complex, loose and less provable hypothesis, or congeries of d hypotheses, which can at most have only a relative, though perhaps continually increasing probability from its power of explaining a great variety of facts. Its strength appears on com-paring it with the rival hypothesis -for such it is -of immediate creation, which neither ex- plains nor pretends to explain any. How the more exact physical sciences are becoming more reconditely hypothetical, especially in the imagination of entities of which there can be no possible proof beyond their serviceability in explaining phenomena, we must not stop to consider. Only this may be said, that the adage, "Where faith begins science ends" is now well nigh inverted. For faith, in a just sense of the word, assumes as prominent a place in science as in religion. It is indispensable to both. Let it be noted, moreover, that the case we have to consider does not come before the tribunal of reason with antecedent presumptions all on one side, as theologians generally suppose. They say to the naturalists, not improperly, we will think about adopting your conclusions, contrary as they are to all our prepossessions, when they are thoroughly and irrevocably substantiated, and not till then. Your theory may prove true, but it seems vastly improbable. Here the naturalist is ready with a rejoinder: In this world of law you cannot