An introduction to Archive Materials

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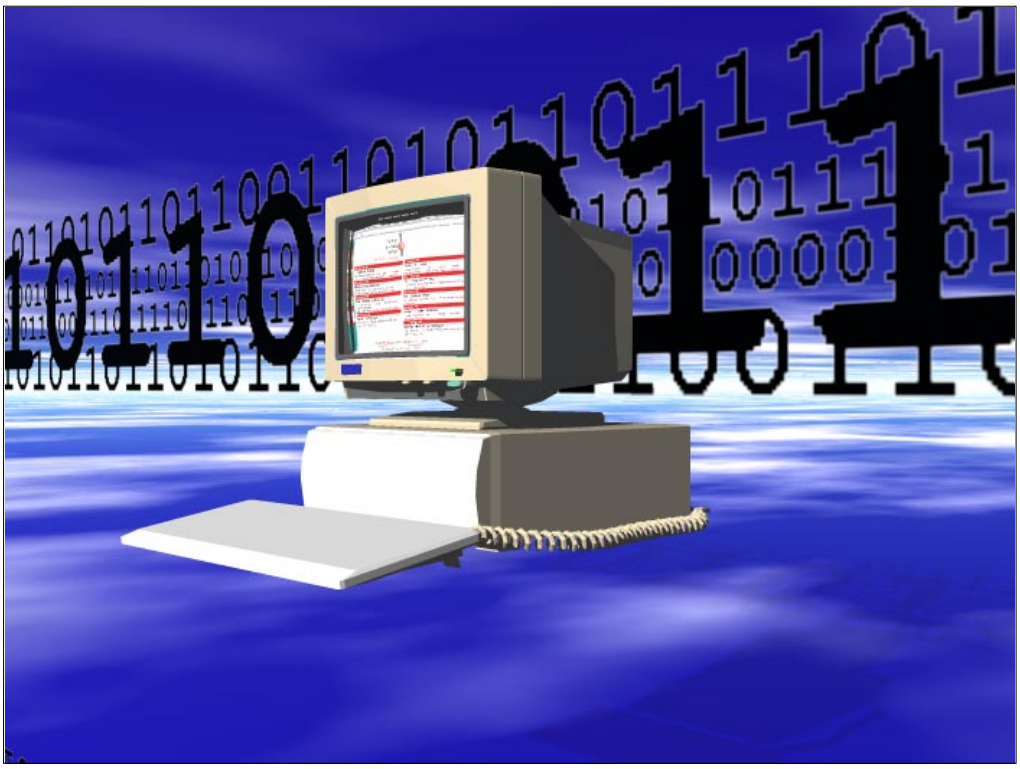
The National Archives

AN INTRODUCTION TO NEW MEDIA



The Public Record Office is very grateful to Jonathan Farley, of the Royal Botanical Gardens, Kew, the author of this pamphlet, for permission to publish it in the series of Introduction to Archival Materials

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INTRODUCTION

Increasingly, modern technology is becoming a part of our everyday lives. More and more we are relying on machinery to store the information we wish to keep as a permanent record, whether at home, office, or even in historic repositories. The methods by which this information is stored is termed New Media.

New Media is defined as an information system which requires a machine interface to interpret the stored data. Unlike Old Media, in the form of books, New Media can not be read by mankind without the assistance of a machine. Photographically based information systems such as microfilm and microfiche are not New Media since the information that is stored may be retrieved by examination through a good lens, whereas the data on a CD or floppy disk must have the appropriate player to recover the data.

New Media did not just happen as a by-product of the computer age as many believe. The computer was an evolutionary step required by the development of the data forms which originally relied on bulky mechanisms as their interface. Improved engineering skills ensured that machines could be made more accurately, and therefore it was possible to reduce size. This meant faster and more reliable mechanisms were possible. The coming of electronics as a replacement to high precision mechanics was inevitable, and with the increasing miniaturisation of the mechanisms, it became essential that the information stores underwent an equal force for miniaturisation.

None of the first computer designers would have dreamed that the mechanisms we take today for granted would become so small, and that every household would own one, whether a processor as part of a washing machine, TV or some other information age gadget. Yet to us now it seems incredible that the average desktop computer is over 2 million times more powerful than the system which landed man on the moon, and that required a complete office block at Kennedy Space Centre to house.

Data carriers on the other hand did undergo such fantasy. From the outset of the information age, miniaturisation was underway. The 78 rpm record gave way to the 33 rpm and the 45 rpm. The reel to reel tape gave way to the mini-cassette and the micro-cassette. The trend in data carriers had already been set. In 1966, the Star Trek episode called Court Martial displayed a floppy disk styled data store eight years before the first floppy disk was prototyped by David Ahl of the Digital Corporation, yet the computer that operated it was still ship sized.

The problem remains that the smaller the data carrier size, the more seemingly insignificant factors will affect them. A grain of pollen will have little effect on a book or a 78 rpm record, but that same grain of pollen may destroy a floppy disk. Of equal importance is the fact that the more miniaturised a data store is, the more removed from the data humans become and consequently the more reliant we are upon the machine interface, and there are a bewilderingly large number of interfaces and data stores.

PAPER CARRIERS

Paper has been used for a variety of New Media formats, most of these are as punched paper and card systems. There have however been a few experimental mechanisms, though these were mostly unreliable, and are consequently fairly rare.

Punched Systems 1500s Onwards

The first punched system was created to operate a musical carillon in Germany, and is believed to have been manufactured sometime in the 1500s. It consisted of a series of punched cards which were fed into the mechanism to operate the notes.

The system was later adopted and developed by the French entrepreneur Jacquard who in 1801 invented the first mechanically controlled weaving loom. The consequence of this was that the weaving industry ceased to be a home industry monopolised by artisans, and became a factory industry producing machine runs of standard designs, the machines themselves no longer requiring such a high degree of training and experience to operate. In addition to this, a second profession started, that of pattern designers. Jacquard loom patterns (or programmes) were the first commercially marketed form of the New Media, although the pattern designers are not generally credited as being programmers. Being the first programmer is an honour reserved for Ada, Countess Lovelace (daughter of Lord Byron), who in 1835 wrote the original programmes for Charles Babbage's Analytical Machine, a punched card mechanism which is considered to be the first computer.

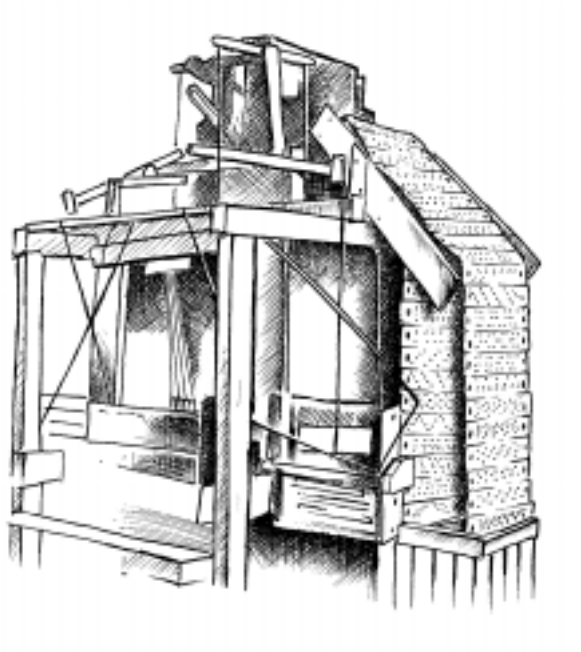

Figure 1 - Jacquard Loom

Following the success of Jacquard, punched systems became popular for many forms of repetitive operation. The most common was the fairground organ, which to many people in the less accessible regions of the world provided the only form of musical entertainment without the necessity of travelling for miles. Between the end of the 19th century, and through the first half of the 20th, fairground organ recitals were common place during the harvest season. The punched system used by the organs gave rise to the player piano, which allowed mechanical music to come to the home. The most popular player pianos were the Aeolean 88 note, and the Duo-arte, and it was the latter of these two systems that enabled Percy Grainger to give a performance of Grieg's piano concerto at the Last Night of the Proms in 1981, seventy years after his death.

Figure 2 - Ada, Countess Lovelace


Grand
Organ · Recital
THE HEATH, KNUTSFORD.
Sunday Evening, May 3rd,
PROGRAMME. SIXPENCE.

Figure 3 - Fairground Organ Programme

The first time that a punched card system was used in conjunction with an electrical circuit was in 1857, when Charles Wheatstone introduced the paper tape as a medium for the preparation, storage and transmission of data, in this case telegraphic Morse Code. The paper tape used two holes to represent Morse's dots and dashes. Outgoing messages could be prepared in advance and transmitted later. By 1858 the Morse paper tape system could transmit on average 100 words a minute.

In 1890, a system was designed by Herman Hollerith to collate and tabulate information from the 1890 US Census. The Tabulating machine could process 9,000 schedules (punched cards) in a day. The proceeds of the census tabulation machine rentals (Hollerith did not sell his equipment), enabled Hollerith to found the Tabulating Machine Company, which was later renamed International Business Machines (IBM).

Figure 4 - Wheatstone Tape

In the printing industry, punched paper was used to control early mechanical typesetting machines such as Monotype and Lineotype systems, and eventually punched entry was adopted for the input of information into the first commercially manufactured and sold computers such as the IBM Model 360. Each of these were produced by enhancements to Wheatstone's original Morse tape system, and in some areas are still being used today.

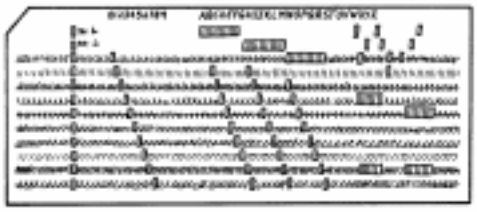

Figure 5 - IBM 360 Punched Card

Figure 6 - IBM 360 Punched Tape

Magnetic Paper Carriers 1938

The first magnetic recording systems actually used paper as their backing. The systems were so fragile that very few of them exist today. However the descendant of one magnetic paper carrier does still exist. One of the first attempts at enabling a computer to understand text (Character recognition) required the development of a system which was understandable to humans by sight, and also to machines. Since in the 1960s and 1970s, optical character recognition was a far off dream, a simpler approach was taken. A special font was devised that allowed a machine to read it magnetically through oxide particles added to the printing ink. This font is still used today on the bottom of cheques, although recognition is now mostly optical.

Paper groove system 1920 - 1976

In the early 1920s a dictation system was devised which recorded speech on to a moving paper tape in the form of a record groove. The system was temperamental, the paper tape snapped easily, and if creased, the data was erased. This did not stop the mechanism seeing a resurgence as a children's toy in the 1970s. Replay was made possible by pulling the strip through a slit cut into the side of a cereal packet. Recordings were given away regularly with many children's comics.

GROOVE-SYSTEMS

The Phonograph

The official date of the invention of the Phonograph by Thomas Alva Edison is July 18 1877 when it was demonstrated to the public at the offices of *Scientific American*. The initial recordings were on foil covered cylinders**,** which allowed only a few playbacks before there was a significant loss of quality. In 1885, Chichester A. Bell, (a relative of Alexander Graham Bell**)** and Sumner Tainter applied for a patent on what they called the Gramophone a machine similar to the Phonograph with the exception that the cylinder was of wax coated cardboard. This had an improved sound quality, and was more durable for repetitive playing. This competition pushed Edison into further development, the result being a phonograph with a solid wax cylinder which was more stable and durable than wax covered cardboard. Although the initial launch of the Phonograph was greeted by a lack of interest, as the continuing development of the wax cylinder produced more long-lasting recordings and a better sound quality, interest picked up and by 1890 the first commercial Phonograph machines were on sale. The necessity however for cylinders to be recorded individually restricted the commercial success of the invention as a recording medium. Its main success appeared to be as a dictation machine in offices and wealthy homes and many dictation cylinders exist to this day. Edison continued to work on the wax cylinder making many improvements until production ceased in favour of other media in 1929.

Figure 7 - Edison Phonograph

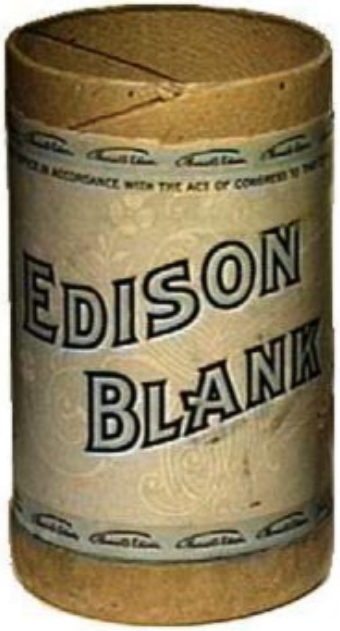

Figure 8 - Dictation Cylinder

The record

It was never really possible to make commercial recordings on the cylinder format. Recording sessions required vast banks of machines all making a recording on to one cylinder. There was no possibility of editing the recordings which resulted in vast wastage should a recording session go wrong. This problem was overcome by Emile Berliner in 1887 who devised a machine which would record on a disc. His approach involved recording on a lampblack covered surface. The impressions were fixed by an application of varnish and then photoengraved on to metal, from which multiple impressions, or pressings could be made. Berliner later changed this method to recording

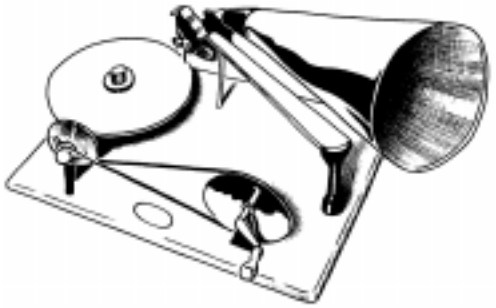

Figure 9 - The Berliner Record Player

on a disc of grease covered zinc. After recording, the disc was dipped into nitric acid, and the resulting etching transferred to the metal below. The first mass manufacturing method for sound recordings was born.

The first Berliner discs were manufactured out of vulcanised rubber, called Vulcanite, which, although advertised as 'indestructible' were found to flatten out and lose their impression. In 1897 shellac was introduced. Shellac, made from the excretions of the lac insect had the appropriate moulding qualities, and sufficient durability to allow multiple playing. Although many discs of the period are referred to as being shellac, shellac was merely the binding agent for a mixture of compounds containing limestone or slate (which gave the record its required hardness), pigment such as carbon black, lubricants such as zinc stearate, binders and modifiers such as Congo Gum and Vinsol. In 1900, the first wax disc was introduced . The wax gave an improvement in sound quality and also had a less noticeable background hiss.

As more manufacturers entered the sound recording market, each vied for the dominant position as sole supplier, resulting in a lack of standardisation. Each disc manufacturer produced recordings to their own standard, each requiring replay mechanisms (sold only by the same manufacturer). The original Berliner disc played at 70 rpm, other speeds between 74 and 82 rpm were common. Pathé recorded at 90 rpm. The variations in recording speed meant that the speed and pitch of original recordings were significantly altered when disks were not played on the devices for which they were intended. As electric motors were introduced, speeds began to be adopted by manufacturers as standard. This was due mostly to the indipendance of the manufacturers, and the cost of the equipment.

In 1927, the first video disk was produced as part of John Logie Baird's television system. The Baird Phonovision recorded the image onto a standard 78 rpm record in groove format. The record, which was played on a standard gramophone connected to a Baird television was only possible because of the low bandwidth of the mechanical television.

In 1948, with the introduction of materials which could contain more compact sound grooves, the long player record was introduced by Columbia. The speed of $33^{1}/_{3}$ was chosen since this speed was in use by several cinematic sound processes. A $33^{1}/_{3}$ record would last the same time as one reel of film and provided the necessary sound quality. Whereas a 78 rpm record could achieve at best 125 lines per inch, the Columbia "Micro-groove" could achieve between 250 and 400 lines per inch. This was due to the improved materials for record making, in this case polymerised vinyl chloride. As with the shellac record, vinyl was not the sole component of the long playing record, most consisted of polymerised vinyl chloride, plasticiser (polyvinyl acetate), filler, pigment, stabilisers and anti static substances.

Long playing records became popular for several reasons, firstly, the longer playing time fitted musical units of length more appropriately. On a long playing record, the Brahms Horn Trio requires one side of a disc, whereas on 78 rpm, the same work required 8 discs and required three side changes in the first movement. The vinyl discs had a better sound quality, and a greater frequency response and dynamic range than the 78 rpm discs, and in addition to which, the vinyl did not shatter as did the shellac.

In 1950, RCA Victor introduced the 45 rpm Extended Play disc as a counter measure to Columbia's LP. Early 45s were made of vinyl, however as the market improved and the medium gained popularity, polystyrene was introduced which was capable of being injection moulded at a higher speed than vinyl. 45s were never used as a serious format for 10 inch extended play format recordings, only becoming popular in their smaller 7 inch form as the "pop single" being capable of taking one popular song per side or two per side in the 7 inch EP format.

In 1970, Decca prototyped a groove monochrome television disc. By 1973, AEG Telefunken had joined Decca to produce an enhanced system which would provide ten minutes of colour images. In 1974, the system was formerly launched as TelDec, with a six disc autochanger which would give a total playing time of one hour. Although the system had a high picture quality, sales were not very good. In 1975, it was relaunched as TeD, with stereo sound, after which nothing more is published about the system. In 1978 Panasonic demonstrated another groove video system called Visc which could produce one hour of colour video per side of a 12 inch vinyl record. Visc was never officially released as Panasonic's partner had by the same time developed the far superior Selectavision system.

Figure 10 - Seven, Ten and Twelve inch Groove Records

By 1988, the sound retail industry had moved to newer formats and the last commercial wholesaler announced they would no longer stock records in their shops. LPs continued as a specialist market for a further year, but by the beginning of the 1990s the industry for the manufacture of analogue groove recordings was officially recognised as dead. Records are still being widely produced, however the quantity of production and the rarity of public availability make this a "Cult" market.

CAPACITATIVE RECORDING SYSTEMS (THE SUPER-RECORD)

Capacitative recording systems stored the information as variations of electrical capacitance on a medium that became part of an electrical circuit. In both of the mechanisms that used this system, this information was recorded in disc form. The capacitance depended on the thickness of an insulating top layer, allowing the discs to be easily manufactured. Replay was by applying a stylus to these surfaces to read the variations.

In 1978, the first super-record was demonstrated by JVC, it was originally intended to be a cross-platform format for both audio, the AHD (Audio High Density) and Video, the VHD (Video High Density). There were no grooves in this system as the stylus followed the tracks of capacitance electronically. Although demonstrated in 1978, the VHD/AHD system was not released until 1983, was only sold in Japan, and disappeared without trace, although rumour persists that some Karaoke machines use AHD disk technology.

Figure 11 - AHD Player

RCA's Selectavision (1983) used vinyl discs which were read using a sapphire stylus. The grooves were 38 times finer than those of standard LPs, and to prevent wear, the disks had to be lubricated, which meant that the disks themselves had to be encased in a special caddie, much as floppy disks are today. Despite being launched world-wide with a large catalogue of available discs for such a new format (over 300 were available), the format was suddenly withdrawn in 1984, one month after RCA had given assurances that the format would receive continuing support.

Figure 12 - Selectavision Record

MAGNETIC SYSTEMS

Magnetic Tape

Magnetic sound recording was first demonstrated by Vlademir Poulsen in 1899. In Poulsen's system, sound was recorded onto a steel wire which moved past the recording mechanism at seven feet per second. The device was called a Telegraphone. Following its introduction, several enhancements were made to the magnetic recording technology, none of which significantly increased interest in the mechanism. In 1912, Dr Lee De Forest, inventor of the vacuum-tube amplifier, added one to the Telegraphone system. In 1921, W L Carldon and G W Carpenter, developed the concept of alternating current bias, which is essential for high quality magnetic recording.

Kurt Stille in Germany (1926) worked on a method of sound recording onto steel bands with some success. The system was used in the broadcasting industry, but the recording machinery was large in size, and the reels of steel bands were heavy to carry. Another German, by the name of Pfleumer originated a method of recording onto magnetic coatings applied to plastic film, (his earlier attempts involved coatings applied to paper tape, see Paper Carriers). In 1931, Allgemeine Elektrizitas-Gesellschaft took over the idea, and on November 19 1936, was able to make the first tape recording of a symphony orchestra. The first broadcast quality recording devices began to appear in 1953.

Until the end of World War II, America was unaware of the development in Germany of plastic tape recording, and between 1945 and 1955, the main magnetic recording devices in America were for the amateur market, and were still based on wire, and there are many recordings in this format still in existence. After 1955, plastic tape largely replaced wire because of its better sound quality. Except for the inclusion of sound enhancing systems such as Dolby - b, Dolby - c and Dbx, and the development of more compact and less damageable formats, the practical mechanics of magnetic recording remain unchanged.

Audio magnetic tape recordings have been marketed in many forms since commercial tape manufacture began. Reel to reel tape existed in ten inch, eight inch, seven inch and three inch versions, which could be recorded at several different speeds. The professional 4, 8, 16 and 32 track recording systems used a wider tape format than that provided to the home market, allowing for a higher quality recording, for broadcast work and mastering records. Following the reel to reel, the Audio cassette was introduced by the Dutch Philips company in 1968, although general acceptance of the new media was not established until 1973. Another variation introduced was the micro-cassette, and although Stanley Kubrick's film *A Clockwork Orange* (1971) promoted this new technology as the direction for home and professional recording by showing a Deutsche

Figure 13 - Mini, Micro and Audio Cassettes

Gramophon recording of Beethoven's 9th Symphony on micro-cassette, the technology only became accepted as standard for dictation machines, where both rim-drive and hub-drive mechanisms exist. Cartridge tape (otherwise known as "Eight Track") systems were introduced in the early 1970s, however the inability to record on to tape, without purchasing expensive equipment reduced the format to that of a luxury in-car stereo system which collapsed in favour of the cassette tape.

Figure 14 - DAT Cassette

All audio recording was in analogue form until 1992 when the digital audio tape (DAT) was introduced. Although this format has found a niche which has ensured its existence, this niche was not in the market for which it was originally intended. The introductory cost of DAT recording equipment was extremely high in relation to its competition. This combined with a sound quality which was not immediately apparent to the home buyer killed DAT as a home recording technology. DAT as an audio medium is almost exclusively used today in the professional broadcast arena, and not to any great extent due to the advent of the recordable compact disk. The main application for DAT today, is as a medium for computer back up, both at home and for mainframe systems.

Video tape recording has also seen many formats since it was introduced to the public in 1951 by Bing Crosby Enterprises. Due to lack of popular support, a lack of reliability, and equipment cost however, the early video formats had a brief existence. Some of the early formats include; Ampex Quadruplex (1956), Ampex signature 1 (1963), Sony CV (1965), Umatic (1971), Philips VCR (1972), RCA Selectavision Magtape (1973), Cartivision (1975), Panasonic Omnivision 1 (1975), Akai VT-120 (1976), Quasar VX (1976), Funai CVC (1984). The most common of these formats was the Philips VCR. During the 1970s, VCR was continually developed, being later re-issued as VCR-LP and SVR. In 1980, Philips issued their final version of this format, the Video 2000. The Video 2000 was the only video format which allowed its tapes to be turned over, like an audio cassette. This meant that a V2000 cassette was capable of holding twice as much information as its then closest rivals Betamax and VHS. V2000 was a late entry into the video format competition, and by the time that the recorders had arrived in the shops, VHS had already won the race.

Figure 15 - Betamax, VHS and Video 2000 Cassettes

Betamax is now considered as obsolete by industry, however tapes are still available from specialist shops, and since many people throughout the world continue to use the system, the format can still be regarded as supported. Umatic is used exclusively in the professional broadcast arena, although this is now being replaced by SVHS, HI 8, and DV.

Early computers such as the IBM model 650 onwards used special reel tape for data storage. Since most computers required the ability to read and update their data stores, computer reel tape had to be capable of being positioned by the system to exact point at which the required data began. This was accomplished by providing a looped back position monitoring mechanism, known as a “tracking” system.

Floppy Disk and Hard disks 1964 -

The first portable storage medium dedicated to the computer was the hard disk. This consisted of a metallic disk housed in a plastic carrying tray known to most early computer programmers as the Flying Saucer. The first computer system which used this storage mechanism commercially was the IBM System 3 (1964). The disk was 12 inches in diameter, and later models of the disk contained a swivel handle for convenience of handling. Subsequent hard disks for the most part have been non removable with the exception of the Bernoulli drive (1989), the Zip and the Jazz drives (1995).

Figure 16 - Flying Saucer Hard Disk

The original floppy drive was introduced by David Ahl of the Digital Corporation in 1974. Early floppy disks were 8 inches in diameter, and were housed in flexible vinyl sleeves. These floppy disks were single sided, and could hold a mere 128 kilobytes of information. Since the motors which rotated the disks were erratic, it was impossible to identify at which portion of the disk the read head was positioned on the original systems. To overcome this, the inner hubs of the disks were perforated on the rim to allow an LED to shine through the disk on to a sensor which in turn enabled the computer to count the arc of the disk. This method is known as Hard Sectoring (HS). The only system still in regular use today which still uses 8 inch hard sectored disks is the Compugraphic typesetting machine. When motor speeds became more reliable so that the rotational position could be calculated more accurately, it became necessary only to re-calibrate the motor on every full rotation. The rim holes were therefore reduced to one, signifying the

Figure 17 - Hard and Soft Sectored Eight Inch Floppy Disks

sector zero, this is known as Soft Sectoring (SS). Later 8 inch disks were soft sectored, such as those used in early Wang processors (1979).

At the same time a newer format was being introduced, the 5¼ inch floppy. Early disks were hard sectored, although this was soon replaced by soft sectoring. 5¼ inch and 8 inch disks also became available as Double Sided, which meant that it was possible to record on both sides of the disk, thus doubling the storage capacity of the disk. For early computers, this required physically removing the disk and turning it over, but it was not long before technology caught up and produced the double sided disk drive. In 1981, IBM introduced the PC (Personal Computer). Although this computer was intended by IBM as an upmarket rival to the home computer industry, it was accepted as the business standard, giving small businesses the opportunity to wield the computing power of larger corporations. With the introduction of the IBM PC, the Double Sided, Double Density 5¼ floppy with a storage capacity of 360 kilobytes became recognised as the industry standard, and was not replaced until the introduction of the 3½ inch disk drive which, although created in 1981, did not become standard until 1988 when it was incorporated into the IBM AT computers. The 3½ inch disk was different from its predecessors in that it possessed a hard case made from ABS plastic which rendered the disk fairly inflexible, although it continued to be called a floppy disk. Early disks were capable of containing 720 kilobytes (720 K), while the later high density could contain twice as much data at 1440 kilobytes or 1.44 Megabytes, which is still considered the standard. It is worth mentioning here that although the same disk could be used across many computer platforms, the storage capacity is dependant upon the platform used. The figures mentioned above are IBM capacities. The 1.44 megabyte attainable on the IBM could store 2 Megabytes on an Apple Mackintosh due to the differences in disk formatting. Other computers which are able to use these standard floppy disk formats are the Atari ST, The Commodore Amiga, the Archimedes, The Commodore 64, the Wang, The Amstrad PCW and many more besides.

OPTICAL SYSTEMS

Laser disc

The first optical disk system was conceived in 1958 by Paul Gregg and Keith Johnson of Gauss Electrophysics. In 1967 the capabilities of Gauss were brought to the attention of MCA who in 1968 purchased a controlling share in the company as well as purchasing the patent applications for the Gauss video project. The first pressing of what became known as the MCA DiscoVision was in 1972. The Magnavox Magnavision VH-8000 player for the DiscoVision disc was officially released in 1978 in Atlanta Georgia. Within two hours, all the $700 players were sold out. By 1979 however, only 50 DiscoVision disc titles had been released, most of these being faulty. The failure rate of disk manufacture ran at 70%, and included such defects as machine operator's thumb prints and even insect parts sealed between the data and the reflective layer.

At the same time Philips were developing their own optical system in the Netherlands. Philips had originally been approached by Gauss Electrophysics in 1967, but had turned down the company, only to begin developing their own system based on the Gauss idea. Realising that two independent formats for Laserdisc would result in a format war which might in turn kill both optical systems. Philips and MCA embarked upon a period of co-operation in 1974. This meant that most, (though not all) DiscoVision discs contained both Philips and MCA control coding. Both Philips and MCA Laser disc players were able to play the DiscoVision discs. Unfortunately, the poor quality of the discs produced discouraged the public from accepting the laser disc format. In answer to this, and the fact that MCA had countered the problem by making the playing mechanisms more tolerant of the faulty disks, rather than improve the disc manufacture, Philips started their own disc manufacturing plant, using only their own control coding.

Figure 18 - Disco Vision Player

DiscoVision, no longer wishing to spend more money on the system, closed its manufacturing plants in 1981, although it still exists today as a licensing company. Pioneer purchased Philips' videodisk patents, as well as over $100 million worth of DiscoVision patents, and continued to manufacture Video Discs under the title of the Laserdisc which are still being retailed today. General Motors discs are unplayable on current Laserdisc players because they only contain MCA coding, however all other DiscoVision discs are still playable on modern systems.

The Compact Disc (CD)

The Compact disc owes a great deal of its existence to the Discovision format, and a great many patent royalties are paid to DiscoVision Associates for the privilege of using the technology. The first commercial CD was released in 1981, a record by the Bee Gees, this was Compact Disc - Digital Audio or CD-DA. The compact disc's initial acceptance was slow due to the cost of the early CD players. By 1984 however, the cost of equipment had reduced enough to allow it to become a common high street purchase item. By 1988, the last high street record store in Britain announced that CDs would be the only record medium sold in their outlets.

Figure 19 - CD Audio (top), Photo CD (middle), CD-ROM (bottom

In the same year, the first CD-ROM (Compact Disc - Read Only Memory) was issued. Since the storage of CD-DA was in digital format, it was inevitable that the same media would be used for the storage of computer data. The next development was CD-I (Compact Disc - Interactive). This is a consumer format that used the CD together with a computer to produce a home entertainment system that provides music, video, and ancillary data. CD-I is usable in standard CD players although there is usually one track (the data track) which will not play. This backwards compatibility has allowed the standard to become more easily accepted. Many computer games are now created in CD-I format, which allows the user to play the game while listening to proprietary CD quality music.

Kodak Photo-CD was the most important breakthrough in the CD format. Although the technology was available to store photographic material on CD, the capability to create individual CDs from personal photographs necessitated a means by which to write to a CD after manufacture. To this point, all optical disks had been created by pits pressed into the poly-carbonate structure of the disc by a machine. The Kodak Photo CD included a dye layer to replace the pits, this was burned by a higher powered laser which vaporised the dye at the focus area of the laser to create a bubble fixed permanently in the layer. This type of disc is known as a "WORM" CD, (Write Once Read Many).

In 1996, Philips in collaboration with JVC produced the Video CD, this is a format which allows linear MPEG-Based video material to be recorded on a compact disc in a standard format.

Digital Video Disc (DVD) AKA "Digital Versatile Disc"

The DVD disc is a recent enhancement (1997) of the CD. Initially, the DVD is double sided, this allows both sides of the disc to be used. The technological breakthrough with DVD is that each side has a semitransparent second layer. This allows the laser to focus through the first data layer on to a second data layer as required. The consequence of this is that the DVD disc is able to contain four data layers equivalent to a single CD layer. In addition to this, the enhanced coding system that is used for the DVD allows nearly 2 gigabytes per layer (8 gigabytes per disc) in comparison to the 650 megabytes of a compact disc. This increased capacity means 4 hours of video per DVD, or 16 hours of CD quality music on the same disc. In 1999 Microsoft predicted that by the year 2001, continued manufacture of CD replay systems would have ceased, and that CD replay would only be possible through the backwards compatibility of the DVD drives which will be the main data medium for just about everything.

Finally

Data carriers today are composed of man made materials, whether the data store is a ticker tape, floppy disk, or DVD-ROM. No man made material is impervious to the forces of nature. Deterioration is a certainty, and the speed of this in some cases can not be identified due to the comparative youth of the component materials. Poly-Carbonate for example, used in CDs, was first produced commercially in the 1960s, and its 40 year lifespan is not long enough to evaluate its deterioration potential compared to the 400 year evaluation period of paper. Some CDs have been seen to deteriorate within two years, while others which were manufactured in the early 1980s are in as good a condition now, as they were when made. So even as books should be treated with care and respect, so should all varieties of the New Media.

The quantifiable deterioration of paper ensures that even now, it will remain the most used and accessible information system. Even though electronic stores may become the main repository for accumulated knowledge, it is entirely likely that paper forms will continue to be the first line intermediary between the data systems of the future and the public at large. After all you can't curl up in bed with a nice floppy disk can you?

Glossary

45 RPM	Disc rotation speed of 7 inch singles. Used as a generic term in place of the term “Single”
33 1/3 RPM	Disc Rotation speed of LPs and Eps (both 7 and 10 inch format). Used as a generic term for LPs
78 RPM	Disc rotation speed of shellac and wax groove records. Used as a generic term to cover pre-LP discs.
ABS	Adenozine, Butadiene, Styrene. A polymer mix used for the plastic casings of 3½ inch floppy disks, some audio cassettes and CD jewel box inserts
Aeolean	88 Note Player Piano Format
Analogue	Analogue systems store information by representing magnitudes using physical quantities such as electrical resistance, magnetic amplitude or even a representative physical matrix such as a record groove.
Capacitative	The property of a substance as an electrical conductor and insulator which enables it to store an electrical charge when a potential difference exists between the conductors. The SI unit of capacitance is a farad.
CD	Compact Disc, also known as CD-DA (Compact Disc - Digital Audio)
CD-i	Compact Disc - interactive
CD-ROM	Compact Disc - Read Only Memory
DAT	Digital Audio Tape
Digital	Digital systems represent numerical magnitudes by reducing the information to a numeric quantity, typically mathematical base 2 or Binary, although this is not necessary always the case, octal and hexadecimal have also been used. Digital is the earliest data format as can be seen by the 1500s carillon. Since a single hole operated a single lever to sound a bell tuned to a single frequency, the process is regarded as digital.
DiscoVision	The first Optical Video System
DSDD	Double Sided - Double Density, a floppy disk format.
DSSD	Double Sided - Single Density, a floppy disk format.
Duo-Arte	Player Piano Format
DVD	Digital Video Disc, otherwise known as “Digital Versatile Disc”
EP	Extended Play, a groove record format. Sometimes 10 inch, and sometimes 7 inch disc diameter.
Floppy Disk	A computer storage system usually made from a polymer disc coated with a magnetizable substance.
Hard Disk	A computer storage system usually made from a disc of magnetizable metal, or a metal disc coated with a magnetizable substance.
IBM	International Business Machines.
Jewel Box	The container in which a compact disc is commercially marketed.

Laser Disc	An optical disc format used for storing video information
LP	Long Player, a groove record format. Usually 12 inch diameter discs.
Poly-Carbonate	(PC) The clear plastic base of an optical disc
Morse Code	The original digital data transfer system, whereby every letter of the alphabet was represented by an unmistakable sequence of dots and dashes.
Magnetic System	An information system that stores its data on a magnetizable substrate.
Poly-Ethylene Terephthalate (PET)	Also marketed as Mylar or Dacron. A flexible polymer used today as the standard support backing of magnetic data carriers.
Poly-Styrene	(PS) Clear or coloured polymer used in the manufacture of magnetic tape cases, compact disc jewel boxes etc.
Poly-Vinyl Chloride (PVC)	Used originally as the backing support on magnetic data carriers, but was replaced by Poly-Ethylene Terephthalate. PVC was also used as the main component of Vinyl LPs.
ROM	Read Only Memory, an array of computer memory which can not be written to, only read.
Selectavision	A capacitative video system released by RCA
Single	A groove record format. Usually 7 inch disc diameter.
SSSD	Single Sided - Single Density, a floppy disk format.
Tabulating Machine Company	The original Name for International Business Machines (IBM).
Wheatstone Tape	A punched tape system used for recording and transmitting telegraphic Morse Code

Appendix

Disc or Disk?

Disc is used as the standard spelling for records, Compact Discs etc., while *Disk* is used specifically in terms of magnetic computer media such as The Hard and Floppy Disk. Although spellings vary between the United Kingdom and the United States, one explanation which has been expounded for the acceptance of specific spellings with regard to certain media is that in the early history of the computer, memory was restricted and small, and programme coding had to be compact and economical. Consequently in one early computer operating system, the fixed and removable drives were referred to as Disk and Disc (4 bytes per reference), rather than Disc1 and Disc2 (5 bytes per reference). Although this story is unverifiable, it does sound plausible when you consider that the programming language Forth had the letter u deleted from its name to save memory space, even though the language's creator envisaged it as the 'fourth' generation in programming languages.

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Internet Resources

CED Magic (Capacitance Electronic Discs)
http://www.cedmagic.com/selectavision.html

TOTAL REWIND - the virtual museum of home video technology
http://www.popadom.demon.co.uk/vidhist/index.htm

Discovision
http://www.oz.net/blam/DiscoVision/

Society of Archivists - Film and Sound Group
http://www.pettarchiv.org.uk/fsgmain.htm#MAINPAGE

Many documents on New Media preservation will be found on:

Conservation On Line
http://palimpsest.stanford.edu/

Wessex Film and Sound Archive
http://www.hants.gov.uk/record-office/film.html