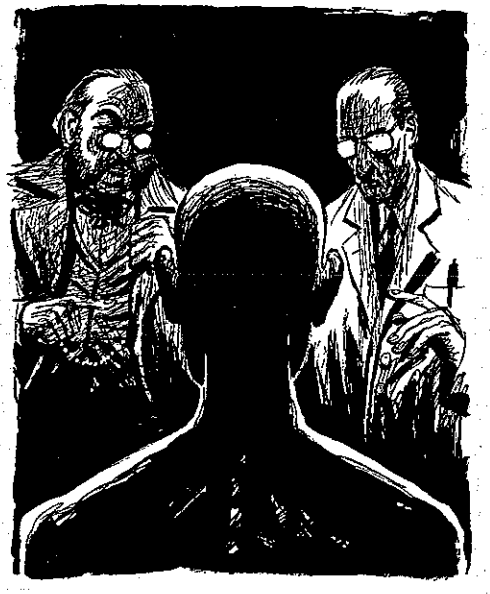
what the eugenicists referred to as feeblemindedness, as it appears to get worse across the generations. The gene that causes it lies on the X chromosome, and so it is more of a problem in men (who have only one X chromosome) than in women (who have a second X, usually unimpaired, to carry part of the load). In this case the repeated word is CGG, and it can be repeated thousands of times—enough to affect the chromosome's structure, hence the name.

Studies of fragile-X demonstrated the link between triplet repeats and anticipation. The severity of the disease is proportional to the amount of repetition. For reasons yet unknown, the repetitions grow longer from generation to generation. Once the repeat site takes it into its head to start growing, it often continues to do so.

Once is happenstance; twice is coincidence; three times is enemy action. In 1992 a third triplet repeat turned out to be the cause of myotonic dystrophy, a common form of muscular dystrophy and another disease which shows anticipation. Geneticists decided the triplets were a real



threat, and began to seek them out.

They sought, and they found. Huntington's chorea, another neurological problem, also shows anticipation. When, in March 1993, researchers claimed to have discovered the gene responsible, they fingered a huge triplet repeat. A second triplet-induced fragile site has been found on the X chromosome. Type-1 spinocerebellar ataxia (SCA-1), yet another nervous disease that seems to show anticipation, is caused by a triplet expansion—and according to Huda Zoghbi, at Baylor College of Medicine in Houston, one of those who proved it, so is a second form of SCA and another neurological problem known as Machado-Joseph disease. Christopher Ross, of Johns Hopkins University in Baltimore, suggests that triplet-repeat expansions might be involved in the most widespread of all mental disorders: bipolar disease (manic depression and allied illnesses) and schizophrenia, which both show some evidence of genetic transmission and anticipation.

No one yet knows why the triplet repeats seem to cause nervous disease rather than anything else, nor how they come about. One idea was that the repeats are made when eggs and sperm are created. This turned out to be wrong. The same repeat may be found at different lengths in the same person, so repetitions can be added long after the egg-and-sperm stage. Nor is the enzyme which copies DNA in normal cell division at fault. There is plenty of room for triplet-repeat research to expand.

Virtual computing

Soft machine

IN THE old days—or the 1980s, as those who work in other industries say—the distinction between hardware and software was clear. Hardware was immutable circuitry, carved in silicon or soldered to circuit boards. Software was the programming that told the hardware what to do. In 1984, though, a new chip was born that is now blurring the distinction. It is ushering in an age of legoware—rigid but reconfigurable.

Microprocessors and memory chips are bits of silicon with "gates" on their surface;

March is the cruellest month

WHEN geneticists gather, as they did in Birmingham on August 15th-20th for an international congress, the talk turns to nature and nurture—if not among the scientists themselves, then among everyone looking on. To all but the most extreme in the fraternity, the most interesting aspect of this debate is how particular environments affect particular genes. Schizophrenia may provide a case in point.

Schizophrenia affects about one in 100, and it is fatal in about 10% of cases: the sufferer commits suicide. Environmentalists argue that it is too common to be genetic; if a gene caused it, natural selection would have all but eliminated it years ago. There are links between schizophrenia and social deprivation that environmentalists can look to for support.

Yet there is also medical evidence that schizophrenia runs in families. And some studies show that abnormalities in the brain which seem to be associated with the disease are often present early on in life—indeed, at birth. If the environment is having an effect, it is doing so early on.

Robin Murray of the Institute of Psychiatry in London and Eadbhard O'Callaghan of the Cluain Mhuire Family Centre in Dublin think they have caught the environment in the act. In the northern hemisphere, people born in March are 15% more likely than average to suffer from schizophrenia; this suggests that something is happening in winter. Dr Murray and Dr O'Callaghan believe that the something is influenza. Following up a study which showed that the 1957 epidemic of Asian flu in Helsinki was associated with a rise in schizophrenia, they correlated the birthdays of 15,000 English schizophrenics with the ferocity of the previous winter's epidemic, as measured by the number of people who died in it. The worse the epidemic, the more schizophrenics turned up.

Dr Murray and Dr O'Callaghan do not believe that all schizophrenia is linked to flu, or that the virus causes the problem directly. Viruses cannot cross the placenta, and so cannot infect the fetus. Antibodies, however, can get across, and can reach the fetal brain. The barrier that shields adult brains from hostile chemicals is not yet fully developed in a few-month-old fetus.

The scientists' best guess is that a protein in the pyramidal cells of the fetal hippocampus (the part of the brain that seems most affected in schizophrenics) looks, to the antibody, similar to one in the virus. That may lead the mother's antibodies to attack the fetal cells. The researchers have evidence to support their idea. Peter Lang of Nottingham University has found that the antibodies rabbits make against flu react strongly with protein from the hippocampus.

Still, genetics has a role. The nature of the antibody and the hippocampal protein will depend on the genes that describe them—some antibodies or some proteins may be more likely to go in for this sort of self-inflicted damage. If Dr Murray and Dr O'Callaghan are right, that may go some way to explaining why schizophrenia persists. The advantage of being able to deal effectively with potentially lethal viruses outweighs the cost of having the occasional schizophrenic child. It also may explain why schizophrenia runs in families, but only manifests itself intermittently. It requires a malicious collaboration of genes and environment to bring it out of the closet.

the gates perform logical functions, like adding data together. The memory chips and microprocessors in a computer are linked to each other and the outside world by logic circuits composed of more gates. This logic used to be made up of lots of small packages—"jellybean logic". As machines became more complex, that became increasingly impractical. Much better to put all your logic on a chip, too. Unfortunately, chips are affordable only when mass-produced—and the whole point of logic circuits is that they differ from product to product.

The first solution to this problem was the application-specific integrated circuit (ASIC). Chipmakers like LSI Logic mass produce semi-finished ASICs, arrays of gates that are not connected. Then they customise the ASIC for particular applications by spraying on a pattern of metal connections. Unfortunately, these ASICs have a drawback. The first batch often fails to work as the designers hoped. The second may well disappoint, too. Going through the cycle three times, as frequently happens, means reworkings at the chipmaker and slippages of weeks or months in production.

The field-programmable gate array (FPGA) was developed to speed things up—but it has done more than that. Instead of having no connections between its gates, it has a huge number of connections or potential connections, depending on the technology. The connections can be made or broken by any programmer with the right tools—they do not have to be made by the company making the arrays. So unique logic chips can be made by their developers without any need for metal and masking. This means prototypes can be made quickly, tested and amended. But the FPGAs are used not just for prototypes; they can also be used for small production runs.

In all branches of the electronics industry other than the mass market, the use of FPGAs is taking off—despite the fact that they still cost ten times as much as ASICs. In 1992, FPGAs were the fastest growing part of the semiconductor industry, increasing output by 40%, compared with 10% for chips overall. Among chipmakers, the FPGA market-leader, Xilinx, is second only to Intel in net income as a percentage of revenue (12.5%, against 13.4%). Other FPGA companies in Silicon Valley, such as Actel, which is about to go public, are similarly profitable.

Chip of all trades

With 90% of the $3.5 billion gate-array market still unconquered, the FPGA makers are devoting most of their resources to reducing costs. Cheaper FPGAs may become attractive for high-volume buyers in consumer electronics, and higher volumes will mean better prices from the suppliers. By 1997 Xilinx hopes to be selling FPGAs at just three times the price of ASICs (partly because it expects the price of ASICs to rise). Eventually, it foresees 60% of the ASIC market falling within its reach.

However the real promise of the FPGA lies not in an existing market, but in a brand new one. Microprocessors are general-purpose chips, which can run programmes designed to do all sorts of different things. If you want to do only one thing, you may be better off with a specialised chip. A chip designed for a single application—for example, finding a certain pattern in data—may do its job as well as a supercomputer.

The FPGA allows the logic circuits in a machine to be reconfigured to the job at hand, and can thus offer a new mixture of performance and versatility. Scientists at the Supercomputing Research Centre in Maryland have used FPGAs to achieve supercomputer performance at workstation prices. Their system was designed to optimise the speed of a programme which searches DNA databases—but with a touch of reconfiguration it can be used for text searches and image processing. In France, researchers at Digital Equipment Corporation's Paris laboratory have built a workstation-like machine that can run ten different applications drawn from a wide variety of fields at supercomputer speeds.

Meanwhile back in Silicon Valley, fleet-footed entrepreneurs have done what they always do. They have coined a buzzword—"virtual computing" (because the software shapes the hardware into a machine that was never really made)—and set out to make money. Quickturn Design Systems is using Xilinx chips by the bucketful to make hardware emulators—machines that allow chip designers to verify their designs. The designers make virtual computers that can take on the shape of new microprocessors.

Until recently new designs were checked with the help of software designed to mimic them. This is slow and clumsy. Also, it allowed processors containing errors (such as an early version of Intel's 486, which could not multiply correctly) to escape on to the market. The 486's successor, the Pentium, was designed with a Quickturn emulator, trimming months from the development cycle. The other big makers of microprocessors also use Quickturn systems.

The market for hardware emulators will probably never amount to more than a few hundred million dollars. But it is a start, and by getting computer designers used to the idea of virtual computing it will undoubtedly spark some new ideas. In the distant future—or the next decade, as those outside the industry say—the virtual computer and its legoware guts could go far. ■

Drawing a blank

THE paperless office is not a dream, it is a joke. Today more gadgets are devoted to spattering more paper with more ink than ever before. At last a Japanese manufacturer of office equipment, Ricoh, is trying to reverse the trend. It has developed a machine that takes in printed paper and spits out clean white sheets. The age of the recycling non-violent shredder may be about to dawn.

Most photocopiers, laser printers and plain-paper fax machines make their marks with a black powder, known as toner, which is melted on to the surface of the paper. The new machine sprays on a chemical to loosen the toner's grip, applies a little heat and then uses a sticky roller to peel the toner off.



Using this technology, a single sheet of paper can be recycled 10 or 20 times, depending on its durability. And as well as eliminating bins full of waste paper, the machine could silence the shredder. Anyone concerned about secrecy could erase his message rather than reduce it to tangles of shredded paper. The result would not fool the experts in a forensic laboratory, but it might well suffice for low-level security.

More work is required. The prototype cleans only three pages a minute. Ricoh has yet to show it can make erasing old paper cheaper than buying new. And only the toner is removed: the machine cannot wipe out marks made by dot matrix printers or thermal-paper fax machines. Pen strokes and impressions made with ordinary printing presses are also immune. This means that text or figures produced with a laser printer could be altered, but letterheads and signatures on the same piece of paper would be left intact. Just what the doctorer ordered.

follow "a convention" that is "purely functional" allowing "no opportunity for variation," she added.

Non-representational Images vs. Simple Shapes

The court of appeals also discounted the suggestion at oral argument by counsel for the Register that Atari's resort to non-representational images for the ball, the paddle and the wall in Breakout shows a lack of creativity.

> [Text] Abstract representation, however, is neither an "obvious" nor an "inevitable" choice. Nor is the coordination of a *square* "ball" and a rectangular *shrinking* paddle a "time-honored" or "conventional" combination. The same may be said of the choice of colors (not the solid red, brown, or white of most brick walls), the placement and design of the scores, the changes in speed, the use of sounds, and the synchronized graphics and sounds which accompany the ball's bounces behind the wall.
>
> We do not in any way question the Register's position that "simple geometric shapes and coloring alone are *per se* not copyrightable." * * * Nor do we hold that all video games are *per se* copyrightable. * * * We are mindful, however, of the teaching of *Feist* that "[t]he vast majority of works make the [copyright] grade quite easily." * * * It is not the Register's task to shape the protection threshold or rachet it up beyond the "minimal creative spark required by the Copyright Act and the Constitution." [End Text]

The court of appeals, concluding that it could find no "rational basis" for the Register's finding, held that the rejection of Breakout was unreasonable when measured against "extremely low" level of creativity required for copyrightability under *Feist*. "It is the Register's duty, as it is ours, to heed the unifying and clarifying instruction furnished by the Supreme Court in *Feist*," Judge Ginsburg admonished.

The judgment was accordingly reversed, and the case was remanded to the district court with instructions "to again return the matter of Atari's application to the Register for renewed consideration consistent with this court's opinion."

Patents

FEDERAL CIRCUIT WILL HEAR IN RE ALAPPAT CASE EN BANC

The U.S. Court of Appeals for the Federal Circuit will consider en banc whether means-plus-function claims may be treated as indistinguishable from method claims for statutory subject matter determinations, despite the requirement in 35 USC 112 ¶6 that such claims be examined in light of disclosed structures. In a Nov. 10 order, the court granted the request for the en banc hearing, bypassing the traditional three-judge panel consideration of the case appealed from the Board of Patent Appeals and Interferences. (*In re Alappat*, CA FC, No. 1381, 11/10/92)

Background

Alappat applied for a patent entitled "Raster Scan Waveform Display Rasterizer with Pixel Intensity Gradation." A raterizer is an electrical device that converts waveform magnitude data into an array of intensity data for use in creating a smooth waveform display.

Claim 15 is directed to a "rasterizer for converting vectors in a data list representing sample magnitudes of an input waveform into anti-aliased pixel illumination intensity data to be displayed on a display means." The claim recites means for determining a vertical distance between vectors, for determining an elevation in a row of pixels, for normalizing the vertical distance and elevation, and for outputting the data as a function of the normalized vertical distance and elevation.

The examiner rejected the claim as consisting of a non-statutory mathematical algorithm, but a three-member panel of the Board of Patent Appeals and Interferences reversed. The examiner moved for reconsideration, and the original panel was expanded to include former Commissioner Manbeck, Deputy Commissioner Comer, Assistant Commissioner Samuels, Chairman Serota, and Vice Chairman Calvert.

On April 22, 1992, the expanded Board held that means-plus-function claims may be treated as indistinguishable from method claims for statutory subject matter determinations, despite the requirement in 35 USC 112 ¶6 that such claims be examined in light of disclosed structures. See 23 USPQ2d 1340 (Bd PatApp &Inter 1992), 44 PTCJ 69. Refusing to read into the claim structures recited in the specification, the Board concluded that a "means for" claim for a rasterizer should be treated as a method which recites a non-statutory mathematical algorithm that reads on no specific apparatus. The three Board members who sat on the original panel wrote a dissent, arguing that *Arrhythmia Research Technology Inc. v. Corazonix Corp.*, 958 F2d 1053, 22 USPQ2d 1033 (CA FC 1992), 43 PTCJ 429, requires that the statutory nature of a "means for" claim be determined with reference to the description in the patent specification.

The events surrounding the Board decision in this case and the prior decision of *In re Akamatsu*, 22 USPQ2d 1950 (Bd PatApp&Inter 1992), 44 PTCJ 53, prompted 33 examiners-in-chief to sign a letter addressed to former Commissioner of Patents and Trademarks Harry Manbeck expressing concern over interference with Board decisionmaking. The letter complained of "an increasing number of instances" in which the composition of Board panels "has been manipulated in a manner which interferes with the decisional independence of the Board and gives the appearance that a predetermined or pre-decided outcome has been reached in cases appealed under 35 USC 134." Former Commissioner Manbeck responded with a letter of his own dated April 29, justifying his actions with regard to the Board. See 44 PTCJ 33, 43. In August, the Patent and Trademark Office requested public comments on the relationship between the commissioner and the PTO appellate boards. See 44 PTCJ 325, 352. A public hearing on the issue is scheduled for Dec. 1. See 57 FR 47044; 44 PTCJ 640.

Federal Circuit Appeal and En Banc Hearing

Alappat appealed the Board's decision to the Federal Circuit, but did not challenge the procedure that

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