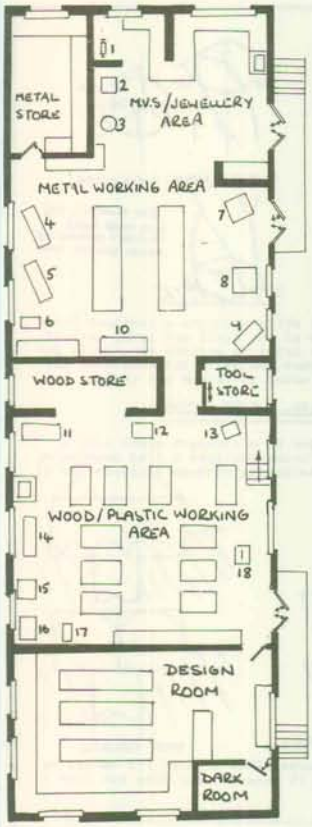
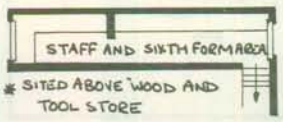
D. Hallam

A-Level Design and Technology at East Barnet School

Layout of Workshops

1 Double ended buffing machine
2 Brazing hearth/forge
3 Crucible furnace
4 Harrison M250 lathe
5 Boxford Industrial 11.30 lathe
6 Pillar Drill
7 Boxford VM30 Vertical Miller
8 Tom Senior Horizontal Miller
9 Boxford Model A lathe
10 Colchester Bantam lathe
11 Boxford Model A lathe
12 Graduate Bowl Turning lathe
13 Pillar Drill
14 Graduate Wood Turning lathe
15 Viceroy Sharp Edge
16 H.U. Miniform vacuum former
17 Startrite Bandshaw
18 Tyzack 10" circular saw





East Barnet School is an 11-18 comprehensive situated on the margin of London's Green Belt. It is a 6 form entry, split site school, with the 1st to 3rd year pupils housed in the Lower School which is approximately one mile away from the Upper School, where the 4th, 5th and 6th year pupils concentrate mainly upon examination subjects.

In 1972 the Technical Studies Department offered non-examination courses in woodwork and metalwork. The arrival of Andrew Breckon as Head of Department in September 1974 was to have an enormous impact on the department and the school. His first task was to make the various groups concerned with the school, the headmaster and senior teachers, the pupils and their parents and the rest of the teaching staff, aware of the potential and educational qualities of a relatively new, design based approach to 'Technical Studies', and the possibility of offering courses suitable for the whole ability range.

With the backing of a forward thinking headmaster and the full support of the Adviser for Art, Craft, Design and Technology for Barnet, Bob Hart (now retired) Andrew was able to offer an

O Level option for the 4th years in Design and Technology (London) in September 1973. He wrote a Mode 3 syllabus for a more practically biased CSE Technical Studies course (East Anglian) to complement the O Level. The technical Studies Department was to be renamed the Design and Technical Studies Department.

Through his persuasiveness in discussion and his tireless efforts in setting up displays and 'selling' the subject, Andrew succeeded in establishing Design and Technology as an important and valuable part of the curriculum that would cater for the needs of the most able as well as the less able pupil.

In 1975 an A Level in Design and Technology (London) was added to the 6th year options and 7 candidates sat the first examination in 1977. The work that was produced by these first candidates at A Level was exhibited at every opportunity to give maximum exposure to pupils, parents and staff, and the interest generated was to ensure the popularity and acceptance of the subject throughout the school.

Andrew was to become Chief Examiner for A Level Design and Technology (London) and left East Barnet in January 1980 to take up the post of Inspector for Craft, Design and Technology for Lincolnshire.

The department continued to make progress and at the moment consists of 5 full time teachers at the Upper School, 4 male and 1 female. The courses currently offered to the 4th year are: –

2 sets O Level Design and Technology (London)
2 sets O Level Graphical Communication (London)
3 sets CSE Technical Studies Mode 3 (E. Anglian) (one set is set aside specifically for girls who specialise in jewellery and light craft. Girls do opt for the O Level course and several have gone on to be very successful at A Level).
2 sets CSE Graphical Communication (E. Anglian)

These groups obviously follow on to the 5th year and in the 6th year the following courses are offered:

Lower and Upper Sixth
A Level Design and Technology (London)
A Level Graphical Communication (London)
One year courses
O Level Design and Technology (London)
O Level Graphical Communication (London)
CSE Motor Vehicle Studies (E. Anglian)
CSE Jewellery (London Regional)

The department is based in a small converted gymnasium with one large room in the main school building used exclusively for the teaching of Graphics. Recent additions of equipment have been a welcome bonus but with large numbers of A Level Candidates, the need for more specialised equipment is always a problem. The layout of the workshops, has however led to the development of a teaching method that has proved to be extremely successful and enjoyable. Up to four groups may be timetabled in the workshops during any one period. The Design room may be used for theory or design lessons and the constant contact of staff in the department ensures that the room requirements are planned well in advance. The setting of open design briefs means that pupils will produce solutions in the material that they consider is suitable, and will subsequently spread out into the main wood/plastic

Above: Wood/plastics working area. Note staff and sixth form area upstairs.
Above right: metalworking area.
Below: pages from pupil produced booklets.

working area or the metalworking areas. At least two teachers are always present in the workshops to ensure that both halves of the practical areas are correctly supervised and a teacher may find him/herself spending a considerable amount of time assisting a pupil from another group. The pupil benefits greatly from this system in that there is:

- always at least one teacher available for assistance.
- pupils experience the work of pupils from other groups and years.
- the social mixing, planning and self organisation required can only help in the pupils personal development. The pupil/pupil and pupil/teacher interaction is greatly increased.

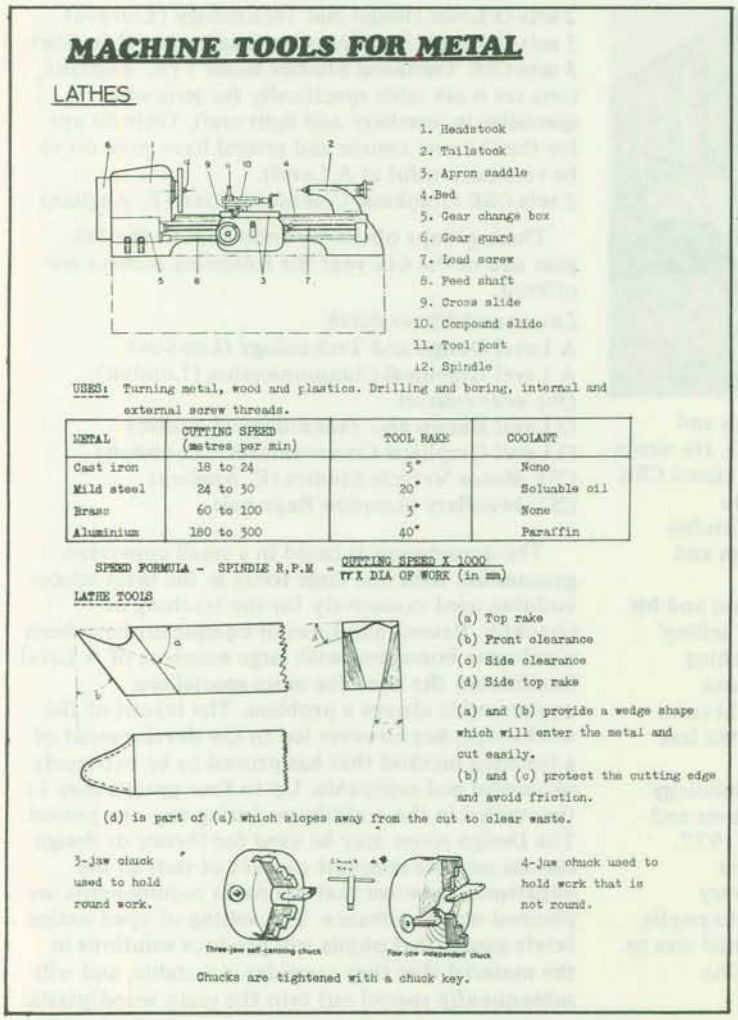
All the current members of the department were trained at Trent Park (Middx Poly) and despite differing specialisms all believe firmly in the design and make philosophy. Rousseaus observation 'teach by doing whenever you can' and the old adage

'I hear and I forget
I see and I remember
I do and I understand'

form the basis of our roles as educators through the use of materials and appropriate technologies. The pupil is encouraged to experience the full design and make process as often as possible and handle as many materials and processes that the workshops can offer. To promote this, every group in the workshop spends at least 75% of his/her time on practical problem solving exercises.

Although regular structured theory work is covered by approximately one lesson per week, per group, the wide range of solutions attempted by groups at any one time in the workshop, ensure a large number of techniques and processes are in operation. These are supported with 5 or 10 minute demonstration or discussion sessions when interesting techniques are demonstrated by the pupil.

Being relatively small and separate from the main building has given the workshops a 'family' or



MACHINE TOOLS FOR METAL

LATHES

1. Headstock
2. Tailstock
3. Apron saddle
4. Bed
5. Gear change box
6. Gear guard
7. Lead screw
8. Feed shaft
9. Cross slide
10. Compound slide
11. Tool post
12. Spindle

USES: Turning metal, wood and plastics. Drilling and boring, internal and external screw threads.

METAL	CUTTING SPEED (metres per min)	TOOL RAKE	COOLANT
Cast iron	18 to 24	5°	None
Mild steel	24 to 30	20°	Soluable oil
Brass	60 to 100	3°	None
Aluminium	180 to 300	40°	Paraffin

SPEED FORMULA - SPINDLE R.P.M = $\frac{\text{CUTTING SPEED} \times 1000}{\pi \times \text{DIA OF WORK (in mm)}}$

LATHE TOOLS

(a) Top rake
(b) Front clearance
(c) Side clearance
(d) Side top rake

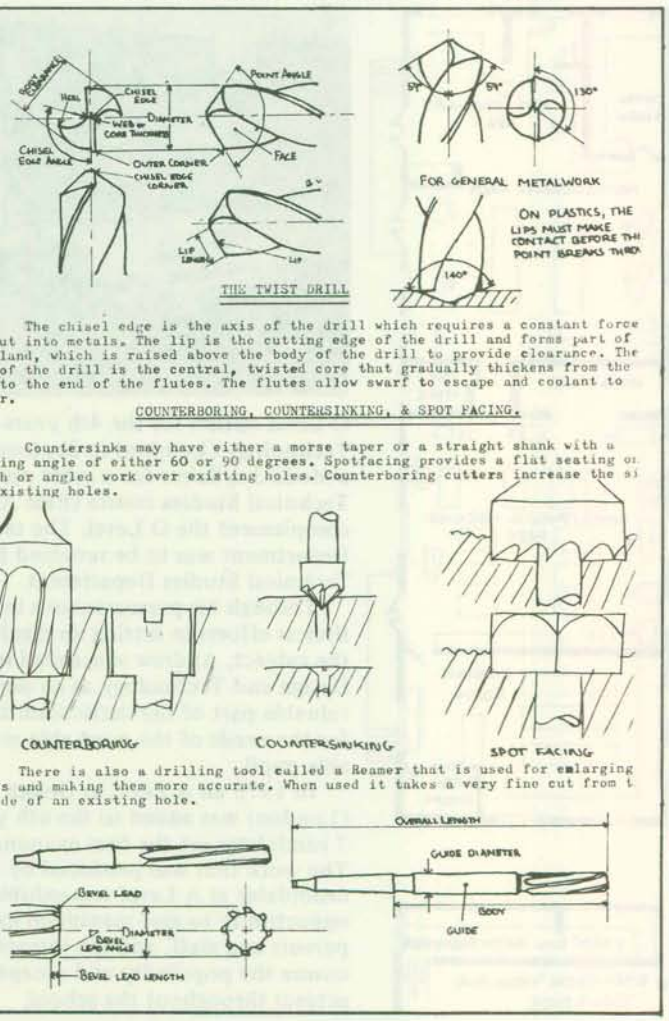
(a) and (b) provide a wedge shape which will enter the metal and cut easily.
(b) and (c) protect the cutting edge and avoid friction.

(d) is part of (a) which slopes away from the cut to clear waste.

3-jaw chuck used to hold round work.

4-jaw chuck used to hold work that is not round.

Chucks are tightened with a chuck key.



THE TWIST DRILL

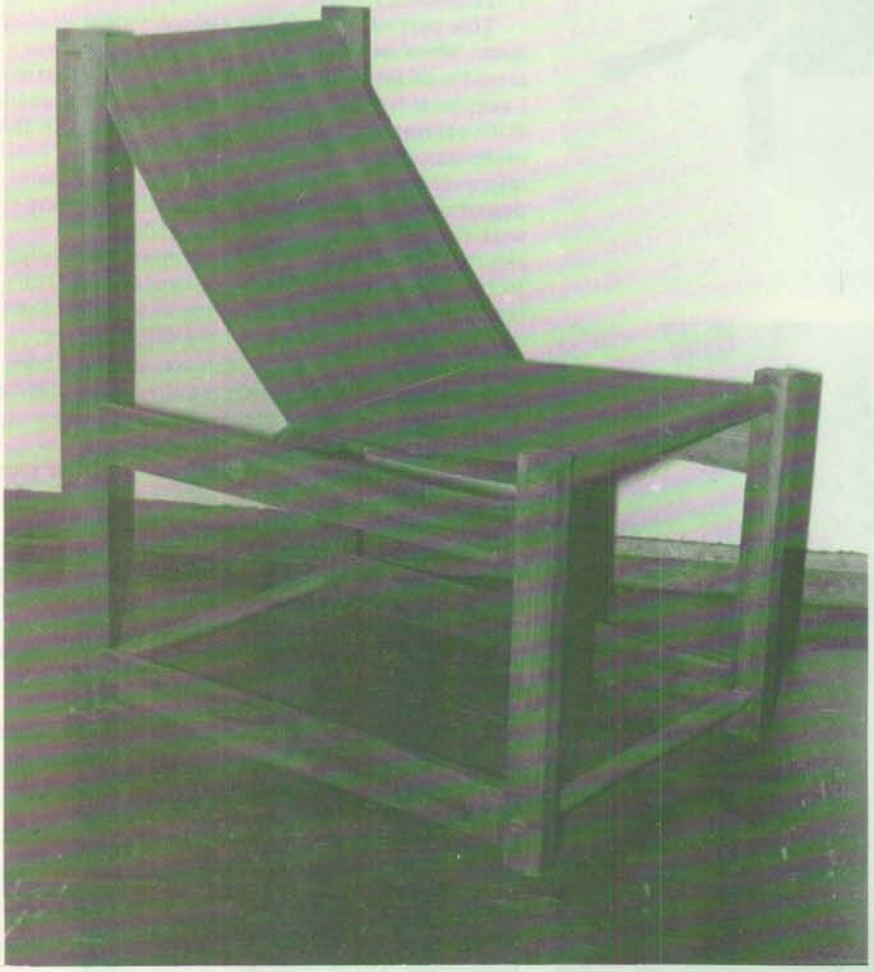
The chisel edge is the axis of the drill which requires a constant force to cut into metals. The lip is the cutting edge of the drill and forms part of the land, which is raised above the body of the drill to provide clearance. The web of the drill is the central, twisted core that gradually thickens from the tip to the end of the flutes. The flutes allow swarf to escape and coolant to enter.

COUNTERBORING, COUNTERSINKING, & SPOT FACING.

Countersinks may have either a morse taper or a straight shank with a cutting angle of either 60 or 90 degrees. Spotfacing provides a flat seating on rough or angled work over existing holes. Counterboring cutters increase the si of existing holes.

COUNTERBORING COUNTERSINKING SPOT FACING

There is also a drilling tool called a Reamer that is used for enlarging holes and making them more accurate. When used it takes a very fine cut from t inside of an existing hole.



Left: Relaxing chair by Keith Barron.
Bottom left: Lounge chair by Svava Sparey.

'community' feeling. Pupils are encouraged to assist a 'hard up' department by obtaining valuable materials from parents, friends and relatives who may have industrial contacts. Such materials acquired in the past have included; acrylic offucts from Signwriters, 'waste' paper from printers, timber from shopfitters and other related trades and this extra income has benefitted our department by approximately £200 per year for the last seven years. Even the pupil who donates the half empty can of left over paint from home feels that he has helped to contribute towards his/her department. The pupil also becomes aware of the need to care for equipment and materials as damage or avoidable waste harms or hinders everyone. The economics of designing are quickly learned.

Sixth form groups were allocated an area of their own in the workshops where they would be able to store their belongings, carry on with schoolwork, use as a base during free periods and probably most importantly, provide a facility to make a cup of tea or coffee.

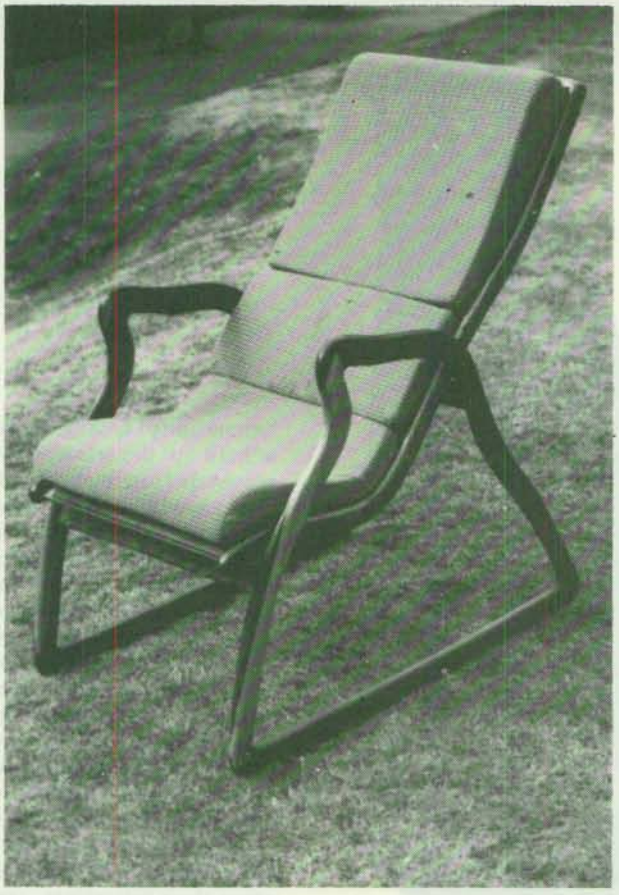
This centre has proved over the years to be a very valuable asset for the individual and the department. – 6th formers spend valuable extra time in the work-shops where they are likely to continue with their coursework. (The popularity of the subject caused difficulties with earlier groups as Design and Technology took an unfair percentage of the pupils' time, sometimes at the expense of other subjects. This problem has been balanced with the reduction of 'home' work set in this subject, and regular discussions with other subject teachers on how pupils are performing.

– Other groups have the benefit of seeing the work produced by the 6th pupil and the processes and techniques involved that they may not otherwise encounter. This provides a great deal of interest and enthusiasm for the A Level.

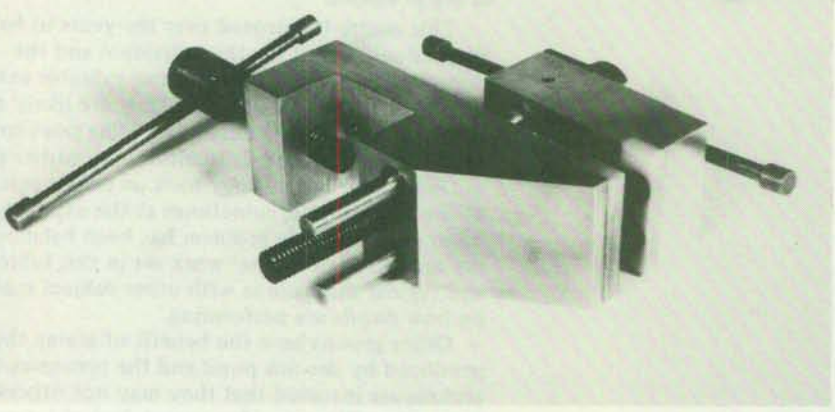
– The increased contact with teachers in the department helps foster a good working relationship and the student gains in confidence.

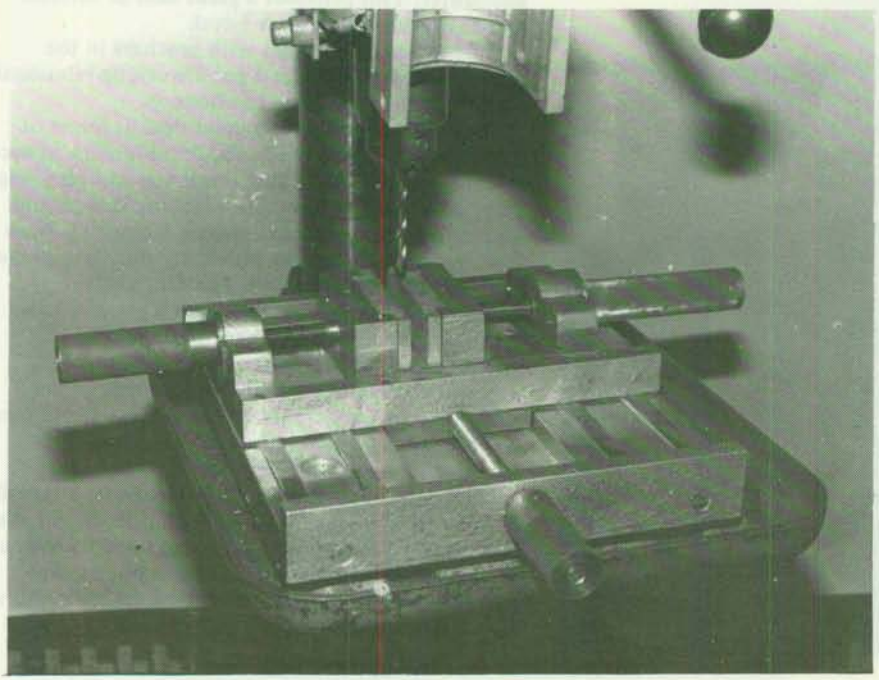
The workshops offer a great deal in terms of providing an environment for development in such attitudes as self discipline, tolerance and planning. They also clearly show that teaching Design and Technology does not necessarily require purpose built facilities, although hopefully one day, modern facilities may be provided. The ethos of the department has been to establish a good A Level tradition which will and has improved the standards in years 1-5. Obviously without the necessary preparation and development in the early years there would be very little A Level work. At this point I wish to concentrate upon the teaching of A Level Design and Technology.

The departments aims and objectives, originally defined by the present Chief Examiner of A Level Design and Technology (London) leave us with an obvious selection for our 6th form pupils. The recent syllabus changes make the London exam a very balanced, demanding and rewarding course.



Left: Upholstered chair by Steven Rolfe. Middle left: Jewellery vice by Lucy Wilson. Bottom left: Adjustable pedestal drill vice by Keith Barron.





The A Level is examined in three main areas:

1. *Design*

Common to all practical courses at East Barnet is the central, basic design and make philosophy. Emphasis is placed upon the full design process which can be simply listed as; finding/selecting a need, analysing/specifying, proposing solutions, making decisions, manufacturing a solution, testing/evaluating. Teacher introduced projects are used less frequently as groups master the basic skills and techniques associated with designing and making.

The actual Design examination can be a test of endurance as well as a test of design competence. The introduction of a Preliminary Design Research Paper will help alleviate the fears of entering such a demanding, lengthy examination 'cold'. It is this examination where 'exam technique' has a special significance. This unique test requires practise in order to establish a pace. My own attempts, and that by other members in the department have made us aware of the difficulties and through this we have been able to provide useful advice. The need for thorough preparation for this examination is essential in our opinion.

2. *Technology*

This part of the syllabus caused a great deal of alarm when an element of basic electronics was introduced into the common core. Our department I assume is typical of many in that our combined skills cannot match the average 16 year old in the understanding of 'newer' technologies of micro-electronics and computers. The Physics department have come to our aid this year but with the necessary background reading, experimentation and in service training, we hope to become more confident and competent. The rapidly changing and developing new technologies can be a daunting prospect for CDT teachers, especially when one takes into account the large, wide ranging syllabus which requires knowledge of, or an understanding of many specialist areas including materials and tool technologies, ergonomics and anthropometrics, mechanisms and structures etc.

An understanding of materials and related processes and technologies is promoted through the frequent access the pupil has to the workshops and their involvement in solving practical problems. The various areas of expertise of members in the department is used to the full and all 5 teachers are involved in teaching the A Level. The syllabus is discussed and each member is allocated areas to cover. Topics left that no one feels really confident in covering are divided up amongst the team, meaning that each member has a relatively small area to research and teach confidently. The time breakdown supplied by the University is of great value when planning the teaching of the course.

A very successful exercise in covering the technical information required has been the production of booklets by the candidates themselves. Three years ago, a group of 11

Right: Jewellery clamp, vice or hand held by Jane Milton.
Below: Lathe attachment to allow basic milling operations by Steven Rolfe.
Below right: Drilling rig Darren Elliott.

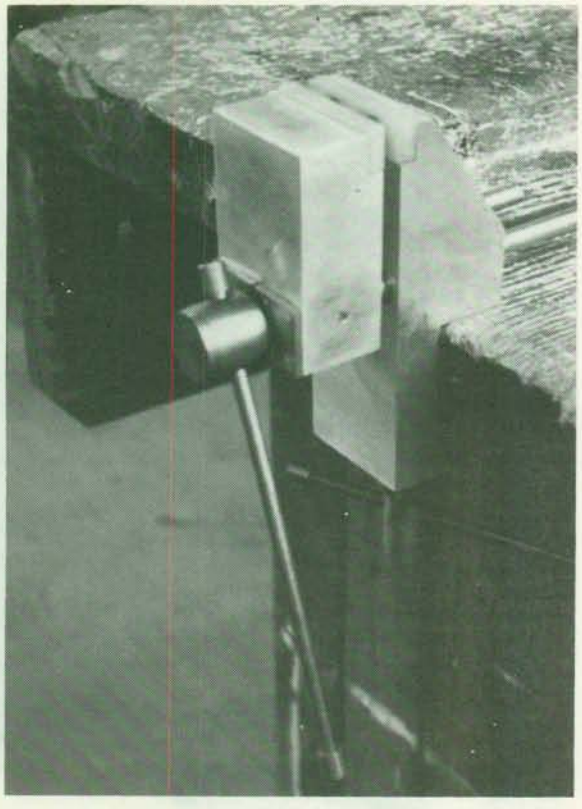
candidates were each given a different topic relating to hand tools to research with the intention of each person producing at least three A4 sheets that could be duplicated and assembled with the rest of the groups work, resulting in a very comprehensive booklet of around 30-40 sheets for each candidate. This exercise has been repeated by other A Level groups, covering different areas of the syllabus and affords sound educational value for the candidate and eases the workload of the teacher.

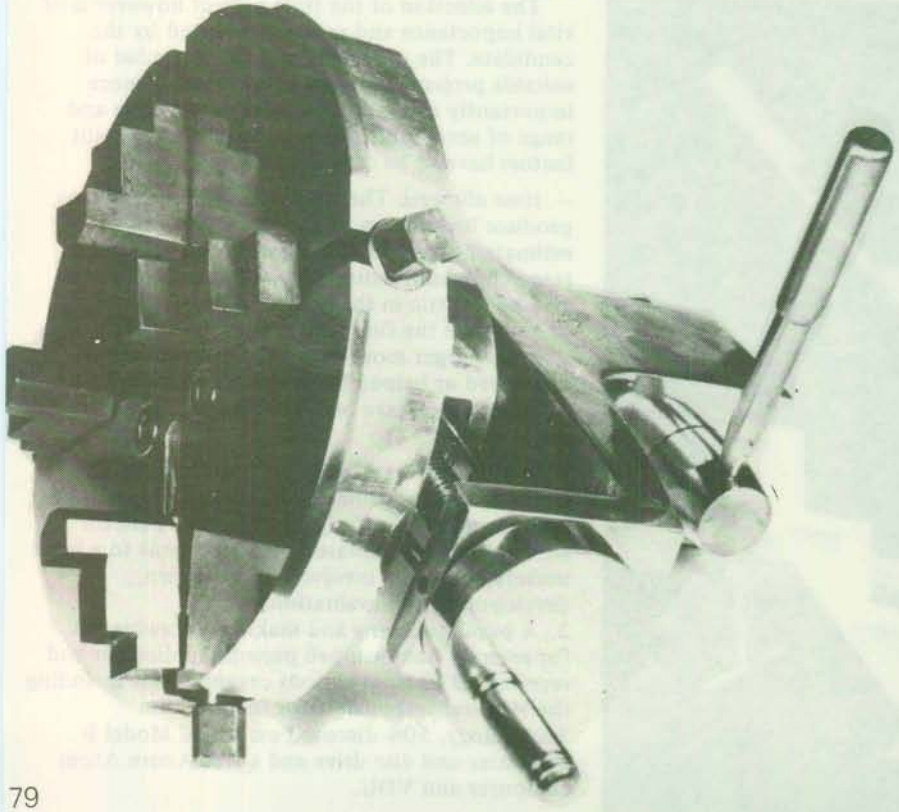
Local industry has proved to be a valuable source of information and places visited have included; plastic fabricators, engineering workshops and veneer producers. The free technical information available from Companies and Institutions such as ESPI, TRADA and ICI for example provide excellent up to date sources of information relating to the subject.

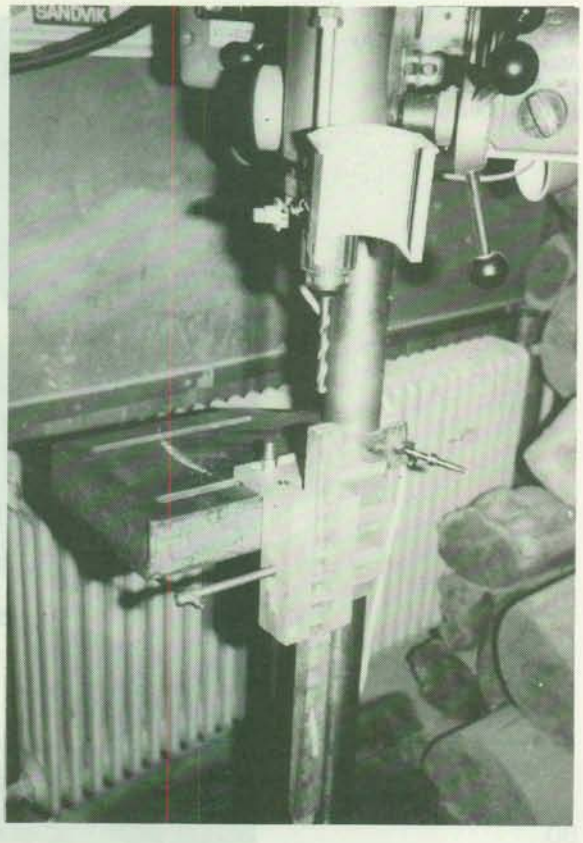
3. *Coursework*

Probably the most enjoyable and rewarding aspect of the course for the pupil and teacher is the practical coursework. Two projects are required in the first two terms and a major project spreads over the last three terms.

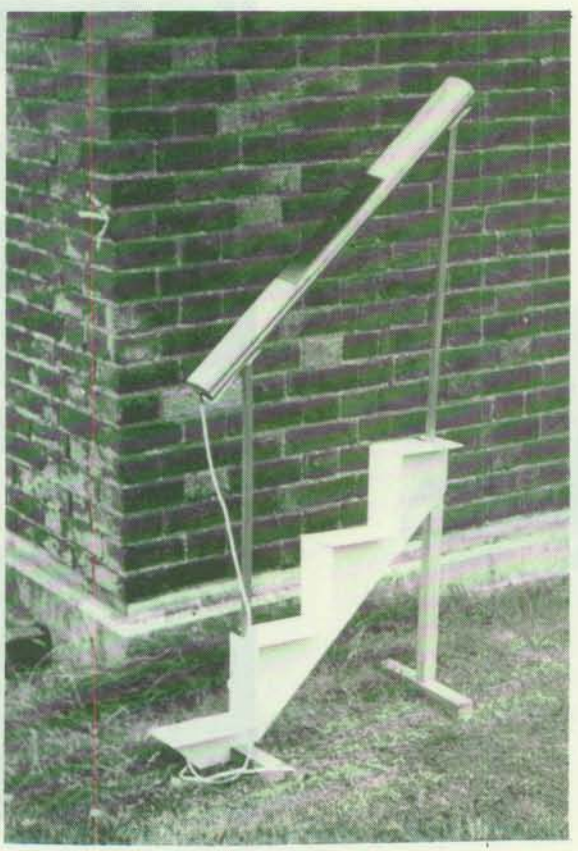
The selection of the projects and the brief specification has to be done by the candidate. This can be a very time consuming and difficult exercise and when one takes into account, the relatively short time available it is sometimes necessary to







Above: Brazing jig by Martin Goodchild. Right: Stair light by Billy Steward.



offer guidance. The syllabus suggests that the candidate must show the use of at least, two main materials. Our first group attempting the 'new' syllabus were offered the general area of 'seating' as a source of inspiration after several weeks of unsuccessful endeavour. Many excellent design briefs were proposed including:

- Child's high chair
- Folding back support for picnics and camping
- Study stool
- Reading chair.

Most candidates obviously chose wood as their main material and so the next project really needed to be produced in mainly metal or plastics.

The general area of clamping device for the workshop was suggested and based upon the candidate's own experience. Several projects were proposed and manufactured, including:

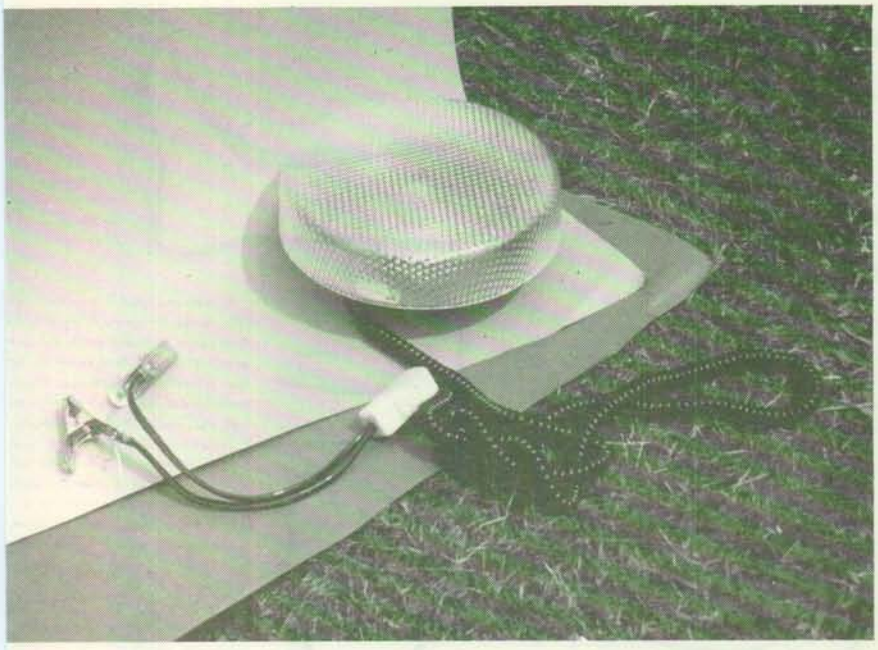
- lathe attachment to permit milling operations
- pedestal drill vice to allow accurate positioning of work to be drilled
- adjustable jewellery vice
- quick action blow moulding clamp

Narrowing the area of research meant that the pupil was able to formulate his/her individual brief more quickly and complete the exercise in the time allowed. The production of related design work also requires a different approach in that the search for a final solution is emphasised and many amendments are made during the manufacturing process.

The selection of the final project however is of vital importance and must be initiated by the candidate. The university will provide a list of suitable projects that can be adopted or more importantly can give some idea of the scale and range of acceptable projects. Several important factors have to be considered:

- *time allowed.* The candidate is encouraged to produce breakdown of time available and the estimated duration of the various stages, that is, research, manufacturers etc. The candidate must also be realistic in the choice of project in order to complete the full project through to evaluation.
- *cost.* Larger more expensive projects can be sponsored or helped by interested parties. Two such examples have been assisted in very different ways:

1. A sand and water play unit was designed and made as a major project. The school adopted the unit as one of its termly charities and paid for all materials and donated the equipment to a local nursery that were involved in the design, development and evaluation.
2. A pupil designing and making a drawing aid for severely handicapped persons applied for and received £320 from various organisations including the Minister responsible for Information Technology, 50% discount on a BBC Model B computer and disc drive and a free Acorn Atom computer and VDU.



– *size,* lack of storage space in small workshops.
– *materials/facilities available.* Local industry and further educational establishments have been extremely helpful.
– *interest/motivational factors.* Will the project sustain interest?

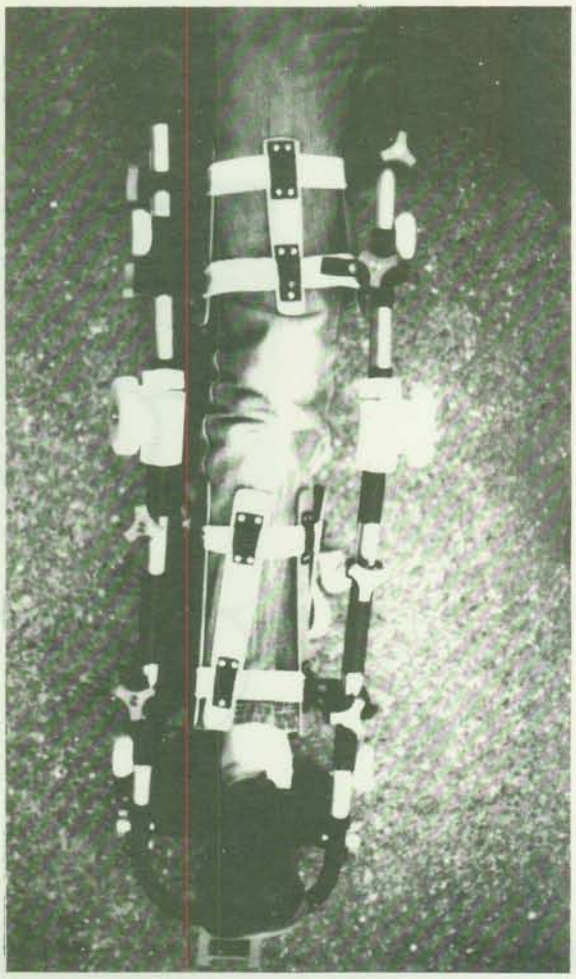
The first two projects give the candidate confidence in working with materials and the related working processes.

The Major project is a much larger exercise and can provide a great deal of benefit and enjoyment. We direct our candidates to look at areas that offer many areas of need;

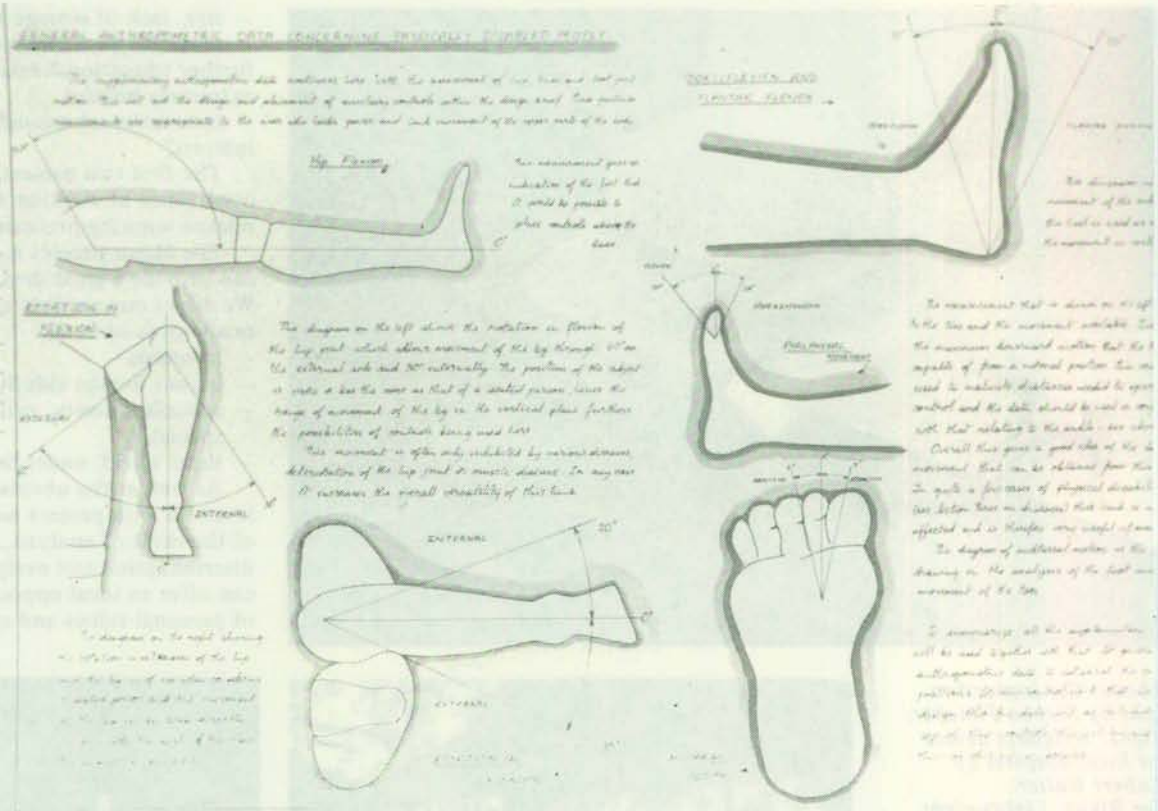
– hospitals
– homes for the elderly/handicapped/mentally ill
– schools, nursery, primary, junior, secondary, special
– third world, under developed nations.

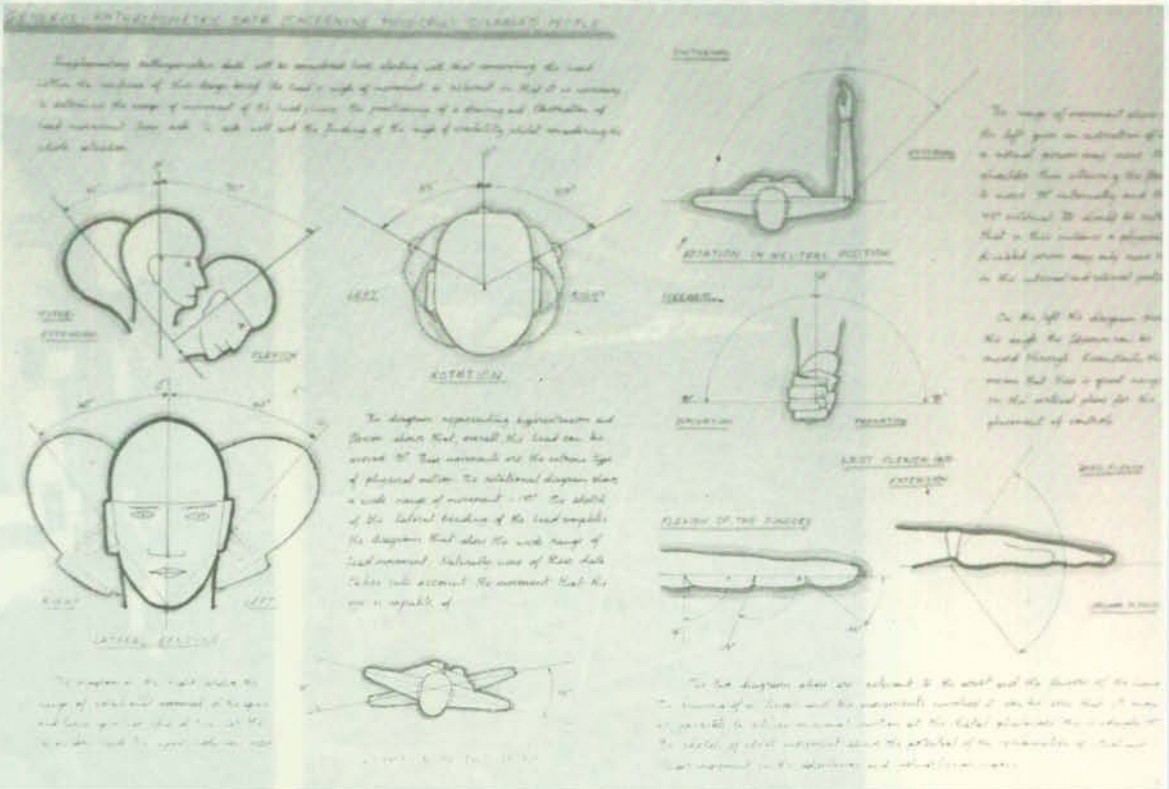
As well as the obvious educational benefits involved with project work such as the development of the skills of analysis, decision making, planning, discrimination and evaluation etc., the major project can offer an ideal opportunity for the development of personal values and attitudes.

Above: Car inspection light by Steven Fletcher. Right: Weighing device for local hospital by Robert Walter. Far Right: Lightweight limb support for rescue services by Robert Lucas.

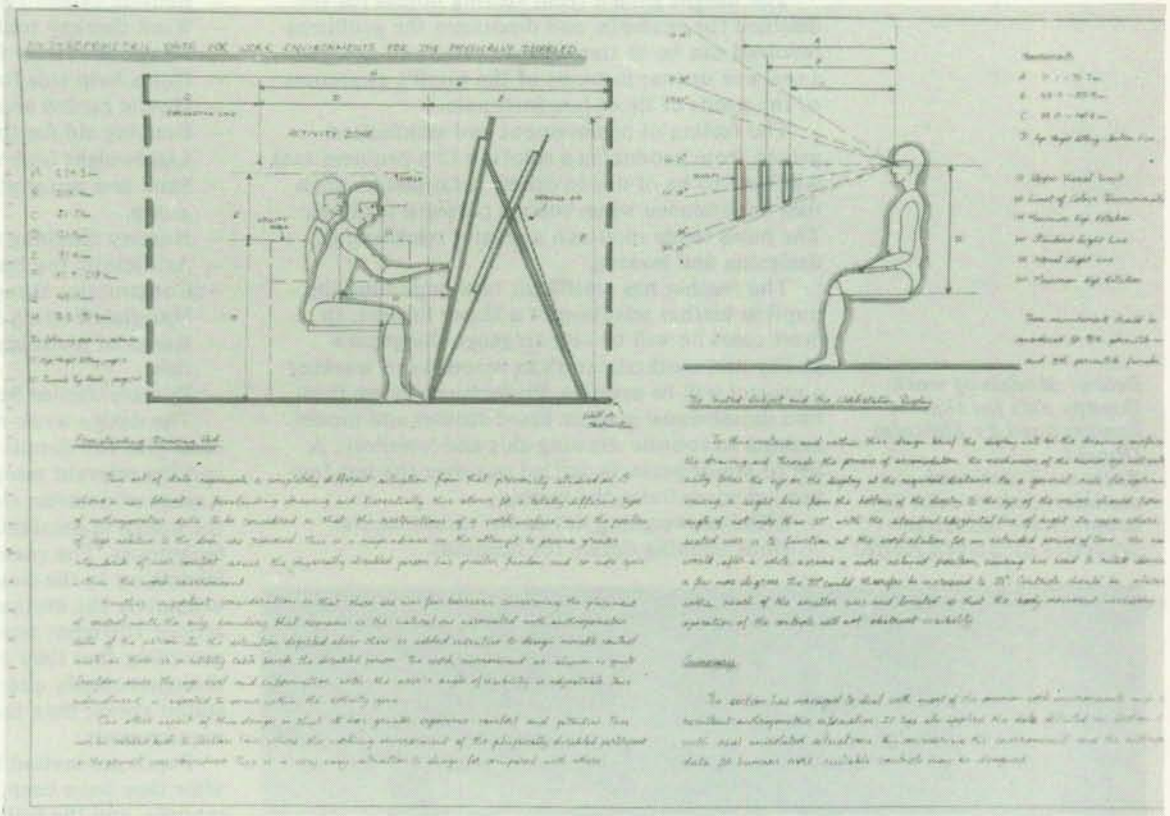


Design sheets from major project folder by Nazam Hamid.

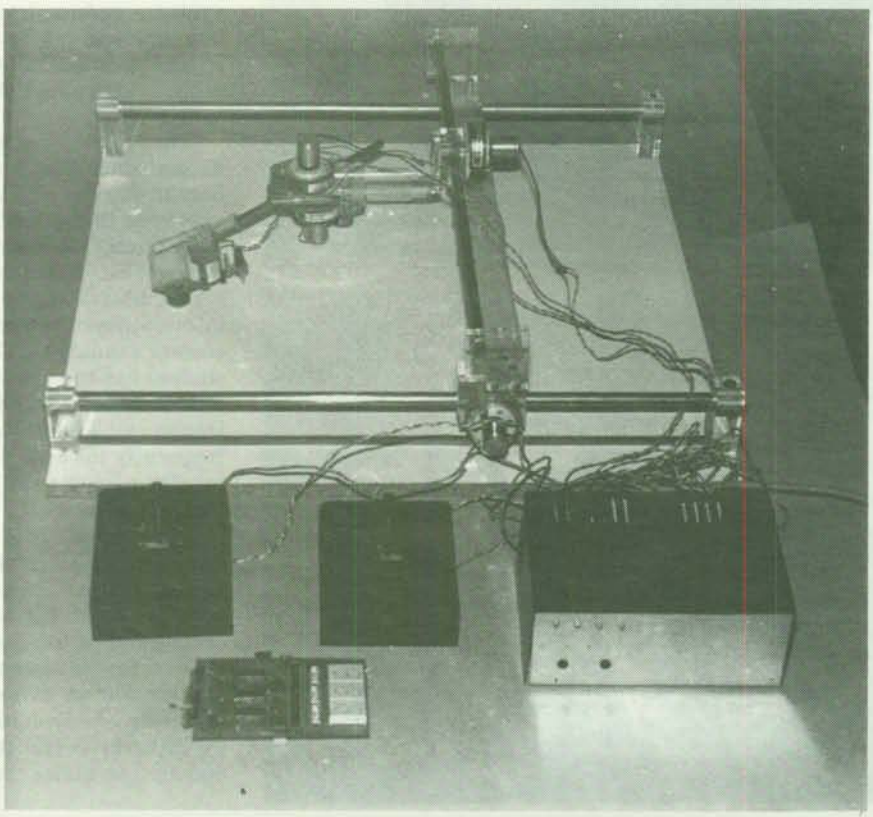




Design sheet from major project by Nazim Hamid.



Drawing aid for the handicapped by Nazim Hamid.



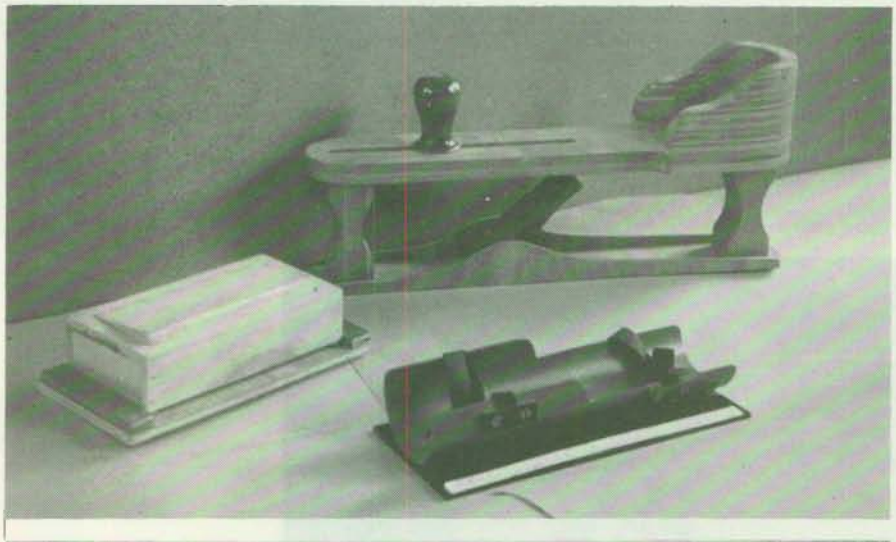
The insight gained from visiting homes for the disabled for example, and discussing the problems involved can be of tremendous value and can be a real eye opener in terms of the pupil's awareness of the needs of those less fortunate.

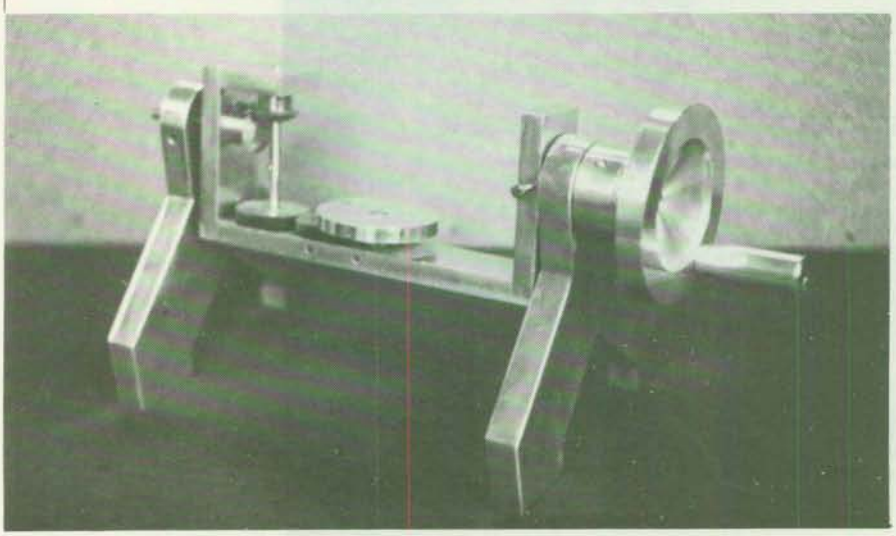
The feeling of achievement and satisfaction gained from producing a solution to a problem tnat will have to be of use to others is far greater than that experienced when solving personal projects. The pupil tends to attach a greater relevance to designing and making.

The teacher has a difficult task in guiding the pupil in his/her selection of a Major Project. In most cases he will be able to gauge the pupil's ability and workrate and can recommend whether a project will be suitable. Projects can range from two dimensional graphic based studies and model making to robotic drawing aids and jewellery. A list of Major projects carried out over the last few years demonstrates the variety;

- Efficient weighing device for local hospital.
- Door opening device for hospitals.
- Bedside cabinet/workstation for hospital wards.
- Work therapy tools for the disabled.
- Range of cutlery for the elderly.
- Home help aids for the elderly.
- Mobile garden area for the housebound.
- Drawing aid for the handicapped person.
- Lightweight limb support for rescue services.
- Sand and water play equipment for nursery group.
- Nursery climbing frame.
- Arithmetic teaching aid for primary schools.
- Constructional toys.
- Materials Testing Device.
- Range of jewellery based upon the movement of fish.
- Primary/Junior School art and craft workstation.

Below: Models of work therapy aids for the handicapped by Malcolm Donald.
Bottom: Rotational moulder, part of a kit to demonstrate industrial processes by Steven Rolfe.



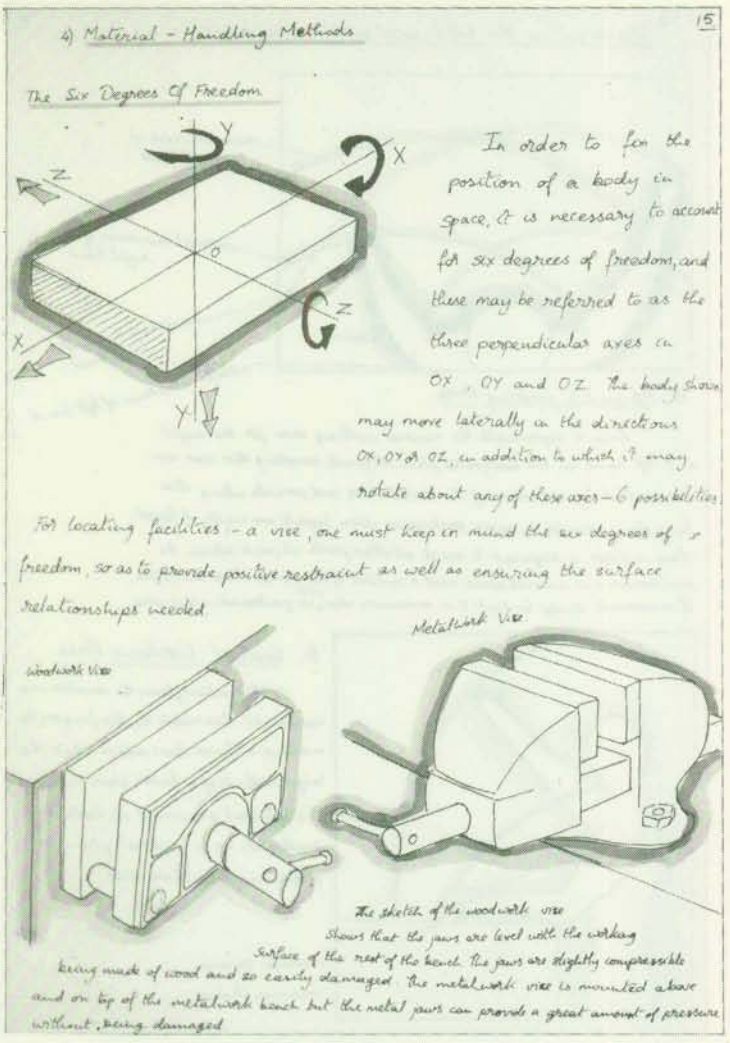


The design work relating to the Major Project must give full details of the problem, its analysis and the relevant research. It must show evidence of a range of possible alternatives and demonstrate the pupils understanding of materials and techniques. The reasoning and decision making leading up to the final production drawings and ultimately the evaluation of the manufactured article. Different pupils have different styles and providing that they communicate their ideas and thoughts clearly and they include all of the areas stated above, then they will be fulfilling the requirements.

Pupils are invited to loan their design folders after they have been assessed, for at least 12 months, and the following year groups use them for guidance and inspiration. Starting off on such a large exercise can be frightening without some idea of what is expected. Obviously the different projects attempted prohibits any opportunity for 'copying'.

The A Level is regarded as the 'flagship' of many departments. This is certainly the case at East Barnet. A great deal of interest and enthusiasm is generated in the 1st-5th years by the work produced by A Level D & T pupils. The A Level must also however be viewed in its relevance to careers and higher education and past pupils provide valuable information of the courses and careers they enter to current candidates. Certainly at East Barnet no student has been penalised when applying to university or polytechnic for studying A level Design and Technology. In fact grades are frequently lowered when interviewers see their excellent folders and photographic evidence of their practical work.

The teaching of A Level Design and Technology can be very demanding but can also be very exciting and enjoyable. The qualities of the subject combined with the natural inventiveness and enthusiasm of the pupil will give rise to a constant flow of new situations and problems, some requiring assistance from outside sources. Despite being relatively poorly equipped, and the deficiencies of expertise in certain areas of the syllabus, we have managed to utilise the strengths and motivational



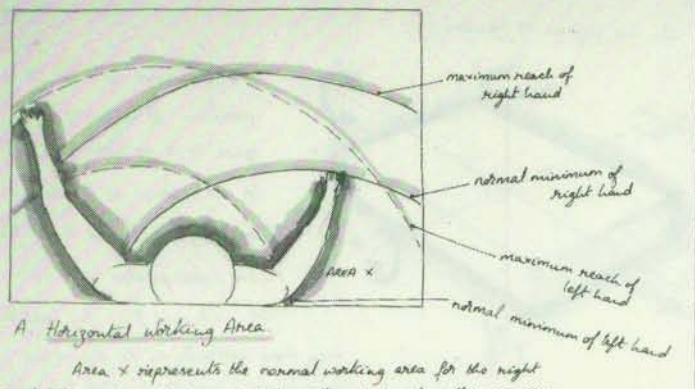
Left: Design work for 1st year project.
Below: Nursery play equipment by Barry Burningham.

qualities of the subject and exposed the talents of our 6th formers. They have shown their worth in the examination and the past two years have produced the impressive statistics of all 18 candidates passing, 12 achieving grade A.

Eric Bolton, senior chief HMI in a recent article (Times Ed. Jan. 20th) foresees in the curriculum of the future that 'the years ahead would see a greater emphasis on technology and design and an attempt to create a better balance between theory, practice and relevance to the outside world'.

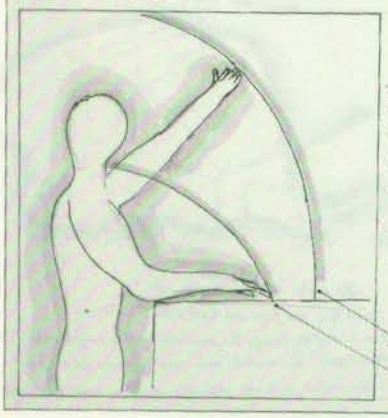
Providing the A Level syllabi keep apace with the developments of new technologies then possibly at last the value of the subject will be universally accepted.

7) Movement in the Work-cycle and Ergonomics.



A. Horizontal working Area

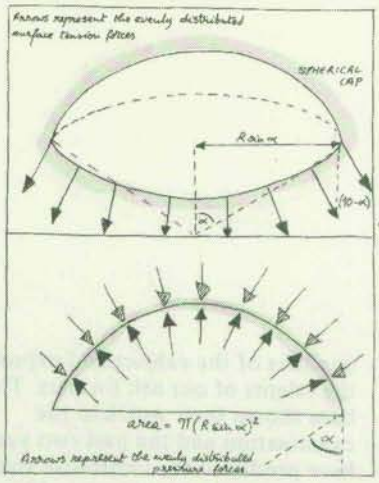
Area X represents the normal working area for the right and left hand in the horizontal plane. All points bounding this area can be reached by a motion of the third class and points along this boundary should be given preference when layouts are made. A fourth class motion is required to reach all other parts - all points between the maximum and normal areas need a motion of the fourth class. The lengths of movements should be kept to a minimum when work is positioned in this area.



B. Vertical Working Area

In the vertical plane, the smaller arc represents that made by the fingers in making a third class motion. While the larger is that of a fourth class motion. The efficient placement of tools & materials in a vertical plane is determined by these arcs.

14. Principles and Theories Behind the Solution to the Adjustable Jaw chosen



The diagrams show a spherical cap of liquid in equilibrium under the action of two sets of forces.

In the first diagram, the force at at a particular point is tangential to the surface, due to surface tension. The resultant of all these forces has a zero resolved part in the plane of the base. But resolving perpendicular to the plane:

γ = surface tension

$\text{Force} = \gamma(2\pi R\sin\alpha)\cos(90^\circ-\alpha)$

$\therefore \text{Force} = \gamma 2\pi R\sin^2\alpha$

The second diagram shows the forces acting on a spherical cap due to excess pressure rather like that exerted in the type of vice jaws to be manufactured. To maintain equilibrium the pressure inside the surface exceeds that outside by δp (pressure difference)

This pressure difference causes a resultant force which has a resolved part equal to zero in the plane of base. But the resultant perpendicular to the plane of the base:

$\delta p \times (\text{area of base}) \Rightarrow \delta p \times \pi(R\sin\alpha)^2$

Since in equilibrium, equate from resolved part of first diagram

$\therefore \delta p \times \pi R^2\sin^2\alpha = \gamma 2\pi R\sin^2\alpha$

$\therefore \delta p = \frac{2\gamma}{R}$

With this type of vice in mind it would be very awkward to carry out these measurements, especially γ, so one must left a large margin to account this