

The Genetic Revolution

[youtube:<http://www.youtube.com/watch?v=SKeorEMkFGY> w auto]

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The first part of this book has been written in an old Tudor farmhouse which my wife and four children stayed in over Easter. It is down a narrow country lane lined with dry stone walls and is part of a cluster of cottages. It was built with thick stone walls, and stone roof, and inside with massive oak beams, oak panelling, huge fireplace, leaded windows and stone floor. Outside there is a group of old farm buildings, a sheltered paddock where the horses graze, a covered well, and in the garden an overgrown stone circle with millstones for grinding corn. People like us but very different -; how different?

Built by ancestors

The unique feature of the house is that it was built by one of my ancestors in 1620 according to the inscription he left carved in stone above the front door. John lived here with his wife, eleven children and his parents, but was not the first to live on the site -; his grandfather William was living and working on the same spot around 100 years earlier.

I have a family tree before me which traces the descendants of these few right down as far as the present day. The farmhouse has been lived in or visited by my ancestors throughout the last

four hundred years. As we sat in the large living room in front of a blazing log fire, and felt our faces glow in the heat, we felt echoes from the past and could imagine clearly what life must have been like so very long ago.

I have often wondered just what else has been passed down over the years -; was it just a memory of stone walls and oak beams? What about inherited family likeness, temperament or personality. Every generation produces a unique blend of two parents but doubtless some of my three billion pieces of inherited information are even older than John or William themselves.

The words I am writing now (by hand as the word processor is elsewhere) are being scribed on a desk that belonged to my grandfather, also an author of several books (together with an encyclopaedia to his name). Again I have often wondered how much of the compelling drive to write has come from a set of genetic instructions I inherited which influence the part of the brain we use for language.

Mixing genes in babies

For millions of years generations have come and gone: individuals have formed relationships, made love, conceived and brought up children quite literally in the image of themselves. Out of this experience of oneness (however transient) has come with conception a unique historical event: a fusion of their two lives and individuality to form a brand new mix of them both as a new child is born. Yet for the generation born this year, or next, it could be the end of the line.

The generation being born now may well be the last to have a "fixed" genetic code, inherited universally in a conventional way. As we will begin to see in the following chapters there may be few alive in 30 years time who have not had the genetic code of at least some of their cells reprogrammed away from what they naturally inherited. For some, as we will see, they will acquire genetic changes which will outlast their own lives because they will be passed on to their children, their grandchildren and their great grandchildren. Subsequent generations will have to judge whether this is a blessing or a biological curse.

The book of life

The quite extraordinary thing about the code of life is that it is so constant: the smallest most primitive living organism to the largest has a book of life written in exactly the same language and structured in an identical way. For evolutionists this comes as no surprise, neither does it to those who believe the sense of the Genesis account is true (not necessarily literal timings or order) and that when God spoke, the language of creation he spoke was in the language of life, or genetic code.

This mystery of life itself is about to be broken, in the testtube of the laboratory and in the brain of the desktop microcomputer. It is happening right now in front of our eyes yet few have seen it happening or understood the consequences. This book is about a few of the consequences, and how we respond to them.

For centuries, people have dreamed of being able to alter themselves, or each other or of being able to produce "clones". More recently parents have thought not only of choosing the sex of their children but also of being able to influence the development of their children to produce high intelligence, attractive personality, healthy constitution, athletic body, musical ability; and maybe even an obedient nature!

Farmers have dreamed of low fat cows, non-bruised tomatoes, cold-resistant bananas, corn which comes up year after year without seeding and other strange creations.

Parents of children with inherited diseases such as cystic fibrosis, where the lung problems are a result of faulty genetic code have dreamed of a day when doctors might be able to programme the faulty gene back.(1)

Those with AIDS have dreamed of a cure for HIV infection, reversing the damage done to cells by the virus called HIV, which programmes white cells to produce more viruses instead of fighting infection.

To say that all these things are already possible would be a gross exaggeration. However, as we will see, the machinery and knowledge is already here and the experience will be before long. But before we look at what is happening now we need to see the "genetic revolution" in

an historical context.

The Thirst for Knowledge

Man's greatest discoveries have often happened by accident or curiosity. Great social change has often followed useful ones. It was by accident that ancient man found metal in the fire after heating earth, and glass after heating sand. The first steam engines in 1698 led to a massive demand for coal and the rapid industrialisation of England (5). Life would never be the same again.

Then came the discovery of electricity in 1820 and the means of storing it in a battery in 1836, together with the means of generating it using magnets and massive coils of wire turning at high speed by 1850, with industrial power generation by 1880.

The petrol engine invented in 1885 also had a massive impact which continues today. Radio transmission started in 1901 as yet another curious experiment before leading to television broad-casts in 1936 and today's satellite technology.

Often the work of the inventor is hijacked by urgent need; the second world war accelerated work on penicillin, aircraft engines and rockets, radar and, of course, nuclear energy.

The continued arms race in the cold war of the 50's and 60's together with the American space programme goal to walk on the moon led to a massive search for ways to reduce weight of electronic equipment. Bulky glass valves using technology dating from earlier this century used a lot of heat, took time to warm up, were unreliable, and heavy. A rocket full of glass was unlikely to go far.

The Silicon Chip

Laboratory discoveries of silicon's remarkable ability to allow electricity to flow well at times

and badly at others, produced a replacement for valves. The age of the transistor dawned. By the 1960s transistor radios were proudly displayed in every High Street. Their main distinguishing feature printed boldly on the box was the number of transistors they contained.

Just over twenty years ago, scientists found ways to produce larger sheets of silicon onto which could be built not two or three but millions of transistors, each vastly smaller than a pinhead. A computer occupying a room 200 feet by 100 feet and with its own generator could now be compressed into a metal box the size of a briefcase, running on batteries.

In 1980, people were predicting that by 1990 every person in the West would own things containing these "silicon chips" -; in cars, washing machines, radios, electric mixers or calculators to name but a few.

In 1980, this looked a little far-fetched. By 1988, it was already a reality. By the mid 1980s, most shops had converted to electronic cash registers, most banks were using electronic cash dispensers and it had become impossible to buy a transistor television, except in a junk shop.

Most of these discoveries were made by inventive, curious people interested in solving puzzles and finding out more about the world we live in. Most of these people were already searching for a particular answer to a particular problem. Few realised at the time how big an impact their own discoveries would have. As we will see, the same has been true of genetic engineering.

Faster and faster

Every ten years, our total scientific knowledge is doubling: we knew twice as much about the world in 1950 than in 1940, four times as much by 1960, 8 times as much by 1970, 16 times as much by 1980 and by 1990, we knew over 30 times as much scientifically as 50 years previously. By the year 2000, we will know 60 to 100 times as much as we did then.

The pace of discovery is increasing so fast that human brains cannot understand it all. We are already beginning to see major problems with equipment we make such as computers because there is not one brain in the world capable of understanding the whole machine. When

unexpected things happen, it can be extremely difficult to understand why, and how to solve the problem.

Even if no new progress is made in computer design for the rest of this century, it will probably take programmers at least another 10 years from now to get to grips with what these early 1990's machines are really capable of. At the top end, scientists are making huge advances every month in making faster, more powerful electronic brains while at the bottom end, we are struggling to keep the electronic brains we now have busy for more than one per cent of their working lives.

Such is the pace of change in computers that the model bought today is guaranteed to be prehistoric within 6 years. Because it can take up to a hundred man or woman years of labour to produce a good program -; say for accounting -; all new machines have to be able to run old programs. Bigger and bigger brains are running systems designed originally for tiny, slow electronic brains over 10 years ago and are working less and less efficiently.

I am emphasising these points because unless we understand what is happening in electronic programming now, we will not fully understand the impact of genetic programming in the future, where, once again, the tools and equipment available is developing enormously faster than our thinking about how to use them. However there is one big difference: computers may make people redundant in many jobs but they do not alter life itself. Genetic engineering on the other hand by definition alters the very substance on which life is based.

The New Industrial Revolution

So, into this new computerised age, we now add the age of the gene, with greater potential to help than the microchip, and possibly (if the technology is used unwisely for peaceful or military purposes) the power to harm of a dozen nuclear reactors or atomic bombs.

The bio revolution is being developed under exactly the same pressures as the computer revolution or any other of the major discoveries this century: it is driven by curiosity, together with commercial interest built on urgent human need. So what are the human needs? It is also built on the discoveries of the past, in particular the progress in computer technology.

Pleasure Today, Nightmare Tomorrow

As we approach the third millennium, we are faced with a series of nightmares that are so hellish that most of us manage to avoid thinking about them. Global warming is not one of them.

My eldest son, John, who is 9, has a freshness in his view of the world. Every week his eyes of understanding open wider and his insights become sharper. Certain unmentionable things are already obvious to him and also to Genetic Engineers.

1. Energy Shortage:

He knows that within his lifetime, the one-third affluent world will largely have burnt out all the main sources of oil and gas. Coal will remain but will be scarce and expensive. How are we going to keep warm or powered up in tomorrow's world -; not just for the next sixty years but for the next two thousand years? We are acting as if there is no tomorrow, no future, no subsequent generations to worry about.

He knows that the world population is growing faster than ever and that many two-thirds world cities are mushrooming chaotically in size and problems. By the year 2000 the great majority of the world's growing population will be living in towns or cities. A new wave of industrialisation must follow to improve standards of living and provide jobs for the milli

2. Materials shortage:

Industry uses power, iron ore, aluminium, plastics from oil, stone, wood, gold, silver, diamonds. The resources will run out faster. Scarcer resources carried further at greater cost will create further hyper-inflation in many countries, and possibly bankruptcy for some of the most vulnerable..

3. Global Warming:

While some scientists still doubt that the world is getting warmer one thing is clear: the level of carbon dioxide in the atmosphere is rising significantly. Global warming happens when the carbon dioxide we breathe out, also released by burning fuels, rises in the atmosphere, trapping the heat of the sun. Carbon dioxide rises as oxygen falls.

Plants and trees breathe in carbon dioxide and when in sunlight they use it to build fibre or wood, releasing precious oxygen back into the atmosphere.

Trees are cut down for fuel in some countries, Africa for example. Without fuel, you cannot boil water or cook meals. Trees are also cut down for building materials. In South America, trees are cut down to grow food. Before we point the finger either way, we need to realize that most of the UK was cleared of ancient woodlands in a short time: for burning, for building houses or ships or furniture and to make suitable land for sowing crops.

4. Massive Epidemics:

There is another historic fact which tends to follow a higher density of people -; especially where population or cities have grown fast: epidemics of disease or plagues.

By the mid 1980s, there was hardly a country in the world not admitting it had been hit by new worldwide plague, spreading faster than scientists had the techniques to monitor it. Known as the silent killer, it had the capacity to destroy countries for some 10 to 20 years before the devastating affects were fully seen. I am, of course, referring to the disease AIDS which is a result of infection by a virus called HIV for up to 20 years prior to obvious disease and subsequent death.

This virus has already infected 11 million worldwide. The death toll from AIDS has already exceeded double that from the Vietnam War, with a total of almost a million infected and likely to need care in the future. In Africa I have recently visited countries where a silent holocaust has already taken place among the young, with a million deaths already of which a great number have been children or babies infected through the womb. In some areas one adult in three is already infected. At least one country is giving reliable test survey figures showing

infection levels as high as one adult in eight throughout the entire population, including the most inaccessible rural areas.

AIDS is a late twentieth century problem: it is mainly a heterosexually spread disease worldwide (over 70% of total world infections currently, expected to rise soon to 80% of total). The rapid spread of HIV is part of a massive global epidemic of a number of other sexually transmitted diseases, related to an increase in the number of sexual partners per average adult in the course of a lifetime. This has been accompanied also by a huge increase in mobility as the petrol engine and low-cost of jet transport have enabled millions to move from town to town or from continent to continent each year.

Syphilis was also known as a plague in previous centuries: until the 1940s, there was no cure, it killed after 10 to 20 years, it was spread sexually with all the associations that brings, and children were infected at birth.

These are just a few of the problems my own children will be confronted with. Progress measured by the microchip, the petrol engine, the discovery of antibiotics, burning earth to make steel, burning coal to make power; none of these society-changing discoveries bring any answers. In fact, these discoveries have simply added to the growing problems of increasing consumption of resources, and increasing population as general health rises and child mortality falls.

Please do not misunderstand: I am not for a moment saying that we should wind back the clock. I am not expressing regret for any of these previous discoveries; on the contrary, I experience, as you do, their benefits every day.

Nor am I saying that the two thirds world should be deprived of their own industrial and technological revolutions by the "greedy" West jealously guarding scarcer and scarcer resources.

All I am pointing to is an unprecedented series of local and global problems which will ultimately affect life on this planet as we know it. The result is a new massive surge of resources, time, money and organisation into the new revolution that, it is believed, could hold the keys to some solutions, and maybe also open the doors to new unimaginable disasters.

So what can the genetic engineer possibly hope to contribute towards such a world as we face tomorrow? Re-designed organisms could offer us new ways to convert scarce sources of energy including coal and industrial wastes to substances we can use to make recyclable plastics. New organisms could provide new food sources, while new ultra-efficient plants and trees could be part of the world lungs of the future. Finally altered microbes could offer complete cures for diseases such as AIDS and malaria.

The Genetic Revolution book by Patrick Dixon - published 1995

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