

is, the more rapidly do its component cells become disorganized and die, and new ones take their place.

In fact, it is upon this rapid change that activity depends; the consumption of cell material, and its constant formation, resembling the fire in the engine, by which the steam is produced. Muscular motion rapidly uses up the muscle cells, and new ones have to be supplied from the blood. *Thought* and *emotion* consume cell matter, in the *brain*, still faster, and the blood has to circulate in it with a rapidity proportionate to the work it performs.

In the next cut is shown the cells in the *brain* of a cat. These are all globular, and soft, being filled only with fluid. At *a* and *b*, some of these cells are shown separately, each with its nucleus.

The skin is simply a layer of flattened cells, and even the claws, nails, and horns

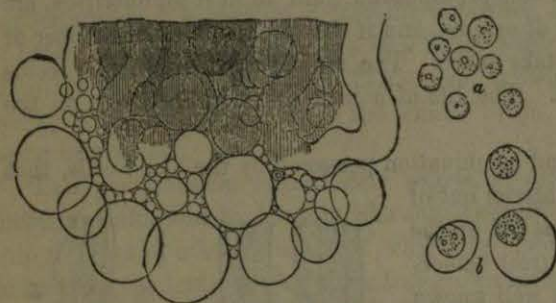


FIGURE 39.—Cells in the Brain of a Cat.

of animals are formed from them; the liver, kidneys, and all other secreting glands, are but clusters of cells, each cluster specialized for its particular purpose.

It will be readily seen from the above explanation, that the *cell* is the foundation of the man, and that even when he is full grown, his life and active usefulness depend entirely upon the ability of his organs to form, and assimilate, new cell material. If he then make too little of this, he becomes poor and feeble; and if the depreciation be carried too far, he dies. If the cells in his blood are deficient in number, or perform their functions imperfectly, his whole system suffers. Debility and disease both come from deranged cell growth, and neither can be got rid of till the cell action again becomes perfect. In some diseases, as in cancer for instance, a morbid or unusual growth of cells takes place, different from those normally existing in the system; and these new diseased cells often increase with astonishing rapidity, at the expense of the proper cells of the body. They resemble those fungus cells which often spring up in a few hours, and choke, or poison, the ordinary vegetation of the place they grow in. The osmotic activity of cells is past all conception. Compared with it, the most rapid action we know of is mere stillness, and it is incessant. A man, therefore, represents not one life only, but untold millions of lives!

In all probability disease cells, as those of cancer above referred to, have become, from some unknown cause, different in structure from healthy ones, and in their osmotic action, instead of selecting that material from the blood which the body needs for healthy growth, they select hurtful material.

It is highly probable that those who suffer from cancer, if they have children, will transmit to them a tendency to this abnormal cell formation, and in this way perpetuate the dire disease. The same may be said of many other diseases, and the first practical step toward getting permanently rid of them will be for people so afflicted not to propagate. In future and wiser ages, I have no doubt, this will be attended to. In fact we do attend to it now, in the *lower animals*, but neglect it in *man*!

PART V.

EVOLUTION.

ORGANIC AND EMBRYONIC DEVELOPMENT.

CHAPTER XI.

EVOLUTION.

ALL real knowledge of Nature, and natural phenomena, is of very recent growth. It was formerly the custom with men, even with philosophers, when they interested themselves about Nature at all, to sit down and *imagine* how things were, and invent *theories* about them. No matter how little those theories accorded with known facts, if they were put forward by *authority*, they were generally accepted, and the facts entirely ignored. Even at the present day this is a very common process, and when any new discovery is announced, the first impulse with many men is, not to investigate, and so find out if it be true, but to see if it agrees with some old theory.

It took mankind many thousands of years to find out, simple as it may seem, that to *know* about anything they must investigate it, and that they can investigate only by using their senses, corrected and controlled by their reason.

Man can really gain true knowledge, about any natural object, or process, only by using his eyes, ears, nose, tongue, and touch. With them he gains the *foundation facts*, by means of which he can truly investigate, and gain knowledge; but without which all his speculations amount to nothing, being like houses built on sand.

It would be amusing, if it were not so pitiful, to narrate the strange and absurd theories which have been put forward, by the greatest men of former times, in regard to the various departments of Nature. The early history of every science is only a record of such theories, one superseding another, according to the weight of authority it could command, and not at all because it was more true. And yet the simple examination of the facts, by means of the senses,—that is, experimentation, and observation,—would have revealed the real truth at once.

No knowledge whatever can be gained of Nature by mere reasoning, unless it be based upon facts taken cognizance of by the senses. And yet it is quite common for men to commence such reasoning, without any previous acquaintance with the necessary facts whatever. Such a course necessarily leads them to all kinds of absurd conclusions, and makes all their reasonings utterly valueless, because they have no foundation.

An anecdote recorded of King Charles II. illustrates this well. He was a very shrewd man, and fond of quizzing the learned pundits around him, whose weak points he well knew. One day, having a large circle of them, he propounded the following question: "Why is it that if you put a vessel of water in a scale, weigh it accurately, and then put in a *live* fish, it will not weigh any more; while if you put in a *dead* one of the same size, it does weigh more?"

The learned men discussed this question, reasoned about it, started all kinds of theories, but could come to no satisfactory conclusion. Finally the king asked a hard-headed old Scotchman, who had said nothing, what explanation he gave.

The old man simply replied, "I doubt the fact;" and, sure enough, on trying the experiment, it was found that whether the fish was dead or alive made no difference, they both made the vessel weigh so much the more.

Now, this is exactly the course the world has hitherto pursued, and which a large number of people habitually pursue now. Whenever any question presents itself to them, out of the ordinary run of their experience, they immediately begin to theorize and speculate about it, instead of first finding out how much they can get to know about it. Fortunately, however, there are always some common-sense men, who, like the old Scotchman, "doubt the fact," and will have it put to the test of experiment.

We are, in fact, indebted to the *doubters*, and to those who always insist upon rigid *examination*, for all the real knowledge we possess; and they have had a hard fight of it against the theorists. At one time it was dangerous to doubt or, at least to question, many prevalent theories, and men had to profess belief in them, even when they knew them to be untrue.

This is especially the case in regard to *man*, and other animals. Men who despised Nature as something vile and brutish, sat down in their closets to explain all about it, without making any observation or experiments whatever. Each one formed his own hobby or theory, which he put forward as infallible, and denounced all the others as heterodox and wicked.

It is hard to judge which are the most absurd and unfounded—the theories about man's body, or those about his mind. We find them vary from age to age, but all alike baseless in fact. It never occurred to these theorists that the only way to understand a man was to *examine* and *observe* him in every possible way; to *take him to pieces*, and to submit every part and parcel, so far as was possible, to direct observation and experiment, by means of the senses. If such a course had been proposed at one time, it would have been denounced as gross, materialistic, and wicked; and the individual suggesting it would have run no little danger. In fact, many of the greatest men who ever lived have lost their lives, after horrible tortures, for doing so. And yet it is the only true course to take, as people are now beginning to see.

If a man should present to the public a curious machine, working in some unknown way, but keep it under a glass case while he asked mechanics to explain it, we should think him very unreasonable. They would naturally demand to be allowed to examine it, to take it to pieces, and to ascertain the motive power. Till this had been done, they might theorize about it, but nothing could really be *known*, and all their theories might be utterly wrong.

This, however, is exactly the course hitherto taken in regard to man; he has been kept under a *glass case* of old theories and prejudices, and no real examination of him allowed to be made, till, finally, some bold spirits, with the sledge-hammer of scientific fact, smashed the case and took the man to pieces! The result proved that he was altogether a different being to what the old theories had made him, and that he stood in very different relations to his surroundings. The orthodox theory has always been that man had a different origin and destiny from all other living beings, and that he stood in a different relation to Nature generally. It was supposed that he was created, just as we find him, by some outside process, out of the inorganic elements of the world, with inherent powers, different from any existing elsewhere in Nature. To doubt this, or to suggest that possibly he might *not* thus

stand apart, but be really only a product of Nature, originating from her inherent creative power, like everything else, was something undreamed of till recently.

Even now the mere proposal to inquire into the matter, to collect facts, and to make observations, with a view to ascertaining how far the prevalent theory may be corroborated or disproved by them, causes the most absurd apprehensions and the most uncharitable denunciations.

Nevertheless, the doubters have determined to *weigh the fish*, dead and alive, with the water, and to see what is the fact. They decline any longer to take any theory for granted without proof; but resolutely determine to examine *all*, and test them by facts alone.

It is the age of weighing and measuring; of seeing and hearing; of bringing together in all possible ways the different natural substances, to see how they act and react upon each other. It is the age when a material cause is assumed and *sought* for every known phenomenon. It is the age when observation and experiments take the place of mere speculation, and when authority alone is not allowed to decide any matter in dispute, especially if it can be submitted to investigation. Men discover that the more they study Nature by observation and experiments, the more capability they find in her, and the less need for outside influence in any way. One after another, the events and things formerly thought to be supernatural are found to be only parts of the natural chain of events, so that the supernatural is steadily receding.

It is now beginning to be seen that Nature includes everything within herself; that there is nothing outside of her in any way, so far as we know; and that she possesses inherently the full capacity for originating all beings that exist, organic and inorganic, man included, with all their powers and capacities of every kind. Astronomy and geology show us that the world was once very different to what it is now; that it had a beginning, probably in a state of vapor, and afterward a long infancy in which no life was possible, but in which the natural forces were constantly acting with an energy of which we now seldom see an example. It had to be cooled; its watery vapor condensed; its jagged, hard rocks softened and worn down into mud and sand to form other kinds of rock, laid in regular beds, one above another, on the floor of the ocean. Finally, the time came when the protoplasmic elements—*ammonia*, *carbonic acid*, and *water*—could exist and combine together, to form the primitive germinal matter which we now call *protoplasm*, when it forms animals, and chlorophyl when it forms plants.

When once this substance was formed, portions of it would inevitably become endued with vitality, from the influence of chemical action, of heat, and electricity, as shown elsewhere. And in this way would originate the primitive *protozoa*, similar to those we now see; beings that are neither plants nor animals, or perhaps either, according to the conditions under which they develop.

As these multiplied and decayed, leaving their own protoplasmic substance to add to that naturally formed, and the general conditions became more favorable to life, other and superior beings would naturally take their place.

In this way began *Evolution*, or that gradual bringing forth, from the primitive unorganized elements, step by step, the long succession of living beings, ending in those now existing.

No organized beings above the lowest protozoa originated in the form we now see them. All have resulted, by gradual change, in a long succession of ages, from

other and lower forms. The largest and most perfect animals, with man himself, can be traced back, step by step, till we come finally down to the speck of protoplasm which is the first beginning of all.

Thus matter, and the force inherent in it, or what we call Nature, has originated all that exists; and there is no reason to doubt that, if all life were to become extinct, on this earth, Nature herself would again produce it; but probably it would begin very differently to what it did at first, because the conditions are different.

This is *Evolution*, the progress upward, from an immature primitive state to a more perfect one, both bodily and mental. For it is not only that animals have, in many ways, become more differentiated, or specialized, in their bodily development, but their mental or reasoning powers have progressed also, notably in man.

This has resulted from a steady improvement in the quality and capacity of the *brain*, on the working of which all mental power depends. Nothing is more striking, in studying the successive stages of fossil animal life, than the steady advance that is shown in brain power.

In former epochs, we find enormous mastodons, and other gigantic creatures, with bodily bulk and strength far beyond the mightiest now existing, but with merely *rudimentary brains*. It was not necessary for them to think, and so the thinking organ was not developed.

As the world changed, however, in its conditions, it became fitted for other kinds of beings. Mere bodily bulk and strength began to lessen, the brain became more developed, and *intelligence* came into play.

This new form of natural power soon made itself felt in many ways, and all other forms became more or less subordinate to it. The small and weak animal, with much intelligence, could more than hold his own with the big, strong animal, whose intelligence was small.

The particular type of animals, to which man belongs, are the only ones with highly specialized brains; and the next class below him, the apes, have the most perfect brains, next to man's.

Recent investigations, especially those of Darwin, have shown that if we take the lowest man as a starting-point, there is less difference between him and the highest ape, on one side, than there is between him and the highest man on the other side. In other words, the Bushman is farther removed from the cultivated Caucasian than the highest ape is from the Bushman. And the difference is mainly in intelligence, or brain development.

Evolution has not ceased, but is going on all the time, all through nature, but especially in man and the animals under his control. The cultivated man of to-day is as far above the barbarian of a past age, in available intellectual power, as that barbarian was then above the apes from which he sprang; and probably the man of the future, by the same process of evolution, will be as far above the most cultivated men of the present day.

The principle of evolution prevails not only in individual life, but in society itself. We see how the first crude social arrangements, such as prevail among savage tribes, are gradually advanced to larger associations, under hereditary chiefs, and how these finally become settled nations. The most powerful and perfected societies of the present day, such as we see in the more cultivated parts of Europe, have all been gradually evolved from savage tribes. History shows us how their laws, their customs, their religions, and their systems of education have all advanced, from the

simplest beginnings, to what we see them now, and in all settled societies they are still advancing. In fact, the only real and permanent progress is made in this way, by gradual evolution; and any attempt to advance society by a jump, to the more perfect stage of a future generation, is sure to end in failure. Many instances of this are to be found in modern history, and even in our present experience.

And this explains why it is that important discoveries are frequently made, and announced to the world, without attracting any attention whatever. They are simply ahead of their time, and the public mind has got to be evolved to a certain point before they can be appreciated. A very short time since there died a gentleman who made, many years ago, a perfect electric telegraph, almost exactly like what we are now using, and invited all the world to come and see it, but it attracted very little notice, and was finally laid aside. Government officials informed him that they did not want anything better than the old semaphore telegraph, with its movable arms, seen through a telescope.

It is just so with everything else: not only have scientific inventions to wait till the public *brain* is sufficiently evolved to comprehend them, but all truths must do the same. And this explains why obvious improvements in laws, in customs, and in religion, are so slow in being made. A few advanced minds can see them, and may urge their adoption, but they have to wait till the dull, inert masses get nearer to their stand-point. It is, however, a sufficient consolation to know that time, by gradual evolution, will certainly bring round all the progress and amelioration that the best minds can conceive of, and probably even much more.

Many excellent people are much alarmed at our present rapid progress, from fear that institutions and opinions, now held sacred, will be swept away, or so modified that they will not resemble what they are now. And this will, doubtless, be the case; but such people should remember that in former ages the same opinions and institutions, which they now hold so sacred, were condemned and dreaded as much as they now fear and condemn the present advanced views. The most orthodox views of to-day, on many subjects, were rank heresies among our forefathers, and many of the much-dreaded heresies and infidelities of to-day will be orthodox in the future.

The human mind must progress, and it is vain and irrational to suppose that the more enlightened future will be bound and trammelled by the immature views of the present. Evolution never ceases, and fortunately all the efforts of ignorant and timid conservatism can never seriously impede its progress.

A remarkable instance of inherited experience, showing itself as improved perception, is shown in the behavior of animals toward railroads and their engines. When they first began to traverse the country, all the animals in the fields used to run away in crowds, in the utmost terror, and constant accidents were occurring with them on the roads. Now, however, the same animals, both in the fields and roads, see the trains pass and repass, and scarcely notice them. This is not only because they have got used to them individually; for the offspring of these animals, born away from railroads, and brought to them when grown up, usually show just the same indifference. This is *evolution!* The animals who first got accustomed to the engines underwent a change of *brain*, owing to their new experience, and this change of brain their offspring are *born with*, and hence their behavior.

The existing knowledge of any community, its habits, customs, modes of thought and beliefs, are only the inherited experiences of past ages, transmitted to the present. The present is the child of the past by the process of evolution.

It would be a great mistake to suppose that the process of evolution is limited to any one or several kinds of phenomena. It extends to all nature, and is everywhere, at all times, going on; in the mental and moral world, as well as in the physical.

The present may be said to be always, not only pregnant, but even in the actual throes of labor, with the future. No age is self-born, nor stands alone, but each is the child of the one before, and the parent of the next beyond.

The present clear conception of this great law of evolution, and its wide acceptance, is mainly due to the labors of CHARLES DARWIN—a man who may be truly said to have created a *new era* in science.

Before his time the development of an egg into a bird was regarded as a simple unconnected phenomenon, wonderful in itself, but not specially related to other phenomena of a similar kind on a larger scale. But we know now that the changes the egg undergoes, before it is fully developed into the bird, are the exact counterpart of those which the progenitors of the bird went through in former ages.

The egg is only a simple cell; but under the influence of heat and moisture, we see it gradually change, going through various inferior forms up to that of the fish, thence to the amphibia, thence to the reptile, and finally to the bird. And if we trace back the bird through its organic descent, as shown by the fossil record, we go back, step by step, first to the reptile, thence to the amphibia, thence to the fish, and finally down to the single cell. It is the same process, traced forward in one case, and backward in the other.

The same fact is shown when we trace the development of a man in his mother's womb. He begins with the simple cell, goes through all the lower forms, ascends to the fish, the amphibia, the reptile, the bird, and still further through all the more advanced forms, till he becomes finally a man.

We can also trace him back, in the past, just as we did the bird. We can track him from his present development, back to the apes, from them to the lemurs, and so on from one form to another of the mammalia down to the bird, the reptile, the amphibia, the fish, and so on finally to the simple cell.

And not only can we thus trace his bodily evolution, but his mental powers, and what are called his moral instincts, can all be traced back to the simple instinctive actions of the beings below him. In them are the germs of the highest mental developments, and the most elevated moral impulses, that we see in the world's sages, heroes, and philanthropists. Even religion, the sublimity of law and veneration for that we fear or love, but do not comprehend, is plainly to be seen, in its first faint glimmerings, in the conduct of a dog to his master.

Every living organism, therefore, develops from a simple cell, and in its progress upward to its final form, gives us an exact representation of the way in which its type originated, in the past, from the primordial protoplasm.

The conclusion also seems inevitable that all the individuals, past and present, of any type, in all their varieties, must have originated from one single ancestor, the first of that type! And this first original parent—say of the vertebrates—was probably evolved from the type below by a combination of conditions that may never exist again. If any type, therefore, should become totally extinct, it would, in all probability, never be brought into existence again. Any of its varieties might die out, and be again reproduced by selection from the other varieties; but the type once gone, is gone forever.

Evolution, then, teaches us that not only have all organic forms been derived

from pre-existing and simpler ones, but also all our social organizations, our moral impulses, and our mental powers. It teaches us, also, that all the various departments of knowledge have not only developed individually in this way; but that they have also developed *communistically*—if we may use the term—or conjointly, as a whole. No one science ever did or could originate and perfect itself, standing alone, but each one hangs upon every other one, and develops only as that does, so that knowledge advances as a whole by separate steps.

The whole universe, therefore, is one in every department, and the same law rules all, from the atom to the mountain, and from simple motion to thought. Everything that is, is indissolubly connected with everything else that is, and there is nothing that exists or acts alone.

It is impossible to overestimate the influence that the perception of this law of evolution will exert upon society in many ways. It will gradually change all our views and practices in regard to government, and revolutionize completely our systems of education. It will bring order out of the present chaos, and immensely aid in bringing about that further and higher development of which man is obviously capable, and to which he will finally surely attain.

It is inevitable, however, that the prospect of such a sweeping change as evolution foreshadows, should alarm those who have always considered the prevailing systems of government, education, and morals as finally established on the basis of immutable truth.

Mr. Charles Darwin, in his matchless work on *The Descent of Man*, thus sums up the conclusions to which his investigations have led him: "We thus learn that man is descended from a hairy-tailed quadruped, probably arboreal in its habits, and an inhabitant of the old world. This creature, if its whole structure had been examined by a naturalist, would have been classed among the quadrumana, as surely as the still more ancient progenitor of the old and new world monkeys. The quadrumana, and all the higher mammals, are probably derived from an ancient marsupial animal, and this, through a long line of diversified forms, from some amphibian-like creature, and this again from some fish-like animal. In the dim obscurity of the past we can see that the progenitor of all the vertebrata must have been an aquatic animal, provided with branchiæ, with the two sexes united in the same individual, and with the most important organs of the body (such as the brain and heart) imperfectly, or not at all developed. This animal seems to have been more like the larvæ of the existing marine Ascidiæ than any other known form."

From this low form it is easy to pass further, till we get to the simple *moner*, and from that to mere formless protoplasm, naturally produced.

The following table will still further illustrate this idea. In it the different strata or rocks, composing the crust of the earth—beginning with the lowest containing animal remains—are arranged in GROUPS, and a list is given of the characteristic animals found in each group.

The progress of *evolution*, from the simple zoophyte up to man, can thus be seen at a glance, by observing the advance from group to group, from the very lowest up to formations of the present age.

The development of the HUMAN BRAIN, in the fœtus, from stage to stage, in each month, is also shown, and the remarkable correspondence between it and animal evolution, from the first beginning of life to the appearance of man.

TABLE

SHOWING THE PROGRESSIONAL DEVELOPMENT OF THE HUMAN BRAIN IN THE FŒTUS,
AS COMPARED WITH THE EVOLUTIONAL DEVELOPMENT OF ANIMAL LIFE
ON THE GLOBE.

FIRST GROUP OF ROCKS.	ANIMAL REMAINS IN THESE ROCKS.	HUMAN BRAIN AT FIRST MONTH.
Clay Slate. Greywacke. Old Red Sandstone. Gneiss. Mica Slate. Silurian System.	Polypes. Double-Shellled Mollusks. Crustacea. Annelids. Crustaceous Fishes.—All Invertebrate Animals, or without Back Bones.	Resembles that of an Invertebrate Animal.
SECOND GROUP OF ROCKS.	ANIMAL REMAINS IN THIS FORMATION.	HUMAN BRAIN AT SECOND MONTH.
Carboniferous Formation; or Coal Beds.	Various—but especially contains True Fishes.	Resembles that of a Fish.
THIRD GROUP OF ROCKS.	ANIMAL REMAINS IN THIS FORMATION.	HUMAN BRAIN AT THIRD MONTH.
New Red Sandstone.	Reptiles. Great Lizards. Crocodiles. Frog-like Animals. Turtles.	Resembles that of a Turtle.
FOURTH GROUP OF ROCKS.	ANIMAL REMAINS FOUND IN THIS FORMATION.	HUMAN BRAIN AT FOURTH MONTH.
Oolitic and Chalk Beds.	Various—but especially Birds.	Resembles that of a Bird.
FIFTH GROUP OF ROCKS.	ANIMAL REMAINS FOUND IN THIS GROUP.	HUMAN BRAIN.
Lower Eocene. Miocene.	1st Series.—Marsupials—Gnawing Animals, or Rodents. 2d Series.—Cud-Chewing Animals, or Ruminants. 3d Series.—Animals that Walk on their Toes, or Digitigrades.	At <i>five</i> months resembles that of a Rodent. At <i>six</i> months resembles that of a Ruminant. At <i>seven</i> months resembles that of a Digitigrade.
SIXTH GROUP OF ROCKS.	ANIMAL REMAINS FOUND IN THIS FORMATION.	THE HUMAN BRAIN AT EIGHT MONTHS.
The Pliocene Formation.	Most of the above—and also Monkeys,—Four-handed Animals, or Quadrumana.	Resembles that of a Monkey, or Quadrumana.
SEVENTH FORMATION.	ANIMAL REMAINS FOUND IN THESE.	THE HUMAN BRAIN AT NINE MONTHS.
Recent Deposits and Caves.	Many of the above, and also remains of Man, the first Two-handed Animal, or Bimana.	Is now that of a true Bimana, or Human.

It is not intended in the above table to give a list of all the animals in each group of rocks, but merely to show how the various distinctive types succeed each other, in an ascending order, as we go upward, from the lowest groups to recent formations.

The remarkable correspondence between the development of the human foetal brain from month to month, and the evolution of animal life, will be evident at a glance.

The animal world at first was all *invertebrate*—so is the human brain at the first month. Later on the animal world advances to the *first* stage—and so does the human brain at two months. The next advance in the animal world is to the *reptile* stage, and at three months the human foetal brain resembles that of a turtle. And so it goes on from group to group, and from stage to stage, the development of the human brain being a strict counterpart of the general animal evolution which has taken place upon the globe. The two are strictly analogous, and man may, in one sense, be said to be an epitome of the whole animal world.

That the world of life, animal and vegetable, has gradually grown from the simplest beginning, or been evolved, just as man grows from the egg, is evident. We may not be able to show every link in the chain of succession, in its exact order, because our knowledge of geology is yet imperfect, and also of existing animals and plants. We know enough, however, to assure us of the general truth, and every day the different parts of the chain that are still disconnected, are being linked together by new discoveries.

A CHANGE OF SPECIES.

DEGENERATE RABBITS.—In the year 1419 a few rabbits were born on a Spanish ship, and put on the island of Porto Santo. There were no beasts of prey there, and these little animals increased so enormously as to become a pest to the country, and compelled a colony to remove from it. They are still there, but in the course of 450 years they have become a "species;" they have a peculiar color, a rat-like shape, are small in size, live a nocturnal life, and are of extreme wildness. And now they refuse even to pair with the European form from which they arose.—*The London Quarterly Review.*