Watch This Space on Your CD

Steve Homer

On their TV screens, users will be able to enter the Smithsonian museum and wander from room to room or take a guided tour.

A NIMBLE-FOOTED computer company is about to go to war with the giants of the consumer electronics industry. The battlefield is the high street, and the weapon is a new concept in home education and entertainment — the interactive compact disc player.

The first contender comes from the American computer company Commodore. Its CDTV burst upon an unsuspecting industry at the Chicago Electronics Show in June.

The project was launched in February when the company set up what is known in the US as a "skunk works" team. Reporting directly to the president of Commodore, and working in great secrecy, the team of 26 came up with a product that brings TV graphics, text, animation and expanded audio capabilities to the CD player.

In unheard-of speed, CDTV will be in the shops this November, priced £699. It will be a fully functional conventional CD player but, linked to the television, will offer a wide range of educational and entertainment opportunities. The key word in all this will be interaction.

Data stored on CD-type discs will be translated by the system into pictures, text and sound. The user will be able to control the system with an infra-red remote control device, similar to current TV controllers, and will select how the information on the disc is interpreted. For example, several foreign language courses are under development and the beauty of the system is that it will allow users to control the course to satisfy their own needs. Users will not be constrained by the linear nature of video or cassette-based systems.

Commodore claims that 50 of the 94 titles under development will be published by December. These include the World Vista Atlas, where the user can zoom in on any continent, region or country and pull down socio-economic statistics, images or soundtracks of music, people talking and other relevant information.

Another title, a Timetable of Science and Innovation, an exploration of the history of science and technology, will have approximately 6,000 individual references and thousands of graphic and multimedia effects. In a lighter vein, Scary Poems for Rotten Kids will no doubt attract many a harassed parent. This title claims "classic stories became interactive learning programmes."

Roughly 30 per cent of the titles are educational, 10 per cent reference, 10 per cent for primary school children, 15 per cent simulation (such as skiing), 10 per cent adventure games, 10 per cent arcade games, 4 per cent quiz-type games, 5 per cent leisure, and 2 per cent "for women."

So far, so good. But buyers of CDTV should beware, because coming up on the rails is CD-I, a similar but more advanced and totally incompatible system. Discs for one machine won't operate on the other, resulting in confusion and extra costs for both manufacturers and the public. Until, that is, market forces establish one system as the "victor."

Soon after Philips created the compact disc in the early Eighties, its computer scientists realised that here was a magnificent way of storing data for personal computers. The Compact disc Read Only Memory (CD-ROM) can store around 550 megabytes, or roughly 550 million characters — that is the entire text of the Encyclopaedia Britannica — twice over on one small five-inch compact disc.

Philips and Sony then decided to offer more sophisticated facilities in a domestic setting. So CD-I (Compact disc-Interactive) was born. Standards for text, graphics, high quality stills and complex video effects were laid down an animation was added. Initially, full motion video (FMV — moving video images of almost TV quality) was not considered possible at a consumer price level. But full screen FMV is now a reality in development model CD-I players.

This, from a product to sell for less than $1,000 (£530), is no mean feat. Sophisticated compression techniques, using advanced microprocessor chips, have now solved the problems of FMV, but wrangling at international standards committees continues, and final confirmation is needed before production models can be made.

CD-I is now backed not only by Philips and Sony but also Matsushita, the three largest consumer electronics manufacturers in the world. But CD-I will not be in the shops until late 1991 in the US and early 1992 in the UK.

Philips and Sony have lined up an impressive range of titles which they claim will be available at launch. With a CD-I disc capable of storing 72 minutes of full motion video, more than 7,000 high-quality still pictures, two hours of hi-fi standard audio or 16 hours of vice quality audio, obvious examples of its use will be encyclopaedias, dictionaries, language courses and the like.

Already there are CD-ROM products that allow music lovers to enjoy their favourite orchestral passages and read the score at the same time. But with CD-I they could also study the string section in isolation, mix in historical instruments or play selected pieces of the score. There is also an adult golf game complete with comments on your golf from Arnold Palmer, applause from the crowd, random effects of wind and a realistic simulation of the ball landing in the lake. This is a vastly different product to the golf computer games currently available.

The most talked about of the existing discs, however, is an early version of The Treasures of the Smithsonian. The famous American museum has, for many years, produced a range of six coffee-table books showing many objects it cannot always display. Six discs, each costing $50, the same as the books, offer even more information. On their TV screen, users enter the museum and wander from room to room, do some desk research or take a guided tour.

Many companies are exploring CD-I for internal purposes. Renault, for instance, has produced service training material on CD-I. With new models coming out all the time, updating manuals and training technicians is a constant headache.

Added to that is the language problem. CD-I's eight audio track capability could make training staff a lot easier. Further, interactive training modules mean that mechanics can experiment with electrical wiring on a CD-I device rather than on your car.

A CD-I system is already operating at the R&A Golf Museum at St Andrew's. Here, since the beginning of July, the rules of the game and an interactive history of golf have been offered to visitors.

The CD-I consortium will soon be launching an underground offensive against CDTV. Through Polygram and other record companies, "CD-I Ready" music CDs will be sold. These discs will play normally on ordinary CD players, but spare capacity will be used to store pictures, discographies and words of songs that will only became usable when a CD-I player is bought.

So what about the long term? There is no doubt that, compared to the sophistication of CD-I, CDTV is a quick fix. The player is essentially a Commodore Amiga home computer with a CD-ROM drive, repackaged as a mass-market consumer product.

But the components are well-established, cheap and reliable, the technology is proven, there are more than two million Amigas already sold world-wide (half a million in the UK) and a huge base of titles with many developers producing software for them. But most important, Commodore will have a clear field for at least 12 months.

The drawbacks of CDTV are inferior graphics handling, inferior pictures, inferior audio management and a lack of full motion video. But That may soon change. Commodore sits on the same standards committees as Philips et al and Commodore says it is hoping to offer FMV on CDTV soon after the final compression methods have been agreed. (This does, however, mean that titles that use FMV will not play on early CDTV players).

What we have is two very similar, very exciting products, using incompatible operating systems, battling for one market. Available titles will be all-important. Both camps make expansive claims, but few finalised products are available and pricing remains hazy. Disc titles are initially likely to cost around the £10-£30 mark.

Once again, the marketplace will have to decide. Shoppers must remember caveat emptor — let the buyer beware. You have been warned.

A Cheaper Way to Touch the Sun

AMERICAN chemists could be close to converting sunlight into a cheap source of energy. Dr Stuart Licht and a team from Clark University in Worcester, Massachusetts, are perfecting a new solar cell that works like a conventional battery as it converts sunlight into electrical power.

The more familiar solid-state solar cells or photo-voltaic devices (which produce electric current at the junction of two substances exposed to light), are found in spacecraft and calculators. These are highly developed and efficient, but relatively expensive to produce. This makes them too costly to generate solar electricity on a large scale, even though solar power would not contribute to global warming. The new device, called a photoelectrochemical cell, though less efficient than solid-state devices, is much cheaper to make. These cells could pose a serious challenge to the supremacy of solid-state devices for solar energy conversion.

Turning the sun's light into chemical energy is not new. For billions of years, photosynthesis has provided the basic chemical driving force for practically all life on earth. Plants convert sunlight, carbon dioxide and water into high-energy carbohydrates, liberating oxygen in the process.

From an industrial point of view, though, photosynthesis is highly inefficient. On average, only 1 per cent of sunlight is converted into energy-yielding compounds such as wood. For an industrial society, such a low efficiency would mean turning over vast tracts of land to solar energy conversion.

The most promising approach so far to solar energy seems to be to convert sunlight directly into electricity. Up to now, this has meant moving away from chemistry and biochemistry and into the realms of solid-state physics.

When light shines on a semiconducting material, it "knocks" electrons out of the outer orbits of the atoms of the material and so generates an electric current. But there is a snag. The conductivity is short-lived. Physicists tackle this by grafting on another piece of semi-conductor with a slightly different structure. Where the two semi-conductors meet is called a p-n junction and the effect is to keep the current flowing for as long as light falls on the device.

These cells are reliable and highly efficient — the best laboratory models work at 25-26 per cent efficiency. But they are expensive to make: fashioning the all-important p-n junction requires all the skills of modern electronics technology.

The photoelectrochemical cell has been developed to help solve the problem. Chemists have put the semi-conductor in contact with an electrolyte — a water-based solution which has the same effect on the semi-conductor as the p-n junction.

The electrons knocked off the atoms of the semi-conductor by the light pass this time into the electrolyte, rather than into another piece of semi-conductor. The effect is rather like what happens at one terminal of a battery. If another electrode is placed in the electrolyte, current will flow through a completed circuit outside the cell, from semi-conductor to electrode. This is the photoelectrochemical cell: to generate a current just shine light on the semi-conductor.

Photoelectrochemical cells could also produce chemical fuels. The passage of an electric current through a water-based electrolyte causes chemical reactions at one of the electrodes, producing hydrogen. This can be burnt or stored for later use.

The chemical cells are also cheaper than photo-voltaic devices. The semi-conductor electrode does not need the hi-tech treatment used in making silicon solar cells. The problem is that the chemical reactions started by the semi-conductor can dissolve it.

This is called photo-corrosion, a light-induced rusting which eats away at the semi-conductor and covers it with an electrically insulating layer. This drastically reduces the life-span of the cell, sometimes to the order of seconds. Moreover, the chemical cells are less efficient in turning light into electricity than the photo-voltaic ones.

In the early Eighties, chemists were so gloomy about the prospects for these cells that they were predicting efficiencies of about 10 per cent by the late Nineties. But in 1984, Nathan Lewis of Stanford University in California smashed the 10 per cent barrier by using electrolytes that did not contain any water. This beat the corrosion problem but at a price: no water must be let into the system. Later, Lewis was able to hoist the efficiency of his cells to 15 per cent in water-based electrolytes by coating his semi-conductor, made from gallium arsenide, with an ultra-thin film of expensive osmium.

Now Stuart Licht has gone one better. He has used a special combination of semi-conductor (this time cadmium selenide, which is cheaper than gallium arsenide and which reacts to light differently) and a water-based electrolyte. This enables the cell to produce its maximum operating efficiency — a new high at almost 17 per cent — over days instead of seconds.

Apart from being much cheaper to make than a solid-state solar cell, Licht's new cell does something that no solid-state cell can do. It generates a comparatively high voltage — 1.2 volts (about the same as a conventional torch battery), compared to only 0.7 volts from a silicon solar cell.

"There is no reason why we shouldn't get even higher voltages in the future, which will lead to efficiencies.

Solar energy panels at the Renewable Energy Research Centre located at Dhaka University Campus. Photo : Jalaluddin Haider.

Hated Red Mud Could Prove a National Blessing

WORLDWIDE, waste is a daunting problem. Jamaica may be small, but its alumina/bauxite industry crates waste headaches relatively as serious as those facing the major industrialised countries.

With one difference. It has been discovered that Jamaican red mud waste contains the biggest concentration of rare earths and phosphorous of any country in the world. And rare earths are of growing importance in today's world. They have been termed energy materials of the future.

As a result of research in the Eighties the potential for Jamaica is only now coming to light.

Bauxite is the ore from which aluminium is made. The waste is collected and dried in artificial ponds or in a valley dammed to form a lake. One such spectacular red lake can be seen on the main road from Kingston to the tourist havens on the north coast.

The ponds have a high content of caustic soda and are highly dangerous. The soda contaminates ground water with harmful effects on humans and animals. One spring near the town of Linstead has been found to contain as much sodium as the red mud itself.

When the mud dries the caustic soda on the surface combines with carbon dioxide in the air to form crystals of sodium carbonate or bicarbonate. These are blown away and people complain of the dust, which is said to be harmful to living things as well as to the roofs of buildings. One mining company has paid out a large sum in compensation.

Attempts to find a use for the dry mud, such as bricks for houses, proved uneconomic, but now the high mineral content of the red mud has opened up other possibilities.

Nearly half the mud is iron oxide and Jamaican industrialist and former minister Robert Lightbourne took out a patent with a Californian chemist for a process to produce iron form the mud.

Prospects looked so good the British company Rio Tinto Zinc (RTZ) provided bench space for Jamaican chemist Barclay Baez in its laboratories at Chessington in Britain.

The project proved unviable, but later the US Department of Energy carried out a survey to find uranium and thorium (a radioactive mineral used to make gas mantles) and it came up with the rare earth discovery.

In 1986 a conference held in Kingston on "Bauxite Tailings" was attended by 100 scientists from a dozen countries. It attracted interest in the scientific world, although only one commercial firm, in Norway, followed up the information given to the conference on rare earths. It sent a field team to investigate.

No industrial commitment has yet resulted, but the presence of rare earths in Jamaica bauxite tailings point to interesting commercial possibilities. Rare earths—lanthanum, cerium, samarium and neodymium—are being used more and more.

Their importance in ceramics is growing. They are also in demand for the manufacture of engines that can withstand far higher temperatures than those made of metal. Tiles covering US space shuttles are ceramic.

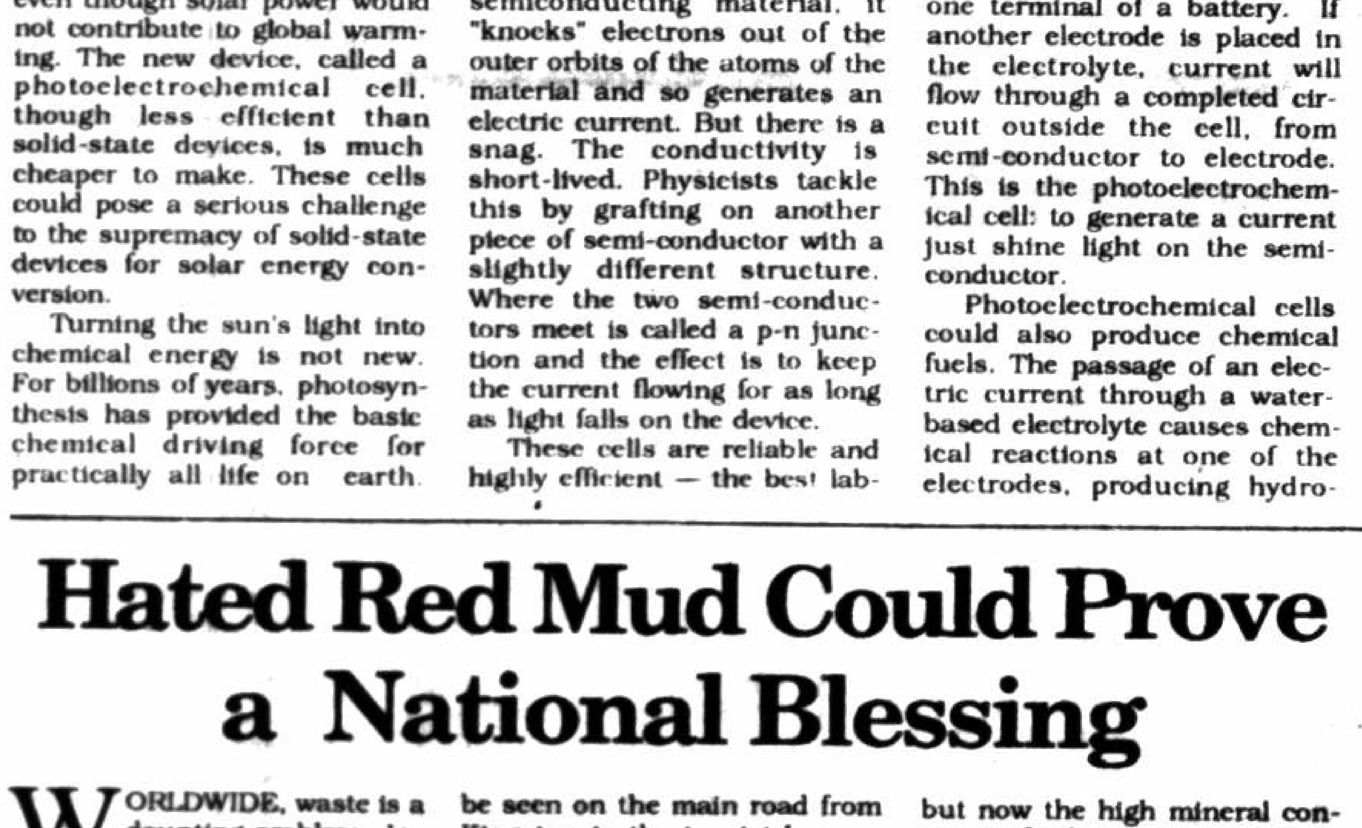
The biggest demand is in the refining of petroleum. About one-third of the total rare earth produced is used in the industry in the form of mixtures, of which the largest proportion is lanthanum oxide.

After long delay the proceedings of the Kingston conference have been made available by Dr Arun S. Wagh, of the materials laboratory of the University of the West Indies, Mona campus in Jamaica. He contributed a paper on Jamaica's rare earths in which he pointed out that they were once used as trace elements and today are used in bulk.

Permanent magnets are replacing electro-magnets and the strength of these modern magnets is some 40 times that of the steel magnets in use at the beginning of the century. The modern ones are made of neodymium-boron-iron.

In his paper Dr Wagh compared 1986 prices of six rare earths, all found in Jamaican red mud, with 1979 prices. That of neodymium was seven-and-a-half times the 1979 price, that of lanthanum 16 1/2 times, samarium 35 times, and cerium 43 times.

The biggest producer of rare earths is the US, followed by Australia, China and India. The US is also the biggest user.



Dr Arun Wagh stands in front of one of Jamaica's lakes of waste red mud

Plants Recognise Their Molecular Signature

WHEN a pollen grain lands on a flower, fertilisation does not always follow. The plant may accept some pollen grains, but reject others. Biologists are discovering, however, that this selection procedure is far from random. It relies on precise genetic mechanisms, which, in turn, depend on a single gene, known as the s gene.

The phenomenon in which a plant rejects pollen is often known as self-incompatibility, because the pollen that it rejects is usually its own. Plants are capable of fertilising, or self-pollinating, themselves because they possess both male parts—the anthers, which produce pollen—and female parts—the stigma and the style. Such in breeding is not desirable, though, so plants have evolved stringent mechanisms to stop "self" pollen fertilising them. New experimental work carried out by Adrienne Clarke and her colleagues at the University of Melbourne has shed light on these processes.

When a pollen grain lands on the surface of the stigma of a plant, the grain puts out a tube that grows down into the flower through the style, eventually reaching the ovary. As the pollen tubes grow, they deposit a substance, known as callose, which researchers can see by using a fluorescent marker.

Clarke and her colleagues have studied the wild tomato, Lycopersicon peruvianum. In this plant, the callose forms long, fluorescent tracks which are ended by callose plugs. Pollen that is "compatible" forms tracks that proceed unhindered and terminate at the ovary of the plant.

Clarke has found, however, that some pollen grains grow in an abnormal way. In some plant species, "self" pollen may die on the stigma. In other species, self pollen gets as far as the style, but its growth then becomes irregular and it often dies. Such abortive attempts at pollination are typical of pollen grains that are genetically identical to those that are produced by the anthers of the host flower, and so are "incompatible".

Recently, researchers have applied the techniques of molecular biology to the mechanisms of self-incompatibility. The behaviour of pollen grains that are incompatible depends on the s gene.

This gene has two forms, or alleles, in the adult plant, but only one allele in the pollen grain. It has multiple alleles, all of which vary slightly. Researchers denote them s1, s2, s3, s4, and so on. These alleles code for slightly different proteins in individual plants of the same species.

The situation is complicated because both pollen grain and style contain proteins produced from the s gene. Somehow, a pollen grain and style that carries the same s allele repel each other. In other words, pollen grains carrying a certain allele cannot germinate on a style that also carries that allele. A pollen grain s1, for example, cannot germinate on a style s1s2 or s1s3 but can germinate on a style s2s3.

In the 1950s, scientists adapted techniques that had been used to identify differences in human blood groups to show that different plants contained different proteins. Later on, scientists liked these proteins, which are often abundant, to the presence of different s alleles. B. Nasrallah and colleagues at Cornell University, New York, first sequenced an s gene in a plant of the cabbage family, Brassica oleracea. Clarke and her colleagues have also described the sequences of s genes from the ornamental tobacco, Nicotiana alata.

The Melbourne team used genetic probes to locate messenger RNAs for the s genes in the stigma, the style and the regions in which the pollen tubes would grow. They showed that the sequences of s alleles were variations on a theme. Some parts of the sequence remained very similar in different alleles. Other regions, however, varied considerably. This kind of genetic structure is reminiscent of some human genes, such as those of the major histocompatibility complex, which is involved in the recognition of self or foreign tissue.

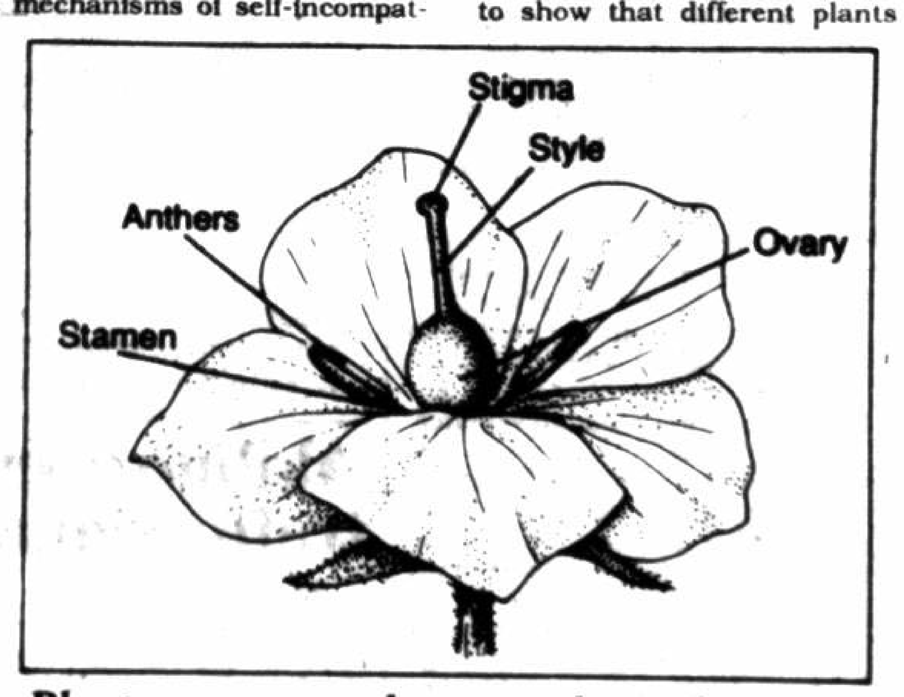
There are so many different s alleles in a plant population that the chance of random encounter between pollen and style carrying the same allele is very unlikely. In addition, forced inbreeding can result in new allele forms evolving. This promotes outbreeding, that is, breeding with other plants.

The question biologists now want to answer is how the protein encoded by the s gene inhibits the growth of similar pollen. Biologists know that plants secrete the s protein into the extracellular matrix that fills the spaces between cells in the style, but they do not know how it acts to stop the pollen dead in its tracks.

Possibly, the s gene undergoes cutting and rearrangement that leads to two different messenger RNAs being produced, one specifying the protein in the pollen, the other the protein in the style.

In pollen, the s protein does not appear to be secreted outside the cells, as it is in the style, suggesting that the two are different. Alternatively, the same protein could be manufactured from the same messenger RNA at both sites, but modified in structure later, giving rise to two different proteins rather than on.

—Sarah Guthrie.



Plants possess male parts, the anthers, and female parts, the stigma and style