# CHARLES KINGSLEY

# SCIENTIFIC ESSAYS AND LECTURES

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# Содержание

# Charles Kingsley
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## ON BIO-GEOLOGY [1]

I am not sure that the subject of my address is rightly chosen. I am not sure that I ought not to have postponed a question of mere natural history, to speak to you as scientific men, on the questions of life and death, which have been forced upon us by the awful warning of an illustrious personage's illness; of preventible disease, its frightful prevalency; of the 200,000 persons who are said to have died of fever alone since the Prince Consort's death, ten years ago; of the remedies; of drainage; of sewage disinfection and utilisation; and of the assistance which you, as a body of scientific men, can give to any effort towards saving the lives and health of our fellow-citizens from those unseen poisons which lurk like wild beasts couched in the jungle, ready to spring at any moment on the unsuspecting, the innocent, the helpless. Of all this I longed to speak; but I thought it best only to hint at it, and leave the question to your common sense and your humanity; taking for granted that your minds, like the minds of all right-minded Englishmen, have been of late painfully awakened to its importance. It seemed to me almost an

[1] An Address given to the Scientific Society of Winchester, 1871.

impertinence to say more in a city of whose local circumstances I know little or nothing. As an old sanitary reformer, practical, as well as theoretical, I am but too well aware of the difficulties which beset any complete scheme of drainage, especially in an ancient city like this; where men are paying the penalty of their predecessors' ignorance; and dwelling, whether they choose or not, over fifteen centuries of accumulated dirt.

And, therefore, taking for granted that there is energy and intellect enough in Winchester to conquer these difficulties in due time, I go on to ask you to consider, for a time, a subject which is growing more and more important and interesting, a subject the study of which will do much towards raising the field naturalist from a mere collector of specimens—as he was twenty years ago—to a philosopher elucidating some of the grandest problems. I mean the infant science of Bio-geology—the science which treats of the distribution of plants and animals over the globe, and the cause of that distribution.

I doubt not that there are many here who know far more about the subject than I; who are far better read than I am in the works of Forbes, Darwin, Wallace, Hooker, Moritz Wagner, and the other illustrious men who have written on it. But I may, perhaps, give a few hints which will be of use to the younger members of this Society, and will point out to them how to get a new relish for the pursuit of field science.

Bio-geology, then, begins with asking every plant or animal you meet, large or small, not merely—What is your name? That

is the collector and classifier's duty; and a most necessary duty it is, and one to be performed with the most conscientious patience and accuracy, so that a sound foundation may be built for future speculations. But young naturalists should act not merely as Nature's registrars and census-takers, but as her policemen and gamekeepers; and ask everything they meet—How did you get there? By what road did you come? What was your last place of abode? And now you are here, how do you get your living? Are you and your children thriving, like decent people who can take care of themselves, or growing pauperised and degraded, and dying out? Not that we have a fear of your becoming a dangerous class. Madame Nature allows no dangerous classes, in the modern sense. She has, doubtless for some wise reason, no mercy for the weak. She rewards each organism according to its works; and if anything grows too weak or stupid to take care of itself, she gives it its due deserts by letting it die and disappear.

So, you plant or you animal, are you among the strong, the successful, the multiplying, the colonising? Or are you among the weak, the failing, the dwindling, the doomed?

These questions may seem somewhat rude: but you may comfort yourself by the thought that plants and animals, though they deserve all kindness, all admiration, deserve no courtesy—at least in this respect. For they are, one and all, wherever you find them, vagrants and landlopers, intruders and conquerors, who have got where they happen to be simply by the law of the strongest—generally not without a little robbery and murder.

They have no right save that of possession; the same by which the puffin turns out the old rabbits, eats the young ones, and then lays her eggs in the rabbit-burrow—simply because she can.

Now, you will see at once that such a course of questioning will call out a great many curious and interesting answers, if you can only get the things to tell you their story; as you always may if you will cross-examine them long enough; and will lead you into many subjects beside mere botany or entomology. So various, indeed, are the subjects which you will thus start, that I can only hint at them now in the most cursory fashion.

At the outset you will soon find yourself involved in chemical and meteorological questions; as, for instance, when you ask —How is it that I find one flora on the sea-shore, another on the sandstone, another on the chalk, and another on the peat-making gravelly strata? The usual answer would be, I presume —if we could work it out by twenty years' experiment, such as Mr. Lawes, of Rothampsted, has been making on the growth of grasses and leguminous plants in different soils and under different manures—the usual answer, I say, would be—Because we plants want such and such mineral constituents in our woody fibre; again, because we want a certain amount of moisture at a certain period of the year: or, perhaps, simply because the mechanical arrangement of the particles of a certain soil happens to suit the shape of our roots and of their stomata.

Sometimes you will get an answer quickly enough; sometimes not. If you ask, for instance, *Asplenium viride* how it contrives to

grow plentifully in the Craven of Yorkshire down to 600 or 800 feet above the sea, while in Snowdon it dislikes growing lower than 2000 feet, and is not plentiful even there?—it will reply —Because in the Craven I can get as much carbonic acid as I want from the decomposing limestone; while on the Snowdon Silurian I get very little; and I have to make it up by clinging to the mountain tops, for the sake of the greater rainfall. But if you ask *Polypodium calcareum*—How is it you choose only to grow on limestone, while *Polypodium Dryopteris*, of which, I suspect, you are only a variety, is ready to grow anywhere?—*Polypodium calcareum* will refuse, as yet, to answer a word.

Again—I can only give you the merest string of hints—you will find in your questionings that many plants and animals have no reason at all to show why they should be in one place and not in another, save the very sound reason for the latter which was suggested to me once by a great naturalist. I was asking—Why don't I find such and such a species in my parish, while it is plentiful a few miles off in exactly the same soil?—and he answered—For the same reason that you are not in America. Because you have not got there. Which answer threw to me a flood of light on this whole science. Things are often where they are, simply because they happen to have got there, and not elsewhere. But they must have got there by some means, and those means I want young naturalists to discover; at least, to guess at.

A species, for instance—and I suspect it is a common case

with insects—may abound in a single spot, simply because, long years ago, a single brood of eggs happened to hatch at a time when eggs of other species, who would have competed against them for food, did not hatch; and they may remain confined to that spot, though there is plenty of food for them outside it, simply because they do not increase fast enough to require to spread out in search of more food. Thus I should explain a case which I heard of lately of *Anthocera trifolii*, abundant for years in one corner of a certain field, and only there; while there was just as much trefoil all round for its larvæ as there was in the selected spot. I can, I say, only give hints: but they will suffice, I hope, to show the path of thought into which I want young naturalists to turn their minds.

Or, again, you will have to inquire whether the species has not been prevented from spreading by some natural barrier. Mr. Wallace, whom you all of course know, has shown in his "Malay Archipelago" that a strait of deep sea can act as such a barrier between species. Moritz Wagner has shown that, in the case of insects, a moderately-broad river may divide two closely-allied species of beetles, or a very narrow snow-range, two closely-allied species of moths.

Again, another cause, and a most common one, is: that the plants cannot spread because they find the ground beyond them already occupied by other plants, who will not tolerate a fresh mouth, having only just enough to feed themselves. Take the case of *Saxifraga hypnoides* and *S. umbrosa*, "London pride."

They are two especially strong species. They show that, *S. hypnoides* especially, by their power of sporting, of diverging into varieties; they show it equally by their power of thriving anywhere, if they can only get there. They will grow both in my sandy garden, under a rainfall of only 23 inches, more luxuriantly than in their native mountains under a rainfall of 50 or 60 inches.

Then how is it that *S. hypnoides* cannot get down off the mountains; and that *S. umbrosa*, though in Kerry it has got off the mountains and down to the sea-level, exterminating, I suspect, many species in its progress, yet cannot get across County Cork?

The only answer is, I believe, that both species are continually trying to go ahead; but that the other plants already in front of them are too strong for them, and massacre their infants as soon as born.

And this brings us to another curious question: the sudden and abundant appearance of plants, like the foxglove and *Epilobium angustifolium*, in spots where they have never been seen before.

Are there seeds, as some think, dormant in the ground; or are the seeds which have germinated, fresh ones wafted thither by wind or otherwise, and only able to germinate in that one spot because there the soil is clear? General Monro, now famous for his unequalled memoir on the bamboos, holds to the latter theory. He pointed out to me that the *Epilobium* seeds, being feathered could travel with the wind; that the plant always made its appearance first on new banks, landslips, clearings, where it had nothing to compete against; and that the foxglove did the

same. True, and most painfully true, in the case of thistles and groundsels: but foxglove seeds, though minute, would hardly be carried by the wind any more than those of the white clover, which comes up so abundantly in drained fens. Adhuc sub judice lis est, and I wish some young naturalists would work carefully at the solution; by experiment, which is the most sure way to find out anything.

But in researches in this direction they will find puzzles enough. I will give them one which I shall be most thankful to hear they have solved within the next seven years—How is it that we find certain plants, namely, the thrift and the scurvy grass, abundant on the sea-shore and common on certain mountain-tops, but nowhere between the two? Answer me that. For I have looked at the fact for years—before, behind, sideways, upside down, and inside out—and I cannot understand it.

But all these questions, and especially, I suspect, that last one, ought to lead the young student up to the great and complex question—How were these islands re-peopled with plants and animals, after the long and wholesale catastrophe of the glacial epoch?

I presume you all know, and will agree, that the whole of these islands, north of the Thames, save certain ice-clad mountain-tops, were buried for long ages under an icy sea. From whence did vegetable and animal life crawl back to the land, as it rose again; and cover its mantle of glacial drift with fresh life and verdure?

Now let me give you a few prolegomena on this matter. You must study the plants of course, species by species. Take Watson's "Cybele Britannica" and Moore's "Cybele Hibernica;" and let—as Mr. Matthew Arnold would say—"your thought play freely about them." Look carefully, too, in the case of each species, at the note on its distribution, which you will find appended in Bentham's "Handbook," and in Hooker's "Student's Flora." Get all the help you can, if you wish to work the subject out, from foreign botanists, both European and American; and I think that, on the whole, you will come to some such theory as this for a general starling platform. We do not owe our flora—I must keep to the flora just now—to so many different regions, or types, as Mr. Watson conceives, but to three, namely, an European or Germanic flora, from the south-east; an Atlantic flora, from the south-east; a Northern flora, from the north. These three invaded us after the glacial epoch; and our general flora is their result.

But this will cause you much trouble. Before you go a step farther you will have to eliminate from all your calculations most of the plants which Watson calls glareal, *i.e.* found in cultivated ground about habitations. And what their limit may be I think we never shall know. But of this we may be sure; that just as invading armies always bring with them, in forage or otherwise, some plants from their own country—just as the Cossacks, in 1815, brought more than one Russian plant through Germany into France—just as you have already a crop of North German

plants upon the battle-fields of France—thus do conquering races bring new plants. The Romans, during their 300 or 400 years of occupation and civilisation, must have brought more species, I believe, than I dare mention. I suspect them of having brought, not merely the common hedge elm of the south, not merely the three species of nettle, but all our red poppies, and a great number of the weeds which are common in our cornfields; and when we add to them the plants which may have been brought by returning crusaders and pilgrims; by monks from every part of Europe, by Flemings or other dealers in foreign wool—we have to cut a huge cantle out of our indigenous flora: only, having no records, we hardly know where and what to cut out; and can only, we elder ones, recommend the subject to the notice of the younger botanists, that they may work it out after our work is done.

Of course these plants introduced by man, if they are cut out, must be cut out of only one of the floras, namely, the European; for they, probably, came from the south-east, by whatever means they came.

That European flora invaded us, I presume, immediately after the glacial epoch, at a time when France and England were united, and the German Ocean a mere network of rivers, which emptied into the deep sea between Scotland and Scandinavia. And here I must add, that endless questions of interest will arise to those who will study, not merely the invasion of that truly European flora, but the invasion of reptiles, insects, and birds,

especially birds of passage, which must have followed it as soon as the land was sufficiently covered with vegetation to support life. Whole volumes remain to be written on this subject. I trust that some of your younger members may live to write one of them. The way to begin will be; to compare the flora and fauna of this part of England very carefully with that of the southern and eastern counties; and then to compare them again with the fauna and flora of France, Belgium, and Holland.

As for the Atlantic flora, you will have to decide for yourselves whether you accept or not the theory of a sunken Atlantic continent. I confess that all objections to that theory, however astounding it may seem, are outweighed in my mind by a host of facts which I can explain by no other theory. But you must judge for yourselves; and to do so you must study carefully the distribution of heaths both in Europe and at the Cape, and their non-appearance beyond the Ural Mountains, and in America, save in Labrador, where the common ling, an older and less specialised form, exists. You must consider, too, the plants common to the Azores, Portugal, the West of England, Ireland, and the Western Hebrides. In so doing young naturalists will at least find proofs of a change in the distribution of land and water, which will utterly astound them when they face it for the first time.

As for the Northern flora, the question whence it came is puzzling enough. It seems difficult to conceive how any plants could have survived when Scotland was an archipelago in the

same ice-covered condition as Greenland is now; and we have no proof that there existed after the glacial epoch any northern continent from which the plants and animals could have come back to us. The species of plants and animals common to Britain, Scandinavia, and North America, must have spread in pre-glacial times when a continent joining them did exist.

But some light has been thrown on this question by an article, as charming as it is able, on "The Physics of the Arctic Ice," by Dr. Brown of Campster. You will find it in the "Quarterly Journal of the Geological Society" for February, 1870. He shows there that even in Greenland peaks and crags are left free enough from ice to support a vegetation of between three hundred or four hundred species of flowering plants; and, therefore, he well says, we must be careful to avoid concluding that the plant and animal life on the dreary shores or mountain-tops of the old glacial Scotland was poor. The same would hold good of our mountains; and, if so, we may look with respect, even awe, on the Alpine plants of Wales, Scotland, and the Lake mountains, as organisms, stunted it may be, and even degraded by their long battle with the elements, but venerable from their age, historic from their endurance. Relics of an older temperate world, they have lived through thousands of centuries of frost and fog, to sun themselves in a temperate climate once more. I can never pick one of them without a tinge of shame; and to exterminate one of them is to destroy, for the mere pleasure of collecting, the last of a family which God has taken the trouble to preserve for

thousands of centuries.

I trust that these hints—for I can call them nothing more—will at least awaken any young naturalist who has hitherto only collected natural objects, to study the really important and interesting question—How did these things get here?

Now hence arise questions which may puzzle the mind of a Hampshire naturalist. You have in this neighbourhood, as you well know, two, or rather three, soils, each carrying its peculiar vegetation. First, you have the clay lying on the chalk, and carrying vast woodlands, seemingly primeval. Next, you have the chalk, with its peculiar, delicate, and often fragrant crop of lime-loving plants; and next, you have the poor sands and clays of the New Forest basin, saturated with iron, and therefore carrying a moorland or peat-loving vegetation, in many respects quite different from the others. And this moorland soil, and this vegetation, with a few singular exceptions, repeats itself, as I daresay you know, in the north of the county, in the Bagshot basin, as it is called—the moors of Aldershot, Hartford Bridge, and Windsor Forest.

Now what a variety of interesting questions are opened up by these simple facts. How did these three floras get each to its present place? Where did each come from? How did it get past or through the other, till each set of plants, after long internecine competition, settled itself down in the sheet of land most congenial to it? And when did each come hither? Which is the oldest? Will any one tell me whether the healthy

floras of the moors, or the thymy flora of the chalk downs, were the earlier inhabitants of these isles? To these questions I cannot get any answer; and they cannot be answered without, first—a very careful study of the range of each species of plant on the continent of Europe; and next, without careful study of those stupendous changes in the shape of this island which have taken place at a very late geological epoch. The composition of the flora of our moorlands is as yet to me an utter puzzle.

We have Lycopodiums—three species—enormously ancient forms which have survived the age of ice: but did they crawl downward hither from the northern mountains or upward hither from the Pyrenees? We have the beautiful bog asphodel again—an enormously ancient form; for it is, strange to say, common to North America and to Northern Europe, but does not enter Asia—almost an unique instance. It must, surely, have come from the north; and points—as do many species of plants and animals—to the time when North Europe and North America were joined. We have, sparingly, in North Hampshire, though, strangely, not on the Bagshot moors, the Common or Northern Butterwort (*Pinguicula vulgaris*); and also, in the south, the New Forest part of the county, the delicate little *Pinguicula lusitanica*, the only species now found in Devon and Cornwall, marking the New Forest as the extreme eastern limit of the Atlantic flora.

We have again the heaths, which, as I have just said, are found neither in America nor in Asia, and must, I believe, have come from some south-western land long since submerged beneath the

sea. But more, we have in the New Forest two plants which are members of the South Europe, or properly, the Atlantic flora; which must have come from the south and south-east; and which are found in no other spots in these islands. I mean the lovely *Gladiolus*, which grows abundantly under the ferns near Lyndhurst, certainly wild, but it does not approach England elsewhere nearer than the Loire and the Rhine; and next, that delicate orchid, the *Spiranthes æstivalis*, which is known only in a bog near Lyndhurst and in the Channel Islands, while on the Continent it extends from Southern Europe all through France.

Now, what do these two plants mark? They give us a point in botany, though not in time, to determine when the south of England was parted from the opposite shores of France; and whenever that was, it was just after the Gladiolus and Spiranthes got hither. Two little colonies of these lovely flowers arrived just before their retreat was cut off. They found the country already occupied with other plants; and, not being reinforced by fresh colonists from the south, have not been able to spread farther north than Lyndhurst. Thus, in the New Forest, and, I may say in the Bagshot moors, you find plants which you do not expect, and do not find plants which you do expect; and you are, or ought to be, puzzled, and I hope also interested, and stirred up to find out more.

I spoke just now of the time when England was joined to France, as bearing on Hampshire botany. It bears no less on Hampshire zoology. In insects, for instance, the presence of

the purple emperor and the white admiral in our Hampshire woods, as well as the abundance of the great stag-beetle, point to a time when the two countries were joined, at least as far west as Hampshire; while the absence of these insects farther to the westward shows that the countries, if ever joined, were already parted; and that those insects have not yet had time to spread westward. The presence of these two butterflies, and partly of the stag-beetle, along the south-east coast of England as far as the primeval forests of South Lincolnshire, points, as do a hundred other facts, to a time when the Straits of Dover either did not exist, or were the bed of a river running from the west; and when, as I told you just now, all the rivers which now run into the German Ocean, from the Humber on the west to the Elbe on the east, discharged themselves into the sea between Scotland and Norway, after wandering through a vast lowland, covered with countless herds of mammoth, rhinoceros, gigantic ox, and other mammals now extinct; while the birds, as far as we know, the insects, the fresh-water fish, and even, as my friend Mr. Brady has proved, the *Entomostraca* of the rivers, were the same in what is now Holland as in what is now our Eastern counties.

I could dwell long on this matter. I could talk long about how certain species of *Lepidoptera*—moths and butterflies—like *Papilio Machaon* and *P. Podalirius*, swarm through France, reach up to the British Channel, and have not crossed it, with the exception of one colony of *Machaon* in the Cambridgeshire fens. I could talk long about a similar phenomenon in the case of

our migratory and singing birds; how many exquisite species—notably those two glorious songsters, the Orphean Warbler and Hippolais, which delight our ears everywhere on the other side of the Channel—follow our nightingales, blackcaps, and warblers northward every spring almost to the Straits of Dover, but dare not cross, simply because they have been, as it were, created since the gulf was opened, and have never learnt from their parents how to fly over it.

In the case of fishes, again, I might say much on the curious fact that the Cyprinidæ, or white fish—carp, etc.—and their natural enemy, the pike, are indigenous, I believe, only to the rivers, English or continental, on the eastern side of the Straits of Dover; while the rivers on the western side were originally tenanted, like our Hampshire streams, as now, almost entirely by trout, their only Cyprinoid being the minnow—if it, too, be not an interloper; and I might ask you to consider the bearing of this curious fact on the former junction of England and France.

But I have only time to point out to you a few curious facts with regard to reptiles, which should be specially interesting to a Hampshire bio-geologist. You know, of course, that in Ireland there are no reptiles, save the little common lizard, *Lacerta agilis*, and a few frogs on the mountain-tops—how they got there I cannot conceive. And you will, of course, guess, and rightly, that the reason of the absence of reptiles is: that Ireland was parted off from England before the creatures, which certainly spread from southern and warmer climates, had time to get there. You

know, of course, that we have a few reptiles in England. But you may not be aware that, as soon as you cross the Channel, you find many more species of reptiles than here, as well as those which you find here. The magnificent green lizard which rattles about like a rabbit in a French forest, is never found here; simply because it had not worked northward till after the Channel was formed. But there are three reptiles peculiar to this part of England which should be most interesting to a Hampshire zoologist. The one is the sand lizard (*L. stirpium*), found on Bourne-heath, and, I suspect, in the South Hampshire moors likewise—a North European and French species. Another, the *Coronella lævis*, a harmless French and Austrian snake, which has been found about me, in North Hants and South Berks, now about fifteen or twenty times. I have had three specimens from my own parish. I believe it not to be uncommon; and most probably to be found, by those who will look, both in the New Forest and Woolmer. The third is the Natterjack, or running toad (*Bufo Rubeta*), a most beautifully-spotted animal, with a yellow stripe down his back, which is common with us at Eversley, and common also in many moorlands of Hants and Surrey; and, according to Fleming, on heaths near London, and as far north-east as Lincolnshire; in which case it will belong to the Germanic fauna. Now, here again we have cases of animals which have just been able to get hither before the severance of England and France; and which, not being reinforced from the rear, have been forced to stop, in small and probably decreasing colonies, on the

spots nearest the coast which were fit for them.

I trust that I have not kept you too long over these details. What I wish to impress upon you is that Hampshire is a country specially fitted for the study of important bio-geological questions.

To work them out, you must trace the geology of Hampshire, and indeed, of East Dorset. You must try to form a conception of how the land was shaped in miocene times, before that tremendous upheaval which reared the chalk cliffs at Freshwater upright, lifting the tertiary beds upon their northern slopes. You must ask—Was there not land to the south of the Isle of Wight in those ages, and for ages after; and what was its extent and shape?

You must ask—When was the gap between the Isle of Wight and the Isle of Purbeck sawn through, leaving the Needles as remnants on one side, and Old Harry on the opposite? And was it sawn asunder merely by the age-long gnawing of the waves?

You must ask—Where did the great river which ran from the west, where Poole Harbour is now, and probably through what is now the Solent, depositing brackish water-beds right and left —where, I say, did it run into the sea? Where the Straits of Dover are now? Or, if not there, where? What, too, is become of the land to the Westward, composed of ancient metamorphic rocks, out of which it ran, and deposited on what are now the Haggerstone Moors of Poole, vast beds of grit? What was the climate on its banks when it washed down the delicate leaves of broad-leaved trees, akin to our modern English ones, which

are found in the fine mud-sand strata of Bournemouth? When, finally, did it dwindle down to the brook which now runs through Wareham town? Was its bed, sea or dry land, or under an ice sheet, during the long ages of the glacial epoch? And if you say —Who is sufficient for these things?—Who can answer these questions? I answer—Who but you, or your pupils after you, if you will but try?

And if any shall reply—And what use if I do try? What use, if I do try? What use if I succeed in answering every question which you have propounded to-night? Shall I be the happier for it? Shall I be the wiser?

My friends, whether you will be the happier for it, or for any knowledge of physical science, or for any other knowledge whatsoever, I cannot tell: that lies in the decision of a Higher Power than I; and, indeed, to speak honestly, I do not think that bio-geology or any other branch of physical science is likely, at first at least, to make you happy. Neither is the study of your fellow-men. Neither is religion itself. We were not sent into the world to be happy, but to be right; at least, poor creatures that we are, as right as we can be; and we must be content with being right, and not happy. For I fear, or rather I hope, that most of us are not capable of carrying out Talleyrand's recipe for perfect happiness on earth—namely, a hard heart and a good digestion.

Therefore, as our hearts are, happily, not always hard, and our digestions, unhappily, not always good, we will be content to be made wise by physical science, even though we be not made

happy.

And we shall be made truly wise if we be made content; content, too, not only with what we can understand, but, content with what we do not understand—the habit of mind which theologians call—and rightly—faith in God; the true and solid faith, which comes often out of sadness, and out of doubt, such as bio-geology may well stir in us at first sight. For our first feeling will be—I know mine was when I began to look into these matters—one somewhat of dread and of horror.

Here were all these creatures, animal and vegetable, competing against each other. And their competition was so earnest and complete, that it did not mean—as it does among honest shopkeepers in a civilised country—I will make a little more money than you; but—I will crush you, enslave you, exterminate you, eat you up. "Woe to the weak," seems to be Nature's watchword. The Psalmist says: "The righteous shall inherit the land." If you go to a tropical forest, or, indeed, if you observe carefully a square acre of any English land, cultivated or uncultivated, you will find that Nature's text at first sight looks a very different one. She seems to say: Not the righteous, but the strong, shall inherit the land. Plant, insect, bird, what not—Find a weaker plant, insect, bird, than yourself, and kill it, and take possession of its little vineyard, and no Naboth's curse shall follow you: but you shall inherit, and thrive therein, you, and your children after you, if they will be only as strong and as cruel as you are. That is Nature's law: and is it not at first

sight a fearful law? Internecine competition, ruthless selfishness, so internecine and so ruthless that, as I have wandered in tropic forests, where this temper is shown more quickly and fiercely, though not in the least more evilly, than in our slow and cold temperate one, I have said: Really these trees and plants are as wicked as so many human beings.

Throughout the great republic of the organic world the motto of the majority is, and always has been as far back as we can see, what it is, and always has been, with the majority of human beings: "Everyone for himself, and the devil take the hindmost." Overreaching tyranny; the temper which fawns, and clings, and plays the parasite as long as it is down, and when it has risen, fattens on its patron's blood and life—these, and the other works of the flesh, are the works of average plants and animals, as far as they can practise them. At least, so says at first sight the science of bio-geology; till the naturalist, if he be also human and humane, is glad to escape from the confusion and darkness of the universal battle-field of selfishness into the order and light of Christmas-tide.

For then there comes to him the thought—And are these all the facts? And is this all which the facts mean? That mutual competition is one law of Nature, we see too plainly. But is there not, besides that law, a law of mutual help? True it is, as the wise man has said, that the very hyssop on the wall grows there because all the forces of the universe could not prevent its growing. All honour to the hyssop. A brave plant, it has fought

a brave fight, and has its just deserts—as everything in Nature has—and so has won. But did all the powers of the universe combine to prevent it growing? Is not that a one-sided statement of facts? Did not all the powers of the universe also combine to make it grow, if only it had valour and worth wherewith to grow? Did not the rains feed it, the very mortar in the wall give lime to its roots? Were not electricity, gravitation, and I know not what of chemical and mechanical forces, busy about the little plant, and every cell of it, kindly and patiently ready to help it if it would only help itself? Surely this is true; true of every organic thing, animal and vegetable, and mineral too, for aught I know: and so we must soften our sadness at the sight of the universal mutual war by the sight of an equally universal mutual help.

But more. It is true—too true if you will—that all things live on each other. But is it not, therefore, equally true that all things live for each other?—that self-sacrifice, and not selfishness, is at the bottom the law of Nature, as it is the law of Grace; and the law of bio-geology, as it is the law of all religion and virtue worthy of the name? Is it not true that everything has to help something else to live, whether it knows it or not?—that not a plant or an animal can turn again to its dust without giving food and existence to other plants, other animals?—that the very tiger, seemingly the most useless tyrant of all tyrants, is still of use, when, after sending out of the world suddenly, and all but painlessly, many an animal which would without him have starved in misery through a diseased old age, he himself dies,

and, in dying, gives, by his own carcase, the means of life and of enjoyment to a thousandfold more living creatures than ever his paws destroyed?

And so, the longer one watches the great struggle for existence, the more charitable, the more hopeful, one becomes; as one sees that, consciously or unconsciously, the law of Nature is, after all self-sacrifice: unconscious in plants and animals, as far as we know; save always those magnificent instances of true self-sacrifice shown by the social insects, by ants, bees, and others, which put to shame by a civilisation truly noble—why should I not say divine, for God ordained it?—the selfishness and barbarism of man. But be that as it may, in man the law of self-sacrifice—whether unconscious or not in the animals—rises into consciousness just as far as he is a man; and the crowning lesson of bio-geology may be, when we have worked it out after all, the lesson of Christmas-tide—of the infinite self-sacrifice of God for man; and Nature as well as religion may say to us:

> Ah, could you crush that ever craving lust
> For bliss, which kills all bliss, and lose your life,
> Your barren unit life, to find again
> A thousand times in those for whom you die—
> So were you men and women, and should hold
> Your rightful rank in God's great universe,
> Wherein, in heaven or earth, by will or nature,
> Naught lives for self. All, all, from crown to base—
> The Lamb, before the world's foundation slain—

The angels, ministers to God's elect—
The sun, who only shines to light the worlds—
The clouds, whose glory is to die in showers—
The fleeting streams, who in their ocean graves
Flee the decay of stagnant self-content—
The oak, ennobled by the shipwright's axe—
The soil, which yields its marrow to the flower—
The flower, which feeds a thousand velvet worms
Born only to be prey to every bird—
All spend themselves on others: and shall man,
Whose twofold being is the mystic knot
Which couples earth with heaven, doubly bound,
As being both, worm and angel, to that service
By which both worms and angels hold their life,
Shall he, whose every breath is debt on debt,
Refuse, forsooth, to be what God has made him?
No; let him show himself the creatures' Lord
By free-will gift of that self-sacrifice
Which they, perforce, by Nature's law's endure.

My friends, scientific and others, if the study of bio-geology shall help to teach you this, or anything like this, I think that though it may not make you more happy, it may yet make you more wise; and, therefore, what is better than being more happy, namely, more blessed.

# THE STUDY OF NATURAL HISTORY FOR SOLDIERS [2]

Gentlemen: When I accepted the honour of lecturing here, I took for granted that so select an audience would expect from me not mere amusement, but somewhat of instruction; or, if that be too ambitious a word for me to use, at least some fresh hint—if I were able to give one—as to how they should fulfil the ideal of military men in such an age as this.

To touch on military matters, even had I been conversant with them, seemed to me an impertinence. I am bound to take for granted that every man knows his own business best; and I incline more and more to the opinion that military men should be left to work out the problems of their art for themselves, without the advice or criticism of civilians. But I hold—and I am sure that you will agree with me—that if the soldier is to be thus trusted by the nation, and left to himself to do his own work his own way, he must be educated in all practical matters as highly as the average of educated civilians. He must know all that they know, and his own art besides. Just as a clergyman, being a man plus a priest, is bound to be a man, and a good man; over and above his priesthood, so is the soldier bound to be a civilian, and a highly-educated civilian, plus his soldierly qualities and acquirements.

[2] A Lecture delivered to the Officers of the Royal Artillery, Woolwich, 1872.

It seemed to me, therefore, that I might, without impertinence, ask you to consider a branch of knowledge which is becoming yearly more and more important in the eyes of well-educated civilians; of which, therefore, the soldier ought at least to know something, in order to put him on a par with the general intelligence of the nation. I do not say that he is to devote much time to it, or to follow it up into specialities: but that he ought to be well grounded in its principles and methods; that he ought to be aware of its importance and its usefulness; that so, if he comes into contact—as he will more and more—with scientific men, he may understand them, respect them, befriend them, and be befriended by them in turn; and how desirable this last result is, I shall tell you hereafter.

There are those, I doubt not, among my audience who do not need the advice which I shall presume to give to-night; who belong to that fast-increasing class among officers of whom I have often said—and I have found scientific men cordially agree with me—that they are the most modest and the most teachable of men. But even in their case there can be no harm in going over deliberately a question of such importance; in putting it, as it were, into shape; and insisting on arguments which may perhaps not have occurred to some of them.

Let me, in the first place, reassure those—if any such there be—who may suppose, from the title of my lecture, that I am only going to recommend them to collect weeds and butterflies, "rats and mice, and such small deer." Far from it. The honourable title

of Natural History has, and unwisely, been restricted too much of late years to the mere study of plants and animals. I desire to restore the words to their original and proper meaning—the History of Nature; that is, of all that is born, and grows in time; in short, of all natural objects.

If any one shall say—By that definition you make not only geology and chemistry branches of natural history, but meteorology and astronomy likewise—I cannot deny it. They deal each of them, with realms of Nature. Geology is, literally, the natural history of soils and lands; chemistry the natural history of compounds, organic and inorganic; meteorology the natural history of climates; astronomy the natural history of planetary and solar bodies. And more, you cannot now study deeply any branch of what is popularly called Natural History —that is, plants and animals—without finding it necessary to learn something, and more and more as you go deeper, of those very sciences. As the marvellous interdependence of all natural objects and forces unfolds itself more and more, so the once separate sciences, which treated of different classes of natural objects, are forced to interpenetrate, as it were; and to supplement themselves by knowledge borrowed from each other.

Thus—to give a single instance—no man can now be a first-rate botanist unless he be also no mean meteorologist, no mean geologist, and—as Mr. Darwin has shown in his extraordinary discoveries about the fertilisation of plants by insects—no mean entomologist likewise.

It is difficult, therefore, and indeed somewhat unwise and unfair, to put any limit to the term Natural History, save that it shall deal only with nature and with matter; and shall not pretend—as some would have it to do just now—to go out of its own sphere to meddle with moral and spiritual matters. But, for practical purposes, we may define the natural history of the causes which have made it what it is, and filled it with the natural objects which it holds. And if any one would know how to study the natural history of any given spot as the history of the causes which have made it what it is, and filled it with the natural objects which it holds. And if any one would know how to study the natural history of a place, and how to write it, let him read—and if he has read its delightful pages in youth, read once again—that hitherto unrivalled little monograph, White's "Natural History of Selborne;" and let him then try, by the light of improved science, to do for any district where he may be stationed, what White did for Selborne nearly one hundred years ago. Let him study its plants, its animals, its soils and rocks; and last, but not least, its scenery, as the total outcome of what the soils, and plants, and animals, have made it. I say, have made it. How far the nature of the soils, and the rocks will affect the scenery of a district may be well learnt from a very clever and interesting little book of Professor Geikie's, on "The Scenery of Scotland as affected by its Geological Structure." How far the plants, and trees affect not merely the general beauty, the richness or barrenness of a country, but also its very shape; the rate at which the hills are

destroyed and washed into the lowland; the rate at which the seaboard is being removed by the action of waves—all these are branches of study which is becoming more and more important.

And even in the study of animals and their effects on the vegetation, questions of really deep interest will arise. You will find that certain plants and trees cannot thrive in a district, while others can, because the former are browsed down by cattle, or their seeds eaten by birds, and the latter are not; that certain seeds are carried in the coats of animals, or wafted abroad by winds—others are not; certain trees destroyed wholesale by insects, while others are not; that in a hundred ways the animal and vegetable life of a district act and react upon each other, and that the climate, the average temperature, the maximum and minimum temperatures, the rainfall, act on them, and in the case of the vegetation, are reacted on again by them. The diminution of rainfall by the destruction of forests, its increase by replanting them, and the effect of both on the healthiness or unhealthiness of a place—as in the case of the Mauritius, where a once healthy island has become pestilential, seemingly from the clearing away of the vegetation on the banks of streams—all this, though to study it deeply requires a fair knowledge of meteorology, and even of a science or two more, is surely well worth the attention of any educated man who is put in charge of the health and lives of human beings.

You will surely agree with me that the habit of mind required for such a study as this, is the very same as is required for

successful military study. In fact, I should say that the same intellect which would develop into a great military man, would develop also into a great naturalist. I say, intellect. The military man would require—what the naturalist would not—over and above his intellect, a special force of will, in order to translate his theories into fact, and make his campaigns in the field and not merely on paper. But I am speaking only of the habit of mind required for study; of that inductive habit of mind which works, steadily and by rule, from the known to the unknown; that habit of mind of which it has been said: "The habit of seeing; the habit of knowing what we see; the habit of discerning differences and likenesses; the habit of classifying accordingly; the habit of searching for hypotheses which shall connect and explain those classified facts; the habit of verifying these hypotheses by applying them to fresh facts; the habit of throwing them away bravely if they will not fit; the habit of general patience, diligence, accuracy, reverence for facts for their own sake, and love of truth for its own sake; in one word, the habit of reverent and implicit obedience to the laws of Nature, whatever they may be—these are not merely intellectual, but also moral habits, which will stand men in practical good stead in every affair of life, and in every question, even the most awful, which may come before them as rational and social beings."

And specially valuable are they, surely, to the military man, the very essence of whose study, to be successful, lies first in continuous and accurate observation, and then in calm and

judicious arrangement.

Therefore it is that I hold, and hold strongly, that the study of physical science, far from interfering with an officer's studies, much less unfitting for them, must assist him in them, by keeping his mind always in the very attitude and the very temper which they require.

If any smile at this theory of mine, let them recollect one curious fact: that perhaps the greatest captain of the old world was trained by perhaps the greatest philosopher of the old world —the father of Natural History; that Aristotle was the tutor of Alexander of Macedon. I do not fancy, of course, that Aristotle taught Alexander any Natural History. But this we know, that he taught him to use those very faculties by which Aristotle became a natural historian, and many things besides; that he called out in his pupil somewhat of his own extraordinary powers of observation, extraordinary powers of arrangement. He helped to make him a great general: but he helped to make him more—a great politician, coloniser, discoverer. He instilled into him such a sense of the importance of Natural History, that Alexander helped him nobly in his researches; and, if Athenæus is to be believed, gave him eight hundred talents towards perfecting his history of animals. Surely it is not too much to say that this close friendship between the natural philosopher and the soldier has changed the whole course of civilisation to this very day. Do not consider me Utopian when I tell you, that I should like to see the study of physical science an integral part of the curriculum

of every military school. I would train the mind of the lad who was to become hereafter an officer in the army—and in the navy likewise—by accustoming him to careful observation of, and sound thought about, the face of nature; of the commonest objects under his feet, just as much as the stars above his head; provided always that he learnt, not at second-hand from books, but where alone ho can really learn either war or nature—in the field; by actual observation, actual experiment. A laboratory for chemical experiment is a good thing, it is true, as far as it goes; but I should prefer to the laboratory a naturalists' field-club, such as are prospering now at several of the best public schools, certain that the boys would get more of sound inductive habits of mind, as well as more health, manliness, and cheerfulness, amid scenes to remember which will be a joy for ever, than they ever can by bending over retorts and crucibles, amid smells even to remember which is a pain for ever.

But I would, whether a field-club existed or not, require of every young man entering the army or navy—indeed of every young man entering any liberal profession whatsoever—a fair knowledge, such as would enable him to pass an examination, in what the Germans call *Erd-kunde*—earth-lore—in that knowledge of the face of the earth and of its products, for which we English have as yet cared so little that we have actually no English name for it, save the clumsy and questionable one of physical geography; and, I am sorry to say, hardly any readable school books about it, save Keith Johnston's "Physical Atlas"—

an acquaintance with which last I should certainly require of young men.

It does seem most strange—or rather will seem most strange a hundred years hence—that we, the nation of colonists, the nation of sailors, the nation of foreign commerce, the nation of foreign military stations, the nation of travellers for travelling's sake, the nation of which one man here and another there—as Schleiden sets forth in his book, "The Plant," in a charming ideal conversation at the Travellers' Club—has seen and enjoyed more of the wonders and beauties of this planet than the men of any nation, not even excepting the Germans—that this nation, I say, should as yet have done nothing, or all but nothing, to teach in her schools a knowledge of that planet, of which she needs to know more, and can if she will know more, than any other nation upon it.

As for the practical utility of such studies to a soldier, I only need, I trust, to hint at it to such an assembly as this. All must see of what advantage a rough knowledge of the botany of a district would be to an officer leading an exploring party, or engaged in bush warfare. To know what plants are poisonous; what plants, too, are eatable—and many more are eatable than is usually supposed; what plants yield oleaginous substances, whether for food or for other uses; what plants yield vegetable acids, as preventives of scurvy; what timbers are available for each of many different purposes; what will resist wet, salt-water, and the attacks of insects; what, again, can be used, at a pinch,

for medicine or for styptics—and be sure, as a wise West Indian doctor once said to me, that there is more good medicine wild in the bush than there is in all the druggists' shops—surely all this is a knowledge not beneath the notice of any enterprising officer, above all of an officer of engineers. I only ask any one who thinks that I may be in the right, to glance through the lists of useful vegetable products given in Lindley's "Vegetable Kingdom"—a miracle of learning—and see the vast field open still to a thoughtful and observant man, even while on service; and not to forget that such knowledge, if he should hereafter leave the service and settle, as many do, in a distant land, may be a solid help to his future prosperity. So strongly do I feel on this matter, that I should like to see some knowledge at least of Dr. Oliver's excellent little "First Book of Indian Botany" required of all officers going to our Indian Empire: but as that will not be, at least for many a year to come, I recommend any gentlemen going to India to get that book, and while away the hours of the outward voyage by acquiring knowledge which will be a continual source of interest, and it may be now and then of profit, to them during their stay abroad.

And for geology, again. As I do not expect you all, or perhaps any of you, to become such botanists as General Monro, whose recent "Monograph of the Bamboos" is an honour to British botanists, and a proof of the scientific power which is to be found here and there among British officers: so I do not expect you to become such geologists as Sir Roderick Murchison, or even

to add such a grand chapter to the history of extinct animals as Major Cautley did by his discoveries in the Sewalik Hills.

Nevertheless, you can learn—and I should earnestly advise you to learn—geology and mineralogy enough to be of great use to you in your profession, and of use, too, should you relinquish your profession hereafter. It must be profitable for any man, and specially for you, to know how and where to find good limestone, building stone, road metal; it must be good to be able to distinguish ores and mineral products; it must be good to know—as a geologist will usually know, even in a country which he sees for the first time—where water is likely to be found, and at what probable depth; it must be good to know whether the water is fit for drinking or not, whether it is unwholesome or merely muddy; it must be good to know what spots are likely to be healthy, and what unhealthy, for encamping. The two last questions depend, doubtless, on meteorological as well as geological accidents: but the answers to them will be most surely found out by the scientific man, because the facts connected with them are, like all other facts, determined by natural laws.

After what one has heard, in past years, of barracks built in spots plainly pestilential; of soldiers encamped in ruined cities, reeking with the dirt and poison of centuries; of—but it is not my place to find fault; all I will say is, that the wise and humane officer, when once his eyes are opened to the practical value of physical science, will surely try to acquaint himself somewhat with those laws of drainage and of climate, geological, meteorological,

chemical, which influence, often with terrible suddenness and fury, the health of whole armies. He will not find it beyond his province to ascertain the amount and period of rainfalls, the maxima of heat and of cold which his troops may have to endure, and many another point on which their health and efficiency—nay, their very life may depend, but which are now too exclusively delegated to the doctor, to whose province they do not really belong. For cure, I take the liberty of believing, is the duty of the medical officer; prevention, that of the military.

Thus much I can say just now—and there is much more to be said—on the practical uses of the study of Natural History.

But let me remind you, on the other side, if Natural History will help you, you in return can help her; and would, I doubt not, help her and help scientific men at home, if once you looked fairly and steadily at the immense importance of Natural History—of the knowledge of the "face of the earth." I believe that all will one day feel, more or less, that to know the earth *on* which we live, and the laws of it *by* which we live, is a sacred duty to ourselves, to our children after us, and to all whom we may have to command and to influence; ay, and a duty to God likewise.

For is it not a duty of common reverence and faith towards Him, if He has put us into a beautiful and wonderful place, and given us faculties by which we can see, and enjoy, and use that place—is it not a duty of reverence and faith towards Him to use these faculties, and to learn the lessons which He has laid open for us?

If you feel that, as I think you all will some day feel, then you

will surely feel likewise that it will be a good deed—I do not say a necessary duty, but still a good deed and praiseworthy—to help physical science forward; and to add your contributions, however small, to our general knowledge of the earth. And how much may be done for science by British officers, especially on foreign stations, I need not point out. I know that much has been done, chivalrously and well, by officers; and that men of science owe them and give them hearty thanks for their labours. But I should like, I confess, to see more done still. I should like to see every foreign station what one or two highly-educated officers might easily make it, an advanced post of physical science, in regular communication with our scientific societies at home, sending to them accurate and methodic details of the natural history of each district—details ninety-nine hundredths of which might seem worthless in the eyes of the public, but which would all be precious in the eyes of scientific men, who know that no fact is really unimportant; and more, that while plodding patiently through seemingly unimportant facts, you may stumble on one of infinite importance, both scientific and practical. For the student of nature, gentlemen, if he will be but patient, diligent, methodical, is liable at any moment to the same good fortune as befell Saul of old, when he went out to seek his father's asses, and found a kingdom.

There are those, lastly, who have neither time nor taste for the technicalities and nice distinctions of formal Natural History; who enjoy Nature, but as artists or as sportsmen, and not as

men of science. Let them follow their bent freely: but let them not suppose that in following it they can do nothing towards enlarging our knowledge of Nature, especially when on foreign stations. So far from it, drawings ought always to be valuable, whether of plants, animals, or scenery, provided only they are accurate; and the more spirited and full of genius they are, the more accurate they are certain to be; for Nature being alive, a lifeless copy of her is necessarily an untrue copy. Most thankful to any officer for a mere sight of sketches will be the closest botanist, who, to his own sorrow, knows three-fourths of his plants only from dried specimens; or the closest zoologist, who knows his animals from skins and bones. And if any one answers —But I cannot draw. I rejoin. You can at least photograph. If a young officer, going out to foreign parts, and knowing nothing at all about physical science, did me the honour to ask me what he could do for science, I should tell him—Learn to photograph; take photographs of every strange bit of rock-formation which strikes your fancy, and of every widely-extended view which may give a notion of the general lie of the country. Append, if you can, a note or two, saying whether a plain is rich or barren; whether the rock is sandstone, limestone, granitic, metamorphic, or volcanic lava; and if there be more rocks than one, which of them lies on the other; and send them to be exhibited at a meeting of the Geological Society. I doubt not that the learned gentlemen there will find in your photographs a valuable hint or two, for which they will be much obliged. I learnt, for

instance, what seemed to me most valuable geological lessons from mere glances at drawings—I believe from photographs—of the Abyssinian ranges about Magdala.

Or again, let a man, if he knows nothing of botany, not trouble himself with collecting and drying specimens; let him simply photograph every strange and new tree or plant he sees, to give a general notion of its species, its look; let him append, where he can, a photograph of its leafage, flower, fruit; and send them to Dr. Hooker, or any distinguished botanist: and he will find that, though he may know nothing of botany, he will have pretty certainly increased the knowledge of those who do know.

The sportsman, again—I mean the sportsman of that type which seems peculiar to these islands, who loves toil and danger for their own sakes; he surely is a naturalist, ipso facto, though he knows it not. He has those very habits of keen observation on which all sound knowledge of nature is based; and he, if he will—as he may do without interfering with his sport—can study the habits of the animals among whom he spends wholesome and exciting days. You have only to look over such good old books as Williams's "Wild Sports of the East," Campbell's "Old Forest Ranger," Lloyd's "Scandinavian Adventures," and last, but not least, Waterton's "Wanderings," to see what valuable additions to true zoology—the knowledge of live creatures, not merely dead ones—British sportsmen have made, and still can make. And as for the employment of time, which often hangs so heavily on a soldier's hands, really I am ready to say, if you are neither men

of science, nor draughtsmen, nor sportsmen, why, go and collect beetles. It is not very dignified, I know, nor exciting: but it will be something to do. It cannot harm you, if you take, as beetle-hunters do, an indiarubber sheet to lie on; and it will certainly benefit science. Moreover, there will be a noble humility in the act. You will confess to the public that you consider yourself only fit to catch beetles; by which very confession you will prove yourself fit for much finer things than catching beetles; and meanwhile, as I said before, you will be at least out of harm's way.

At a foreign barrack once, the happiest officer I met, because the most regularly employed, was one who spent his time in collecting butterflies. He knew nothing about them scientifically—not even their names. He took them simply for their wonderful beauty and variety; and in the hope, too—in which he was really scientific—that if he carefully kept every form which he saw, his collection might be of use some day to entomologists at home.

A most pleasant gentleman he was; and, I doubt not, none the worse soldier for his butterfly catching. Commendable, also, in my eyes, was another officer—whom I have not the pleasure of knowing—who, on a remote foreign station, used wisely to escape from the temptations of the world into an entirely original and most pleasant hermitage. For finding—so the story went—that many of the finest insects kept to the tree-tops, and never came to ground at all, he used to settle himself among the boughs of some tree in the tropic forests, with a long-handled net and plenty of cigars, and pass his hours in that airy flower-garden,

making dashes every now and then at some splendid monster as it fluttered round his head. His example need not be followed by every one; but it must be allowed that—at least as long as he was in his tree—he was neither dawdling, grumbling, spending money, nor otherwise harming himself, and perhaps his fellow-creatures, from sheer want of employment.

One word more, and I have done. If I was allowed to give one special piece of advice to a young officer, whether of the army or navy, I would say: Respect scientific men; associate with them; learn from them; find them to be, as you will usually, the most pleasant and instructive of companions—but always respect them. Allow them chivalrously, you who have an acknowledged rank, their yet unacknowledged rank; and treat them as all the world will treat them in a higher and truer state of civilisation.

They do not yet wear the Queen's uniform; they are not yet accepted servants of the State; as they will be in some more perfectly organised and civilised land: but they are soldiers nevertheless, and good soldiers and chivalrous, fighting their nation's battle, often on even less pay than you, and with still less chance of promotion and of fame, against most real and fatal enemies—against ignorance of the laws of this planet, and all the miseries which that ignorance begets. Honour them for their work; sympathise in it; give them a helping hand in it whenever you have an opportunity—and what opportunities you have, I have been trying to sketch for you to-night; and more, work at it yourselves whenever and wherever you can. Show them

that the spirit which animates them—the hatred of ignorance and disorder, and of their bestial consequences—animates you likewise; show them that the habit of mind which they value in themselves—the habit of accurate observation and careful judgment—is your habit likewise; show them that you value science, not merely because it gives better weapons of destruction and of defence, but because it helps you to become clear-headed, large-minded, able to take a just and accurate view of any subject which comes before you, and to cast away every old prejudice and every hasty judgment in the face of truth and of duty: and it will be better for you and for them.

# Конец ознакомительного фрагмента.