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Structure and stability of the ecosystem

1.1 The ecosystem

What does the term *ecosystem* actually mean? One dictionary gives the meaning as 'a system formed by the interaction of a community of organisms with their environment'[1] with an encyclopaedia giving the proviso[2] that the assembly of organisms can be of any size and level, provided they are all free to interact together in a single complex whole and are in close relationship with the environment. In a sense then, all life, everywhere on the Earth, can be seen as a single ecosystem, or our planet's entity can be divided into a range of ecosystems. Typical examples of such subdivision could include, say, an ocean, or the atmosphere, or a tropical forest or an urban city, and all of them would then be combined together with a host of other ecosystems to form the biosphere as a whole. What these all share in common is that they are a location where life is supported and where all forms of that life are living together in equilibrium.

1.2 Life

Next, how is 'life' defined? Most people could recognise a dead body when it appears on the television screen, so this familiar scenario can be used to focus attention on the differences between an 'alive' and a 'dead' state.

The investigating officer can be recognised as representative of the living and the corpse is definitely a dead object. Underneath the corpse, however, is a myriad of creatures, existing in a wide range of shapes and minute sizes, some too small to be seen by the naked eye. There may, for instance, be worms, insects or vegetable matter. All of these would be unhesitatingly accepted as examples of life, but there will also be bacteria and perhaps lichens or fungi. Now, the borderline between living and non-living creatures is less certain. Further down the scale are the amoebae, washed out of the victim's bloodstream; where do these belong in our interpretation of life? And what about the fragment of yeast, left by a final glass of wine residing in the victim's stomach; where does that fit into the grand scheme of things?

Most people would agree that the sheep that provided the wool used to make winter garments worn by the two human examples, and the cotton plant that provided the raw material for their underwear or shirts, were alive. But what about the wool or the cotton fibres after they had been harvested? And, if we accept the validity of the well-known Gaia Hypothesis[3], is the Earth itself really a living creature, holding its breath to deceive us into thinking it is not alive and lurking in wait to send us all to destruction as soon as we become too much of a nuisance?

In scientific terms, many of these (with the possible exception of the fibres and the entity of the Earth) are examples of living organisms. For the purposes of this book, whether or not we agree to accept the Gaia Hypothesis, the whole planet, together with its atmospheric envelope and everything inside that envelope, will be considered as a 'living' ecosystem. After all, if any portion of this entity is destroyed or 'killed' by any action of ours, then the entire system is likely to go into a tail spin and end up as a lifeless hulk, along with any residual bits and pieces of all its inhabitants, including us.

1.3 Necessities of life

For a healthy existence, there are certain necessities that must be widely available. Not all the 'living' parts of the ecosystem require all of them and some 'living' units may be able to survive without any of them, but the vast majority of this planet's inhabitants need four commodities for their survival. These are, in order of frequency of need for humans and other higher animals, clean air, clean water, food and protection from external or internal ambient conditions.

1.3.1 Air

If human beings are considered to be the typical example of the most developed of the inhabitants of the planet, we can examine each of the necessities of life in turn as they relate to humans. The oxygen contained in air is needed to allow the cells of the human body to effect its continuing existence. Blood carries oxygen to remote parts of the human body where it oxidises impurities and transports the products of this reaction as waste to the lungs (or other appropriate places) for removal. In order to survive, oxygen is needed on a more or less continuous basis; in its absence, survival will only be maintained for about four minutes without experiencing irreversible brain damage and clinical death will follow in about six minutes.

Unfortunately, the air has to be pure. Nitrogen can be tolerated as a diluent for oxygen, and to some extent carbon dioxide, but in modern times there may be other constituents of air that are much less acceptable to the human system. If there are toxic materials or an excessive quantity of carbon dioxide present, then human beings are likely to succumb to the hazards of these impurities and to suffer illness, or even death. Other lower organisms in the biological kingdom share this regrettable inability to survive in a poisonous atmosphere, but there are some recipients who might thrive on such compounds. The most obvious example is plant life, which absorbs carbon dioxide and converts it into oxygen, replenishing the supply of this vital (to animals) gas. This happy coincidence will be discussed further, later in the book. There are also certain bacteria that can be trained to gobble up oil slicks or other forms of pollution when an emergency spill takes place.

1.3.2 Water

The second need is for water, a substance that constitutes over 90% of the human body. Again, the water must be pure; the slightest trace of bacterial contamination can bring on a marathon attack of various illnesses that manifest themselves as vomiting and diarrhoea. The cause of this reaction is a protective mechanism that reacts to get rid of the offending impurity as quickly as possible, especially if the immune system involved has not developed natural arrangements to give it the ability to deal with the contamination.

The need for the actual water, though, is much more critical. Human beings could survive the bacterial invasion, and do so on a regular basis, but cannot survive the absence of the water that carries these bacteria. The human body consists of millions of cells, each of which includes water. The 90% figure mentioned above results from water being taken up by these cells and combined to make some form of chemical compound that is an essential component of the specific cell or of its ability to function. Cells are living organisms, so change constantly. Impurities arising as a result of their operation are removed, usually in aqueous solution, so the water that washes away the waste products has to be replenished to allow the cell to continue living. A fresh supply of water has to be available for the cell to recharge itself and this is where the need for water arises. Without water, the cell would dry up and die, then be rejected as waste in its own turn by the body. Obviously, if there is no water, there can be no healthy cell replacement, and if every cell is rejected as waste, there will not be much left of the body to keep life ticking over. One small consolation is that the person would not know much about such a disaster, because brain cells, which require replenishment very frequently, are lost early on in the dehydration process and madness quickly sets in if water is denied. Lack of water can drive human beings insane in a matter of a few days. Death does not take much longer.

1.3.3 Food

A human body needs vital chemical substances to sustain its existence. Nutrition is the process by which the body takes up these chemicals and converts them to muscle, fat, blood, energy and all the other important bits and pieces that are needed to continue functioning in a healthy manner. Without food, we become angry, impatient, listless and eventually unable to sit up and retain an awareness of life around us. Most human beings can survive for weeks without food (as long as water is available) before succumbing to starvation. People can also survive for years without adequate nutrition, as evidenced by the grim pictures shown on our television screens from time to time when famine strikes in some of the less fortunate regions of the planet.

1.3.4 Protection

The last crucial need is one that humans have continually and considerably refined over the last few millennia. As primitive creatures, our forebears were able to survive in the wild, just as animals do today, with little or no help from artificial (i.e. non-natural) sources. In modern times, that ability has been lost, mainly as a result of our determination to cosset ourselves with all kinds of luxury. The consequence is that now humans cannot survive without some form of protection. This is of two broad types: shelter as a shield from other forms of life and from the elements and textiles as protection from these same elements and from the harmful effects of abrasive or wounding contact with objects that are encountered throughout life. The textiles also provide mental protection in hiding our bodies from the gaze of other people, a subject that will be discussed again later.

In both types of protection, the primary purposes are to keep the body's integrity intact and to allow its built-in mechanisms to remain functioning without unduly overloading them. We continue to exist and move about because our hearts pump blood around the body, our gastrointestinal systems convert food energy to a useful form, our thermoregulatory systems keep our bodies within a satisfactory temperature range, our cardiovascular systems continue to supply fresh oxygen and remove excess carbon dioxide and our muscles continue to operate without getting wasted away or suffering from spasms. Without any of these advantages, we would run a grave risk of dying. One of the purposes of textiles is to support the body in retaining them.

1.4 Other species

What can be said of animals and plants? The larger animals that provide us with textile fibres, such as sheep, goats, camels, and so on, have similar needs to our own. They need air, water and food to survive. They are, though, not as dependent as we are on pure water, because they are able to tolerate pollution of various kinds without harm. They generally also do not need external protection, since they already have warm coats (which are, of course, the bits that humans take for textile raw materials) to fill this role. Smaller creatures that produce textile fibres, such as silkworms or spiders, are even less demanding in their vital requirements, though the silkworm produces poorer quality fibres in the absence of an optimum diet.

The plants that are used to make our textiles will thrive to some extent even if

Table 1.1 Categories of pollution production

Code	Type	Emission	Effects	Typical example
A-1	Air	Carbon dioxide	Greenhouse gases	Burning wood
A-2	Air	Toxic gases	Poisoning of species	Burning rubber
A-3	Air	Smoke	Visibility loss	Tenter exhaust
W-1	Water	Heat	Fish stress	Power station effluent
W-2	Water	Colour	Potability concerns	Dyehouse effluent
W-3	Water	Toxic liquids	Poisoning aqueous species	Chemical plant effluent
L-1	Land	Salts	Plant growth stunted	Ice salt
L-2	Land	Toxic solids	Food chain poisoning	Agricultural chemical discharge
L-3	Land	Microbiological hazards	Disease or death	Manure discharge
N-1	Noise	Moderate HF and LF	Psychological nuisance	Rock music
N-2	Noise	Loud HF	Deafness	Spinning frame
N-3	Noise	Loud LF	Building damage	Weaving shed
V-1	Visual	View obstruction	Aesthetic loss	Hoardings
V-2	Visual	Discarded garbage	Landfill overload	Textile waste
V-3	Visual	Smog	Limited visibility	Coal fires

HF and LF represent high and low frequency, respectively.

adequate conditions are not provided. Thus, cotton, linen or bast fibres will continue to grow even in poor soil, though the fibre quality is, once more, lower in the absence of good nutrition. Like all plants, they will benefit from excess carbon dioxide, even in amounts that would be fatal to human beings. In many cases, too, pollution of certain kinds may actually be advantageous. Manure, for example, is highly beneficial for a plant to thrive, in direct contradiction to its toxic behaviour as a source of the potentially dangerous (to human beings) *E. coli* organism. Where they lack endurance is in the matter of temperature and light tolerance; plants will die in cold or dark ambient conditions that would be accepted with little trouble by human beings or other animals.

There are some chemical compounds that are harmful to plants as well as to animals. These substances will be brought into sharp focus in the later parts of this book. They can be loosely classified into various categories, as shown in Table 1.1, where they are grouped according to the harmful effects they produce in different living species. There are, naturally, many more substances than are shown in Table 1.1. The list is intended only to illustrate the type of harmful behaviour that can be produced. Later in the book, one or more of these types will be referred to wherever a compound that is environmentally undesirable in some way is derived from a textile-related activity. The occurrence of pollution will be identified by an asterisk with the specific category code placed in parentheses, bold-faced and italic (see Table 1.1). Thus, a toxic gas poisonous to any species, whether animal or plant, will be referred to as ***(* A-2)*** in the text.

The need of flora and fauna for a non-toxic environment is the root cause of the importance of cleanliness in air and water. Even if the contamination is a very small proportion of the air or water, it can still be harmful. To recognise the truth of this statement, imagine breathing a sample of air, or swallowing a glass of water, containing an almost insignificant quantity of cyanide. Thus, both the nature and the amount present of a pollutant should be taken into account in determining the potential harm of each substance. This approach is used by governments in arriving at legislation defining the permissible level of contamination of harmful substances, as will be discussed in a later chapter. Amounts exceeding these levels may not be fatal, but are likely to cause sickness in a species susceptible to their harmful effects. Other consequences that should be considered may include genetic changes, fertility loss, lower survival rates or lifetimes and the onset of diseases that would not exist in the absence of the contaminant.

1.5 Land hazards

It is not only in the air or water ingested that caution has to be observed. The land itself can also be a source of harm to those living on or feeding from it. Toxic agents in water may be washed into the soil and find their way into growing plants. Harmful substances in the air may be deposited onto the ground, or may be absorbed by components of the soil, again being transferred into plants. The harmful chemicals will eventually be washed out of the soil and into drinking water supplies, so it is virtually impossible to take adequate precautions against the unpleasant consequences of land pollution. The effects of this movement are that the toxins enter the food chain, either via plant absorption or after animals have drunk them. Eventually, as a result of the predator–prey relationship, they end up in the bodies of many other species, including our own, where their adverse effects will ultimately make themselves known in the all-too-familiar forms of food poisoning. Aquatic species, whether fish or plant, are particularly rapidly susceptible to this type of harm, since they are totally dependent on water (which may be heavily contaminated by the chemicals washed off from the land at an early stage of the distribution process) for their successful functioning.

1.6 Dust

We should not ignore various miscellaneous types of activity that can prove harmful to the planet or to its inhabitants. The first of these is the dust that is present everywhere, in large or small amounts. Dust is formed by microscopic-sized particles produced when some larger object breaks down. The larger object may be a soil crumb, or the skin on an animal's body or portions of a plant. In the context of this book, it may be the textile fibres being processed in a mill or the solid residue after a substance (such as a starch or finish) has been applied to a fabric.

Dust, of whatever kind, is responsible for a number of ecological problems. If its origin is soil, then the disappearance of that soil means that plants dependent on it will not grow as well. If it is from an animal or plant, then the effects of its presence may include setting up allergic reactions in other creatures (including humans) nearby. If it is from a textile fibre, or other substance in the mill, then workers in the vicinity may suffer from serious illnesses, in the form of severe lung diseases from breathing it in too high a concentration. Dust can also cause deterioration of nearby objects, either by abrasion (as on buildings, for example) or, in the textile case, by producing a dirty product or by bringing about wear in a fabric structure or machine component.

1.7 Atomic radiation

Atomic radiation should be included in this survey of environmental contaminants. If a radioactive substance comes into contact with a living cell, the radiation emitted can bring about harmful changes in the structure of a cell. These may confer on cells an inability to divide in a healthy manner, or (for larger organisms) prevent the organism from reproducing correctly. The result may be unhealthy offspring, a failure to operate correctly or, in the limit, an inability to survive. Even low-level radiation, such as that present in equipment designed to measure thickness, evenness or static electricity in textiles, is now suspected of being dangerous on long exposure, so precautions have to be taken to shield human beings from its presence. Power stations are an obvious modern source of atomic energy. The accidents that have happened internationally over the past few decades are a constant reminder of the dreadful destructive power of atomic radiation.

1.8 The Earth's environment

It would not be ethical to omit the Earth's own environment from our list of origins of problems. Virtually all the harmful sources that have been specified as being risky in this chapter occur in nature. The Earth is constantly being bombarded by cosmic radiation from the universe. Dust storms arise in dry seasons. Volcanoes spew out toxic fumes. Forest fires, started by lightning strikes, increase the concentration of toxic chemicals and of carbon monoxide or carbon dioxide in the air. Water is contaminated by animal excrement. Natural sources of radium or uranium bring about genetic modification in animals living near them. Solar radiation can cause skin cancer in animals or loss of water from natural habitats that provide shelter, food and drink.

1.9 Environmental balance

Environmental balance is delicate and sensitive. Without human interference, the

Earth has, over the millions or billions of years of its existence, managed to bring about a stable equilibrium, so that all natural creatures can survive in harmony with the planet. Unfortunately, the presence of humanity, especially since the days of the Industrial Revolution, when mechanical aids were found that enhanced the meagre powers of human beings, has changed matters in drastic ways. Nature can now be overridden and harnessed at will. We can take all we want from the planet and pay no heed to the effects that our behaviour might have.

Or so we used to believe. Now, though, there are signs that the planet's ecosystem is responding in a way that bodes ill for the future and even for the survival of human beings on Earth. Environmental harm is increasing. The adverse effects that human behaviour can have on nature and, in the limit, on humanity itself are beginning to be noticed. Indeed, some scientists believe that we are on the brink of causing such adverse reactions and that we are already on, or possibly past, the threshold of destroying our prospects for survival. We appear to be happily acquiescing to our own self-destruction; we rush to buy the latest car or computer or furniture or household appliance or other such gimmick long before we need to do so for utilitarian purposes. Our motivation is often purely to display status or wealth, not taking account of the enormous environmental costs incurred.

1.10 The textile industry

In this headlong rush towards self-extinction, the textile industry, because of its major and ubiquitous presence on the Earth, must share some of the blame. The exact amount of its responsibility has never been established (and, indeed, may be impossible to establish). Thus, the first aim of this book is to identify which textile processes are harmful to the health of the Earth and to arrive at an estimate of the extent to which their contribution may be guilty. The second aim is to attempt to judge how much of the harm being done is fairly attributable to the textile industry and how many of the accusations levelled against it are unfair.

In the following chapters, the textile production process will be examined, stage by stage, comparing the textile industry briefly with other industries with respect to environmental harm. It will then be shown how the environment itself can turn the tables by being harmful to textile goods. By the end of the book the reader should have been provided with a factual and realistic assessment of what problems are associated with textiles and how the industry, or consumers, can help to reduce them.

References

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2
The health of our planet

2.1 Planetary stability

Now that what factors constitute a stable ecosystem have been examined, the factors that maintain stability and, if stability is not maintained, what factors bring about perturbations in the environmental equilibrium that disrupt the desired state can be addressed.

The first point to make is that any equilibrium is temporary in nature. We live on a planet that is doomed. Even if we were not and had never evolved, the Earth would not survive for ever. It may take a long time to disappear all on its own, but its disappearance as we know it will take place in due course.

The sun, like all stars, will either expand or shrink before reaching its final state of oblivion. Depending on which of these two takes place, the Earth will either be swallowed up (with everything on it charred) or be lost to outer space because gravitational attraction can no longer keep it in thrall as a planet. In that case, it will become just another dead piece of rock floating in space. The Earth, moreover, is limited in its ability to support life and no miracles are available to change this, either in the short or the long term. The demise of the dinosaurs provides proof that no species can expect to survive for ever.

The balance that allows the Earth and all its inhabitants to continue to exist is a very delicate one, established over aeons of time. It involves an equilibrium between all the elements present here, especially the air, the water and the land, which has been achieved by natural processes too complex to consider in any detail here, but which have brought about the miracles of planetary stability and life. If an imbalance occurs in the equilibrium existing on Earth, then survival of more than just people can be jeopardised. Unfortunately, imbalance can arise from natural causes, as well as from the habit of humanity of inflicting on the planet the kind of interference that is the subject of this book.

2.2 Natural factors

As can be seen from the examples introduced briefly in the previous chapter, there are many natural factors than can disturb, or even (in the course of millennia) destroy completely, the stability of the planet. Geological and fossil records show that, over the long period since its creation, the Earth has only been able to sustain recognisable life forms for a minute fraction of its existence. The basic structure of the planet has been ripped apart many times by natural sources of change that include plate tectonics, volcanic eruptions, solar radiation and, more recently, the existence of weather variations. The former two bring about massive changes, causing continents to shift and mountains to be lifted or destroyed. Solar radiation may cause droughts that can alter the appearance of the countryside, changing it from green to brown, and can initiate melting of the ice caps, with severe flooding of the land as a consequence. Extreme weather conditions, where excessive amounts of rain fall or winds blow, can also produce flooding capable of washing away trees, removing topsoil or bursting the banks of rivers to redefine the landscape. Even relatively small amounts of rain are capable of washing away topsoil, reducing plant growth, leaving the land more barren and, once more, changing the face of the Earth.

The sun has other potentially harmful side effects. Cosmic, ultraviolet or infrared rays can accelerate changes in the process of mutation, causing organisms to become modified at a far greater rate than would normally be expected on theoretical grounds. Protective arrangements are in place to prevent some of these changes, consisting of such checks as the filtering effect of the atmosphere or the compensating factor of tree growth for volcanic gas emissions. Ever since they have evolved, animal and plant species have acted as prey or predator for each other, maintaining numbers of each type of creature at an approximately constant level. Chemical reactions (the neutralisation of excess acidity by the solution of limestone, for instance) keep the Earth's soil in a state that will permit plant growth to continue. All of this means that the Earth's environmental balance is in an extremely delicate and sensitive state.

2.3 Human interference

Sadly, one group of the planetary family does not seem to fall in with the system of checks and balances that should keep things plodding along happily; human interference has constantly upset this ideal situation. As a species, we have interfered with nature virtually since the day we began to exist. Our entire aim has been to adapt the world around us to enhance our own stature, comfort, wealth or other state that is perceived to be desirable. Of the myriad reasons why we carry out such changes, many depend on some form of textile assistance. These reasons should be carefully examined in preparation for the investigation of textile importance in environmental changes. They can be broadly categorised into three distinct types: survival or protection, war or weaponry and desire for possessions.

2.3.1 Survival

First and probably most obvious is the matter of survival. Animals are content (or so it must be assumed) to live their allotted life span without any effort to prolong it. This is in direct contrast to the human animal. If we can, we will prolong our lives to the last instant, often after natural death should have taken place, and have always had the desire to do so. Our distant forebears developed tools to defend themselves against animals of superior speed and strength. They banded together to outwit prey that would otherwise have escaped, leaving the human beings without food. Once the food was killed, they dragged it home to their kinsmen with the aid of twisted strands of grass, vines or other units that formed the earliest ropes (and probably the earliest true textiles). The only animals they could not easily defeat were those too small to be seen, like bacteria, or those of comparable size and intellect, other human beings. Against the former, they began to practise simple medicine, using the Earth's resources to produce healing foodstuffs, drugs, balms or ointments. They also used textiles in the form of primitive cloth coverings that kept a wound clean to aid in the healing process. As time passed, they developed means of protecting themselves against dangerous sources of infection, often by adopting textile structures to prevent damaging contact with sharp rocks or other surfaces.

Today, we use medical technology to protect us against disease by means of inoculations that have a history dating back to Edward Jenner in the 17th century. If this fails, we try, with an intensity that has accelerated enormously during the last 50 years or so, to conquer the disease by using cures that have slowly evolved since ancient times. If even the drugs fail, surgical intervention may be attempted, dating back at least to Ancient Egypt and evolving slowly in distinct steps since that time. Finally, if surgery is not immediately effective, a patient may be attached to machinery that takes over completely the body's functions, so that the person can stay alive indefinitely in a state of suspended life. In a modern hospital, textile products are omnipresent, appearing as implants, tissue engineering, hygiene and health care products, protective covers for wound operation sites, bandages, uniform clothing, bedding items, operating room gowns, packaging for surgical instruments or in a host of other applications.

2.3.2 Conflict

In the second broad category of how humanity has changed the environment, and in the face of competition from each other, human beings have adopted the art of fighting, aided by the evolution of weaponry. The earliest weapons, made of flint, took a long time to prepare, so fatalities must have tended to be less numerous. Human ingenuity then brought about improvements in weapons by the development of newer materials, such as copper, bronze and, ultimately, iron. Protection against some of these could be achieved by means of clothing, so the techniques of textile production evolved alongside those of attack against animals or human beings. It has always been the author's contention (though it is unlikely ever to be proved) that skill in making textile materials is the major, or even sole, reason of the survival of any specific group of human beings. For instance, a clan using the optimum size of spinning whorls would probably defeat one using whorls of inferior size. The reason is obvious; an optimum whorl produces a better (that is, stronger) yarn because it provides better twist, evenness and fineness. If the yarn is better than that of your rival, then so is the fabric. If the fabric is stronger, then two results inevitably follow. First, it will give better protection, allowing the wearer to enjoy an increased chance of survival in combat. Second, it will not need replacing as often, which means that the people spinning the yarn and weaving the cloth can devote the time saved to other tasks, such as food gathering or child care, that will aid the survival of the clan.

In our own day, and at close quarters, we have devices that can injure or kill an opponent by a simple movement of a finger on a trigger or button. We have weapons that can destroy our enemy at a distance, even as far away as the other side of the world. These weapons can be attached to vehicles that can cross rough terrain, travel on top of the sea, fly through the air or even venture outside our Earth's atmosphere before returning to deliver their burden of death. Once again, textile products support these activities in the shape of uniforms, parachutes, camouflage, webbing, seat cushions or other aids to enhance the effectiveness of the battle unit.

2.3.3 Possessions

But survival and protection are not the only aims of human existence. Another powerful driving force is the desire to acquire and keep possessions or goods. Since about 7000 BC, when the first civilisations appeared, human beings have been concerned with ensuring that their possessions stay with them as long as they are alive. On their death, apart from the grave goods buried with them as necessities for their comfort in the afterlife, all their possessions had to be passed on to their legitimate offspring to be kept as a part of the wealth of their true descendants. Anthropologists assure us that modesty, the refusal to expose the human body to other people not permitted to view it, began as a means of preventing illicit sex between the wife of one man (her 'owner') and another man, so helping to ensure that any child born to the woman did indeed have her 'owner' as its father and could inherit his wealth.

With the passage of time, this characteristic for acquiring goods, which modern humans tend to equate with status, has become so entrenched that we now clutch fiercely to all we own. Despite our protestations to the contrary, our laws, religious beliefs and social standards do not regard all people as being equal. We happily heap adulation on the chosen few who have obvious wealth, even though that wealth may be built on what many people would regard as spurious worthiness.

This wealth has to be displayed to all and sundry, and one manifestation of this is the wearing of elaborate, conspicuous clothing made from the richest cloths and the most up-to-date fashions, just to let people know that we have, indeed, acquired 'eminence' in the world. At the same time, we casually ignore the plight of millions of our fellow creatures who are on the verge of extinction because they have insufficient food, or water, or money for medical supplies.

The need for possessions is not confined to individuals. Countries or regions, too, can exhibit an acquisitiveness that can be harmful to our planet. Disputes flare up on a regular basis over land, often of such poor quality that it seems pointless to bother about. Access to water, or the rights to extract oil, or coal, or gold and other precious metals, or diamonds, or a whole host of similar valuable minerals, are also frequent causes of disagreement between nations. In our pursuit of the wealth represented by these displays of ostentation, we almost invariably make use of textile products. The protective clothing worn by prospectors or workers in hostile climates, the cloth used in filtration processes to extract or purify the minerals, the tarpaulins covering the area or sheltering examination sites; all of these are examples of textiles that simplify, or sometimes even make possible, the extraction of the minerals. So too are the uniforms and camouflage of the armed forces whose presence is necessary to defend the land once it is annexed in order to keep possession of it.

2.3.4 Curiosity

We must not forget the other related acquisitive human trait of curiosity. From their first days, our distant ancestors had an urge to investigate and to explore. The earliest human migrations, spreading the new species over the entire surface of the globe, may have been the result either of curiosity about new terrain or a need for self-preservation in the fight for scarce food resources, but later movements were certainly motivated by inquisitiveness. From explorers looking for new markets or new routes to existing ones in ancient times and in the age of discovery that took place principally in the 15th to 19th centuries, to the modern family going abroad for a holiday, human beings have been driven to spread their presence far away from their place of origin. Once again, textiles in the form of clothing (for personal wear or for trading), sails, or tents, or seating and tyre cords in transportation, have played a vital role in ensuring the success of these excursions. Indeed, without them it is entirely possible that our species would never have survived the rigours of the inhospitable climates they must have met on their early migrations, so that it can be fairly claimed that we owe our very existence to these ubiquitous materials.

Our curiosity does not end with travel around the planet. We are now exploring parts of the universe outside our planetary limits and in the not-too-distant future we will probably begin to embark on journeys beyond our own galaxy. For all of these pursuits, textiles have been called into service. Space suits, isolation garments, filter fabrics and other such refinements can be added to the list of uses already summarised.

We also explore the Earth about us in ever more increasing detail, from the plants or animals that surround us to the minute particles from which they and we are made. We extend our enquiries into the very bodies, or even minds, of our own species, trying to discover what makes us work. In the immediate future, it will almost certainly be possible to make a copy of ourselves, once we have overcome (or ignored) the ethical scruples we have that deter us from creating life by artificial means. Textile structures are often used as a framework for culturing replacement organs and body parts, so may well play a significant part in prolonging life and increasing the planet's population burden.

In all of these many characteristic traits of modern human existence, our motivations closely reflect those of our ancient ancestors, enabling the route by which we have arrived at our current attitudes to be easily traced. One issue that will be explored in the rest of this book is the effect that all this activity has had on the health of our planet, and what can still be done (especially in the context of textile production or use) to keep it in as healthy a state as possible. In general, there are two overall planetary problems brought about by the consumption created by our determination to survive, enjoy luxury and investigate our world. They are, respectively, the depletion of resources and the production of pollution.

2.4 Changes occurring

The changes occurring when resources are used up by our activities may be inert or damaging ones. It is not particularly important for the future of the Earth, for instance, if all the coal or oil is extracted from the ground. It may well be important for the survival of humanity, which is what is usually meant when the survival of the Earth is discussed, but the presence or absence of these particular materials will not affect the survival of the remainder of its inhabitants. On the other hand, if the resource used up is oxygen, or pure water or the vegetative cover, then a different conclusion would have to be drawn. True, the barren planet would continue to rotate around the Sun (until that source of energy disappeared), but the remainder of the living ecosystem would be altered so drastically that no stable conditions could be expected to remain. There may be a reinvention of evolution once the system had stabilised again, but whether that evolution would bring about the existence of animals or human creatures is by no means certain.

2.4.1 Pollution

The other major effect, that of pollution, can sometimes be a more serious matter. When unwanted items are discarded on the surface of the Earth, their presence there tends to be forgotten. The end result of their being jettisoned, though, may be harmless or serious, depending on their nature. In the main, any substance derived from a natural source, without chemical treatment in its production, will bring about no physical harm to the Earth (though it may be objectionable to view), but a chemical treatment will, on the whole, make the discarded object harmful. Thus, a piece of wood thrown into a field will fairly quickly decompose back to organic products that can be absorbed into the soil with no ill effects, but a piece of plywood or paper made from wood that has been treated with resins or bleaching and printing compounds can contaminate the soil ***(* L-2)*** (see Table 1.1 for explanation of codes) with the resultant decomposition products.

Any chemical substances thrown away can have a range of undesirable environmental effects. First, they may leach into the ground where they are dissolved into the subterranean water and hence reach streams, rivers and springs, from which animals (including humans) get their drinking water. A steady diet of these compounds is not recommended for healthy existence and can indeed accelerate the mutational changes by which a species evolves. The probable consequence, though, is for evolution to be retrogressive, rather than advantageous.

The second problem is much more tangible. The use of chemical compounds can quickly lead to the destruction of the soil crumb structure. Soil particles become finer and can be washed or blown away as dust in rainy or windy weather. The topsoil, in which most of the nutrients are stored, is then lost, making the ground less fertile. This increases the need for artificial fertilisers, which then compound the erosion problem. Finally, the chemicals applied in this act of compensation can blow about during application, to be inhaled by any local population, causing health problems that may, in the worst-case scenario, be fatal. Crops not destined for treatment can also be contaminated (and hence damaged or even destroyed), though geotextiles now available can help to prevent this problem and can also restrict to a considerable extent the occurrence of soil erosion.

2.4.2 Side effects

Harmful human activities do not consist exclusively of discarding chemically modified consumer goods. In our wish to survive, acquire, explore, conquer and so forth, we produce a wide variety of other side effects, too numerous to describe in detail. Suffice it to say that the end results of our actions in producing or using energy, medical products and agricultural crops, or in excessive hunting, overfishing and destruction of forest cover, tend to be entirely negative from the viewpoint of global health. While we continue to replace land by buildings, roads or other of the appendages of our ‘civilised’ way of life, we can expect to bring about a loss of free space and hence a loss of habitat for animals and a loss of species diversity. If we add to this noise or visual pollution, then we induce terror, behavioural changes and possibly even physical damage into the equation, not to mention a reduction in aesthetics that can bring about emotional distress. Our electromagnetic onslaught, compounded by excess power use and by the current state of information overload to which we subject ourselves may, according to some experts, cause other physical changes, such as damage to the brain, that will not improve our existence.

Add to these problems the effects of compounds released to the atmosphere. Gases that are poisonous to humans or that remove oxygen can bring about drastic harm to individuals, either directly or by increasing climate change effects, such as global warming, tornadoes, floods, and so on. Liquids or gases discarded may also be toxic ***(* A-2, W-3)*** to animals, plants and fish, as well as to human beings. Oily liquids can change flotation properties of birds or can be carcinogenic. Detergents may alter the balance of aquatic species. Toxic solids at microscopic size ***(* L-2)*** can impede breathing or stunt plant growth. Thus, water damage, biodestruction and other effects can be devastating to the Earth's health. Here again, textiles are invaluable aids in many of the filtration systems used to minimise the spread of pollution.

Finally, there are the other actions of human beings that must be tolerated by the ecosytem. Outbreaks of fire, accidents, explosions of bombs and dust production from such events as erosion or blasting operations are all likely to have some adverse effect on planetary health and hence on our survival.

Clearly, there is much more damage caused to the Earth's health than that from the actions of the textile industry, even though the industry has some part in many of the causes of harm described above. In particular, it should be noted that textiles intended to provide protection against environmental problems may bring about such problems during the course of their manufacture. However, no quantitative or even qualitative survey has yet been carried out of what blame can be squarely attributed to the textile industry, in contrast to the blame allocated to the industry solely as an auxiliary operation connected to some other cause of harm. It is time to take a closer look at what real problems the industry can legitimately be accused of causing.

3
The nature of textiles

3.1 Properties

Before trying to get any idea of how textile production can affect the environment, there are some basic facts that have to be recognised. These stem mainly from the nature of textile materials themselves and bring about the need for special consideration that is not always realised by people even closely involved in the industry.

The first fact that needs to be accepted is that textiles are unusual. This may seem strange at first, considering the number of pieces of cloth, strands of yarn or fibre bundles lying around in every corner of the planet, but, despite their ubiquitous nature, textiles are an extremely odd type of substance. To be useful, they have to combine a wide range of properties, such as adequate strength, high flexibility, the ability to accept many different chemical treatments, optical, thermal or electrical characteristics of a variable nature as desired by the user and ease of maintenance. It is difficult to imagine any other engineering material that could achieve half of these necessary attributes.

3.2 Textiles as engineering materials

It is important to appreciate that textiles are indeed engineering materials in the true sense of the term. A textile product is manufactured by carrying out a range of treatments, which may be any combination of mechanical, chemical or physical in nature, just as happens with any other engineering material. The difference in textiles lies in the basic starting unit, the fibre. Fibres, though, are not typical engineering components. If you compare a fibre with a metal rod, a wooden beam, a slab of concrete, a brick or any other solid material used in engineering applications, there is an obvious difference. If any of the other solids are pushed, they move away in the direction of the push. A push on a fibre, yarn or fabric, though, does not move it away in a simple straight line. It makes it distort and fold up on itself. This is the basic cause of the difficulties that have existed in the manufacture of textile materials throughout history.