All of us are drug users, in the broadest sense of the word. Drugs can be medicines, they can be used for pleasure, and they can also be used to protect our long-term health. It is important that we are well informed about the drugs we use – how they work, their benefits, and their risks. This book is a unique guide for the general science reader to the drugs of everyday life – from the main types of medicine through to recreational drugs and food supplements. It looks at how drugs interact with their targets in the body, where they come from, how they are developed and what drugs to expect in the future. All the major pharmaceutical medicines are reviewed – painkillers, antibiotics, anti-cancer drugs, anti-depressants, heart drugs, tranquillisers and hormones. However this book is much more than a consumer handbook – it also conveys the fascinating science of drug discovery in an easily accessible way.

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SUSAN ALDRIDGE

Magic Molecules

how drugs work

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Introduction

Drugs have an impact on all our lives. Many people rely on a daily dose of aspirin or insulin to maintain their long-term health. Others may hope for better drugs to treat challenging illnesses such as cancer or schizophrenia. Away from the realm of serious disease, casual use of painkillers or indigestion remedies relieves minor aches and pains. And most people use some form of recreational drug such as caffeine, alcohol, or nicotine to help them cope with the stresses and strains of everyday life – or just for pleasure.

New drugs are coming onto the market all the time. There are now effective treatments for stroke, AIDS, and multiple sclerosis – where none existed before. Prescribing habits change too – long-term use of tranquillisers and sleeping pills is now frowned on, and slimming drugs are, officially, off limits. The range of medicines available over the counter is continually changing too. Now you can buy the anti-ulcer drug Zantac without a prescription, but some hay-fever remedies and even paracetamol (in large quantities) have moved into the prescription only category. Walk into a health food shop and you will discover an alternative pharmacy – vitamins, minerals, phytochemicals and herbs – in a bewildering array of strengths and dosages.

But how well do we understand the drugs we are prescribed or choose to take? What informs our doctor's choices, and our own? And is there really a 'pill for every ill'? Where *do* you find out about the drugs you take?

By law, companies must insert an information leaflet into every packet of a prescription drug. While efforts have been made recently to make these more comprehensible and accessible, they say far more about side effects and contraindications than they do about whether, why, and how the drug might improve the consumer's quality of life. And an information leaflet cannot even hint at the fascination of the science that lies behind the drug.

Turn to the media and there is certainly no lack of drama when it comes to discussing drugs. Television and newspapers tend to concentrate on new 'wonder' drugs (in reality, there is no such thing). For instance, it is true

that the recently launched protease inhibitors to treat HIV/AIDS are a remarkable breakthrough. They have opened up the possibility of AIDS becoming a chronic disease, which the patient lives with, rather than an inevitable death sentence. But you may not have heard the full story; the long-term effects of the drugs are unknown, they are unaffordable for the majority of AIDS patients, and treatment with them involves a complex dosing regime.

On the other hand, scare stories about the side effects of drugs are often taken out of context and, worse, people act upon the information they read. Remember those news reports, in 1995, about the increased risks of developing deep vein thrombosis with some brands of oral contraceptive. Thousands of women stopped taking their Pill immediately, terrified they would die of a stroke or heart attack. Many became pregnant as a result – thereby actually *doubling* their risk of a clot.

There is the same need for hard information and a balanced overview when it comes to discussing 'illegal' drugs and substance misuse. The arguments for and against the legalisation of cannabis, for instance, are often driven more by social, economic and political factors than by science.

In this book, I hope to give this broad and much-needed overview of the drugs we use – from medicines that save lives to drugs which enhance the quality of life. I have called it *Magic Molecules* because I have drawn quite heavily on the 'magic bullet' concept of Paul Ehrlich, the founding father of the modern pharmaceutical industry. Ehrlich's dream was to create safe and effective drugs which would home in upon their target in the body – be it an infectious bacterium or a cancer cell – with the precision of a 'magic bullet'.

Much of the discussion will be about pharmaceutical drugs. While I will celebrate some of the industry's remarkable breakthroughs – such as antibiotics, painkillers and hormonal contraceptives – I hope this book will also give readers cause to reflect on how well pharmaceutical drugs actually serve people's health needs.

In the West, heart disease and cancer are the leading causes of death and disability. So it is hardly surprising that many of the world's top selling drugs are for heart disease – it is a huge market. It is slightly harder to explain, in purely clinical terms, why the world's top selling drug is for ulcers – and not for cancer, or infection.

Worldwide, however, infectious disease remains the biggest killer, claiming the lives of 17 million people a year. We thought we had conquered infection with antibiotics – but these clinical weapons are fast losing their

power as microbes evolve resistance to them, leaving us with a major public health problem. This has been caused, in part at least, by lack of vision, and reluctance to invest, on the part of the pharmaceutical industry.

And we still do not devote sufficient pharmaceutical resources to tropical diseases. Malaria kills three million people a year, one million of them children. But research into malaria receives only $60 million a year, compared to $140 million for asthma, $300 million for Alzheimer's disease and $950 million for AIDS. Is this fair?

But this book is not just about the pharmaceutical industry and its products. Drugs are molecules which have a biological effect. It really is not relevant whether the drug is legal or illegal, recreational or medicinal, synthetic or natural. The biology and chemistry of drugs crosses these boundaries. Therefore I have also looked at many of the drugs which are used for pleasure, and at the products of the health food industry; both are as important, in their way, as pharmaceutical drugs. In the end, this is a book about chemistry at its best – about how a 'magic molecule' finds a target within the body, and causes a biological response which may have a profound effect at many levels upon the individual.

Many drug names are mentioned in this book. Names whose first letters are lower case are generic names (the official medical names). Where appropriate I have also referred to UK brand names; these names begin with a capital letter.

Susan Aldridge