# cardiff college of art

Diploma in Art and Design
Final year students' individual exhibits at : Cardiff College of Art, Howard Gardens, Cardiff
Saturday 19 June, Monday 21 and Tuesday 22 June 1971, 10am–5.30pm

## FINE ART

The College provides courses for the Diploma in Art and Design in the Fine Art area. The developments are not limited to any formal or historical concepts in terms of painting and sculpture. Students can work specifically in the areas of two and three dimensions or 'between' the two areas. They may use any combination of these areas with whatever combination of relevant media they wish to select and extend any aspect of individual sensibility.

The college runs on an open-studio and integrated workshop system. There is freedom of movement between the different areas of study and direct relationship between any subsidiary areas. The student is given a considerable amount of freedom and responsibility which is ultimately dependent on his own potential and capacities. There is in fact, an individual development for each student within each course so that his education is aligned to individual creative capacity.

The language and structural systems which the student works in are his own responsibility and the student is also expected to invent the majority of his projects. A student is expected to be largely self programming and considerable initiative and personal discipline are expected from students. The amount and degree of specialisation is also determined by the student within the framework of a balanced course. These are largely experimental and are [illegible] carried out to equip the student technically early in [illegible] course. All students are assessed informally throughout the course. Any final demonstrations are a part of the total assessment and a student is able to define the basis of his assessment, i.e. the proportion of importance given to any principal area or category of study. Students who [illegible] to develop in a less specialised way will be given every opportunity to do so.

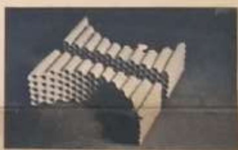
Students in this department have carried out a considerable number of co-operative projects, particularly with the Music Department, and the Arts Society of the University, and presented performances at the Reardon Smith Auditorium, Bute Street Community Centre, as well as further afield in London, Coventry and elsewhere. Visitors come from all over the world to see the educational processes of this area in action.

## CERAMICS

The ceramic course offers the student the opportunity of discovering and developing his own personal direction and philosophy.

The course evolves from a programme of basic disciplines and experimental approach to personal discovery.





A wide range of equipment and technical facilities for all kinds of ceramic production, vitreous enamelling and other media is provided within the college to enable the student to extend his practical ability and creative potential.

During the latter part of the course an individual emphasis towards a particular aspect of ceramics and related studies is developed and areas of specialisation include Architectural Ceramics as well as Studio and Industrial Ceramics.

## HISTORY OF ART
### & COMPLEMENTARY STUDIES

The department is primarily concerned with supplying a variety of courses which supplement the practical work done in the studios. Almost all artists, no matter how radical their work may appear, invariably acknowledge the debt they owe to their predecessors. It is hoped that in a number of ways students will be placed in contact with the work and philosophies of both contemporary and past artists. This is achieved by lecture courses, individual tutorials, visits to exhibitions in London and abroad, invitations to specialist lecturers and practising artists and art films. Students are also required to do individual research and in the past this has often provided valuable reference material for the college library. Facilities for research include an extensive library, a record and tape collection and a library of approximately seven and a half thousand slides.

Complementary to the art history area are a series of courses which are of a general sociological nature and which discuss the roles of the students both as artists and as members of a wider society. Extra curricular activities in the past have included programmes of films, symposia, the production of a Jarry play performed in Cardiff and Newport, various performances and events including poetry and music and a research project on art gallery attendances. Many established and practising artists are now collaborating with specialists in a variety of disciplines, which hitherto have not been directly related to the visual arts. As a result of this tendency an important and ancillary role of the department is to make contact and liaison with individual specialists who might be able to assist particular students.

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Howard Gardens, Cardiff
Saturday 19 June, Monday 21 and Tuesday 22 June 1971, 10am–5.30pm

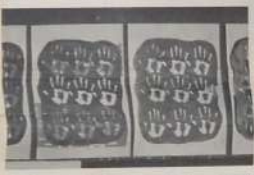
# FOUNDATION

A year's intensive training in visual literacy, preparatory to specialised study in art or design.

Essentially diagnostic in character, and with an increasing responsibility on the part of the student to discover his personal development, the course encourages the growth of effective critical faculties and leads the student to be objective in analysis of his abilities.

The foundation year can lead to Diploma (degree equivalent) or Vocational courses in fine art, graphics, fashion, textiles or three dimensional design (interior design, ceramics, product design, furniture, jewellery etc.), to courses at university, teacher training college, or professional training schemes. The course is therefore demanding in terms of both hours worked and effort required.

The course content is concerned with visual, or other, languages to deal with the world as we find it; time here spent on such studies as: objective and subjective investigations, environmental research, 2D/3D organisat introduction to technical processes, history of art, liber studies, etc.; with a maximum flexibility and range of materials. (Facilities are available for students to work comprehensively with wood, metal, plastics, resin, printing, fabric, film, etc.)



The studies are centred around the personal evaluation and individual exploration of ideas, through as wide a variety of materials, processes and technological applications, as are appropriate to establish meaningful experience and individual fulfilment of the various problems and opportunities concerned.

Following an initial study period, each student pursues a course of studies appropriate to his or her own personal interests, ideas and needs, leading to a point at which each student can be self-motivated and self-programming.

# ART EDUCATION
## SUPPLEMENTARY COURSE

The Course is for serving teachers from both Primary and Secondary Schools and its aims are to encourage teachers to examine in depth opportunities for creative work in the broad field of art and design, with special emphasis on the educational implications of this experience related to 'workshop centred' activity and inter-subject co-operation.

# INTERIOR DESIGN

The department provides a three year course for those with inventive and creative ability wishing to train as Interior Designers.

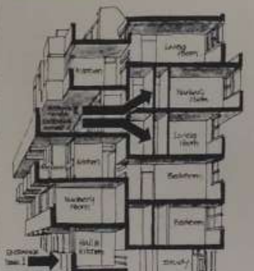
Emphasis is placed upon use of materials, methods of construction and professional practice.

Students are encouraged to think logically and with purpose upon a wide range of projects.

Active participation in live projects, liaison with local industry and Architectural Design Consultancies is essential.

Each year a number of lectures are given and projects set by visiting Architects and Designers.

Approval is being sought for recognition of this course for the Licentiateship of the Society of Industrial Artists and Designers and the Associateship of the Incorporated Institute of British Decorators and Interior Designers.



# FASHION

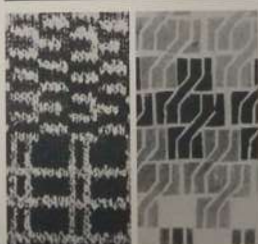
**The course covers – men's and women's wear, children's wear, lingerie, shoes, knitwear and leather, millinery and accessories, theatre costume design, weave, print and embroidery as related to fashion.**

There are strong links in all these areas with industry, local and otherwise.

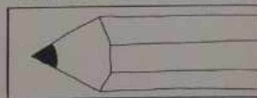
Students must spend part of their two or three year course in a factory gaining first-hand industrial experience.

The course includes all aspects of design, cutting and finishing so that a student is ready at the end of the course to enter industry as a designer.

Students who achieve the necessary technical and creative standards find an interesting choice of work available to them.



# GRAPHICS



The solution to a design problem may seem obvious, – but it is the skill and expertise of the designer to find the most effective and apposite solution to what may be a complex situation – and then to make it obvious, – easily understood, readily assimilated.



'Graphic design is my love. (He's a graphic designer)'
Mary Evans

'Graphic Design is selling new, improved, whiter than white sand to the arabs'
Arwel Hughes

'Graphic Design is selling sand to anybody'
Robert Oliver

'Graphic Design is all the way from Kenya to Howard Gardens Cardiff'
Naina Shah

I've used to their reasons that ... related to my mental state ... I love Silkscreen

Evans Hughes Oliver

## PROGRAMAÇÃO DIÁRIA

9/13 h — Turno da manhã.
13/14 h — Almôço.
14/17 h — Turno da tarde — trabalhos práticos.
17/18 h — Debates e Seminário.

## DINÂMICA

Iniciando os trabalhos pela manhã, serão realizadas diàriamente palestras, ou alguma outra forma de apresentação. Estas introduções, na parte da manhã, serão acompanhadas de apresentações visuais, na forma de *slides*, filmes etc.
Após cada uma destas funções, será reservado um horário para a formulação de perguntas e discussões teóricas. Em seguida, os trabalhos práticos completarão o ciclo diário.
Quando possível, os trabalhos práticos serão realizados ainda pela manhã. E tôdas as tardes serão dedicadas a atividades práticas com a participação dos alunos.
O último horário do dia será reservado para a realização de debates, finalizando com um Seminário para a avaliação das experiências.
Cada curso será precedido de uma palestra geral, no intuito de transmitir o significado da filosofia seguida por TOM HUDSON, e de seu trabalho.

## VAGAS:

40 alunos por curso.

## CERTIFICADOS:

com 85% da freqüência.

## TAXA:

Cr$ 500,00 (quinhentos cruzeiros), total que inclui o material necessário para as aulas práticas.

## INSCRIÇÕES:

na Secretaria da Escolinha de Arte do Brasil, Av. Marechal Câmara, 314, 4º andar — tel. 222-4521.

Agôsto 1971

# Tom Hudson

Artista,
"Creative Educator",
Diretor de Estudos
da Escola Superior de Arte
de Cardiff.

## Educação Criadora

Criatividade,
Educação e Tecnologia.

Dois cursos

Realização comemorativa
do 23.° aniversário da

# Escolinha de Arte do Brasil

GRUPO FINANCEIRO TAA

Man's individual form and potential is recognisable in every child. The child is one of the greatest discoveries of this century - every child is capable of developing its own visual and plastic consciousness and language. It needs to be armoured with an adequate education so that in a world of wavering and changing values it can at least see its predicament, ask itself the questions which might help to erect personal standards and new values.

12. Teaching can and should be a creative process, with ideological growth, rooted in effective philosophy, variable in form, adaptable and personal. It should be sufficiently open-ended to be self-critical, self-generative and revitalising. Of all the educative disciplines our own is, and must continue to be the most progressive, critically introspective and creative. During recent years we have begun to examine our educational conscience and we have found that there is no one way to teach creatively anymore than there is one way to be creative.

(There is a body of experience, knowledge and creative power which we can call our culture; whatever is worthwhile in it should inspire us to participate in it and add to it. Education should be inspirational and revelatory and yet it all too often is not. There is little evidence for example that the recognisable creative energy and vital qualities of adolescents is reflected in what they do in the art room. Until every classroom and studio is its own research situation we shall be hopeful practitioners of a primitive language.
In our acquisitive society the teacher looks like being left behind by pupil and student in terms of changing conditions, changing roles, etc. The end of the elite, but limited, "knowall", role of the teacher means that he requires the conditions so that he can adjust to and develop possibilities.
It is ridiculous in such a changing world that the teacher receives a so-called education and then is almost invariably exposed for life. No wonder that many teachers are rapidly over-exposed. After the first five years of teaching he should be able to go to his Teachers Centre for creative research for a period e.g. 3 months, after the ninth year a further 6 months, and between the twelfth and fifteenth years he should be able to make application for an effectively programmed sabbatical year. Some such pattern must be evolved or we will find that effective ideology is degenerated, new principles founded before they can be fruitful - and we will forever be left with the Image of an artistic education instead of the Reality of a creative one.)

Tom Hudson.

## Art in Secondary Schools

### 2 Dimensional Work

1. a. Work in two dimensions has too often been concerned with limited pictorial subject matter and the development of hand-skill - instead of developing visual literacy on a much broader front. While one needs to learn to observe in an accurate and objective way it is necessary to go beyond the superficial appearance of things. The pupils' curiosity should be stimulated to "go inside" the "object", in fact or as an act of imagination and probe deeply into the problem or idea, in terms of what he feels subjectively about what he observes and knows.

   b. Whereas general areas of interest can be defined by the teacher the pupil should be encouraged to choose his own specific aspect and demonstrate a personal point of view. The language that the pupil works in should be his own choice out of natural inclination and development. It is unnecessary for the teacher to decide what language (level of abstraction, degree of figuration) a child should work in.

   c. It will generally be necessary to teach some traditional aspects of vision, and some useful projective systems, but these methods should be looked on as special aspects of functional communication and not necessarily employed as the basic of everyone's personal language. We can, of course, exploit visual systems devised by other disciplines.

   d. The two dimentional area should contain the traditional attitudes of research - (drawing researched subject, form, idea etc.) - analysis and development, as well as allow for immediate ideas, inspired concepts, creative accidents etc.

   e. Material and media can be of any kind or combination; creating surfaces to work on as well as exploiting different existing surfaces. Although work may begin in two-dimensions, if the idea or creative development warrants it, it should at times be able to continue in relief or evolve in 3 dimensions. Media exist to be exploited for a wide range of individual interpretations, as well as an exploratory source for new forms and ideas; but should not be used in the teaching of superficial techniques; if the ideas are vital and the child creatively involved the "techniques" look after themselves, i.e. they evolve as part of the form of the idea, expression, statement.

   f. The child should learn to demonstrate an equivalent for various phenomena. As he perceives the world of nature, man-made nature, and environment - he should learn to invent or make visual and structural equivalents in 2 dimensions. His marks can represent, be the equivalent for, how things are made, how they come into being, how they work, are motivated, engineered, constructed etc.
   Mark making should also be the basic source for experimenting with an exploiting one's physiological capacities, the movement of fingers, hands, arms, body; the processes of action used creatively.

g. No marks are necessarily better than other except in a particular context. As very few children have a high degree of so-called "natural" hand skill - this factor should not be held up as the basic qualification of achievement - there are many other bases for evaluation, and "doing things well". Mechanical aids and any practical means should also be permitted, explored and exploited as well as traditional artistic "handwriting", just as diagrams, graphs and other two-dimensional systems can be as useful and effective as more subjective mark making.

h. This is also the area which involves the systems of visual communication at the direct and indirect levels of sign, symbol, image etc. What do we mean, how do we demonstrate, how do we interpret etc. Different systems, different languages, different levels of symbolism are used in the world around us, in our everyday environment - we learn to adjust to this, and find our way through the countless information, to classify and order it for our personal and collective use.

i. There will obviously be many special aspects which teachers will want to develop - but there are obviously some areas which ought to be developed for the benefit of everyone. The development of biological sensibility to colour, research into the complex range of possibilities followed by personal exploitation and development would appear to be one imperative.

2. a. 3 Dimensional Work should not be limited to traditional modelling and sculpture, and the appreciation of 3 dimensional form should not be limited to the characteristics of natural form. Work can exploit any material, no materials are better than others, or more specific to the creative process, except in particular contexts - banana skins and ashes can be as effective as marble and gold. Materials of all kinds should be collected, classified and exploited.

b. Work can be a development from 2 dimensional ideas, or be a specifically 3 dimensional idea. 3 dimensional work need not necessarily be concerned with solid and mass, it can also include any development which can be evolved between 2 and 3 dimensions. Pupils should have the opportunity from time to time to work simultaneously in 2 and 3 dimensions. If pupils are given the opportunity much more work would be done and more would be achieved in 3 dimensions than exists in schools at the present.

c. Preconditioning leads to predetermined reactions - materials and 3 dimensions should not be restricted to the geometrically processed materials any more than to the modelling-carving media. Aformal and informal methods which lead to new relationships, new combinations of material should be exploited. Materials should be experimented with to "destruction" as well as "construction". What is "right" for one is "wrong" for another - what is effectively brutal construction for one person might be rejected by someone who preferred a smoothly finished piece of precision production.

d. Children should often work on the basis of their strengths rather than their weaknesses. Preference for particular materials and forms should be indulged and exploited, but this should be counterbalanced by a diversity involving complementary values.

Work should be carried out with a meaningful sense of scale, rather than a fashionable or arbitrary size. All pupils should carry through some projects which involve group work, collaboration and organisation. Projects should, as far as possible, be "real" and "meaningful" rather than "hypothetical" and "academic".

e. 3 dimensional work should involve dynamic as well as static forms and concepts: many children are able to deal with simple mechanics and electronics. There is no reason why this shouldn't be exploited as well as being a means for integration with other disciplines.
It should also be remembered that although the processes and equipment might be limited in the classroom, studio or workshop, any known processes (or their products) whether traditional or "modern", hand or machine operated, mechanical - electronic - are open to exploitation.

3. Materials and Processes

a. Where possible there should be specific developments in workshop practice and the constructive use of materials. This might be limited but need not be inhibited by physical conditions - paper, card, string, rope, elastic, wire, rods etc., can be used in a classroom with minimal technology. A workshop situation can often be best achieved by collaboration with other departments (wood and metal) but every "Art" department should endeavour to extend its selective range of equipment and machinery.

b. A creative and constructive technology is as much the problem of the art teacher as it is for the technology specialist. Children can invent their own technology - they can invent forms while they are learning to use tools. Every technical problem is also an aesthetic problem.

c. After experimenting with materials, "fastening materials/things together", etc., pupils should have a period for exploiting their discoveries. This should be personal - whether functional problem-solving or open-ended expression.

d. Every pupil should have the opportunity to work with a wide range of materials - but more particularly to deal with different characteristics, e.g. rigid, flexible, mass, particles, liquids, gases (space).

e. The craft tradition has often built-up uncreative inhibitions. When craft, or process are pedagogically important in the curriculum there must be open-ended objectives and the minimum of preconceptions, e.g. printmaking doesn't have to be limited to small two dimensional pictorial imagery suitable for framing for walls - why not three dimensional prints, folded prints, "soft" prints, structure prints, multiple and mural prints, mixed media images etc. etc. Ceramics too often declines into "muddy achromatic pottery" where children act out historical roles - (making neolithic pots to order) - when there is the whole range of possibilities, of personal, expressive, sculptural, constructive, architectural, industrial, studio, environmental ceramics to work in.

f. Many homes possess more sophisticated tools than the art-room (electrically operated hand-tools, tape recorders, etc.). Every child doesn't want or need to use advanced machinery, but do you try and collaborate with others - to bring a creative attitude to the technology department, or "real" problems into the physics department (colour, light, dynamics). Even if you aren't necessarily able to use the most recently evolved modern materials are you sure you are fully exploiting traditional materials (the "wrong" way as well as the "right")and are you trying out new combinations.

4. Organisation and design

a. Traditionally "design" has been dominated by "paper work" and two dimensional thinking. There is certainly a place for two dimensional design in the curriculum but this should not be restricted to decorative or arbitrary pattern-making.

b. Pattern making requires either/or

(i) well researched sources of information, nature, organic, inorganic, all scientific sources, historical sources, man-made, formed, structured sources.

(ii) a sense of organisation and scale - symetric, asymetric, dynamic balance etc. sense of geometric, informal, order, control and repetition.

(iii) inspired ideas; ability to develop basic material, adapt, vary and orchestrate.

(iv) capacity for creative and visual play, "mind-free" manipulation of imagery - simultaneous thought and action.

Pattern should preferably be employed to some purpose, either as an invented form - personal art, or for an invented purpose - function.

c. Two dimensional organisation should also be the area where the pupil can deal with all types of variation of surface, by optical and tactile processes as well as by visual systems. Colour should be an integral part of organisation; local colour of material and media should be considered as important as manipulated, imposed colour. The work should involve a very diverse range of form, language and development of marks, linear structures, area of manipulation and coordination.

d. Pupils should exploit their structures and imagery in whatever way they can - either as personal unique images, or as repetitive forms in the field of information.

e. After the exploitation of material and processes in three dimensions - there will be natural desire to exploit or evolve initial developments - but projects and problems should be available.

Again opportunity must be given for personal selection and development, but there should be a balance of the creatively unique and the function.
If possible, there should be some problems which are the result of consultation with other subjects and disciplines. Where schools have specialised processes and an existing tradition, they should try to develop new forms and new problems.

f. Creative geometry should be one of the most developed areas of three dimensional organisation. Geometry is so for the dominant systems that man has devised for restructuring the universe. It is valueless to simply reproduce Pythagorean solids at the level of Xmas decoration. We must involve the child in creative structuring, bringing some sensible concern to the problems of structure and space but developing beyond solid and plane, rectilinear and angular, geometry to curvilinear, flexible elastic forms which relate to modern mathematic concepts.

5. Integrated and interrelated developments, mixed media, information and ideas

The barriers between disciplines diminish, the isolation of the senses succumbs to the free flow of responses and ideas. Too often we have isolated activities, out of exaggerated respect, out of the fear of unskilled incompetence in an unknown language - yet there are all kinds of available possibilities arising out of new combinations of systems or simply by not limiting the mode of expression to a one-sense operation. For too long we have been inhibited by an over-simplistic separatist attitude towards the senses. The mechanical object makes a noise, the structure involves sound - whether we stay at the level of noise and sound or develop into music is a matter for individual capacity or group collaboration. The physiology of mark making involves action and movement - these might be developed as well as the image - serial developments, time-sequence, the demonstration of ideas by action and involvement are natural aspects of creative life. The responses to ideas should be at least as important as response to materials. When ideas are strong, important, and significant they demand and create their own new forms. We don't know what the significant forms - the "Art" of the future will be - but we do know that all the forms which exist in the art of the twentieth century exist in the work of the child. Every classroom can be its own research situation and pursue its own truly creative developments.

6. The Environment

a. So far there is little evidence that the creative capacity of adolescents has been clearly and strongly evidenced in art education. Seldom also do we see strong links between what happens in the art room and the dynamic world outside. Artistic reflectence is not enough.

Children should use their visual training not merely to observe in an appreciative way - but to respond to other inferences and implications - there is a considerable field of "visual sociology" and "visual psychology" for investigation. Seeing a static world from a fixed point of view - captured in a pictorial image by itself alone, might well reveal very little of the nature of life.

b. How can we develop our objectivity, how do we collect information, how do we select, classify and use it. What tools and aids do we employ, can we use other people's information and images? How do we deal visually with complex visual forms and complex social concepts.

c. Everything that is made is an aesthetic proposition - everything we see is open to critical judgment and evaluation. Value judgments arising from tradition, training, imprint - high culture and popular culture, should be understood in the light of personal experience and assessment.
The world we live in and create - delightfully and destructively. The objects we make - and what do we make of ourselves - are questions to be defined, negotiated, and assessed. (We are the most destructive and the most neurotic societies and yet probably the most creative and perceptive that have ever lived).

d. What do we know of other men (a) now (b) the past. History seen as collective experience, the importance of our culture, the culture of the first really "self-conscious" men.
The timeless images - the cultures of other men (preferably not dominated by W. European culture).
The twentieth century developments of the industrial revolution, the new electronic revolution, architecture, design, information.
Adequate visual aids, slide library, library, periodicals etc.

e. Personal orientation and a psychological point of view - The development of personal standards - the evolution of collective tastes, modern patterns of different life-styles. Visual education provides the basis of standards rather than the imposition of predetermined standards of good taste. The breaking down of unreal mental barriers, avoiding the restrictive practices of isolated disciplines, and the artificial barriers between subjects prepares a child to cope more effectively with the complexity of modern life.
The implications of an increasingly journalistic culture require more than ever, the capacity to penetrate problems in some depth. Another implication is that children will want, more and more, to have everything subjectively orientated on an often already indulged "personal centre", it is the role of education to develop the personal centre on the basis of its existent strengths, but also to involve the individual in a responsible way, so that he can contribute to his society and environment rather than be a complaisant and apathetic victim.

# CARDIFF COLLEGE OF ART

TECHNICAL COURSES METAL DIP.A.D.

Metals are found in the earth's crust as ores which are natural and impure chemical compounds usually oxides and carbonates. These are mixed and refined by heating or chemical processes to give the comparitively pure metals with which we are familiar. Some metals, notably gold, silver and copper are occasionally found naturally in the metallic form.

Iron Ore The modern blast furnace for the smelting of iron can produce as much as 2,000 tons of iron in 24 hours.

Iron melts at approximately 1570°C and the blast furnace at its hottest point reaches temperatures of 1800°C. A large furnace would be about 100 ft. high and 30 ft. in diameter.

A mixture of ore, coke and limestone fills the interior of the furnace and streams of air are blown in through nozzles distributed evenly around the furnace.

The prime function of the air blast is to enable the coke to burn and produce the required high temperature. Its second function is to combine with the coke to form carbon monoxide gas which reacts with the iron ore producing iron and carbon dioxide. The limestone acts as a flux and also absorbs some of the impurities.

In falling to the bottom of the furnace the iron absorbs a number of impurities from the coke and contains about 3 to 5 percent carbon, 1% manganese, up to 3% silicon and some sulphur. Most of the impurities are contained in the limestone slag which floats on the molten iron.

The metal is run off from the bottom of the furnace into moulds giving pig or crude iron. This is usually conveyed (still hot) to the steel works where it is further purified and the carbon content regulated which in turn regulates the properties of the steel. In general the higher the carbon content the harder and more brittle will be the steel.

Aluminium This is the most plentiful metal in the Earth's crust but was until quite recently almost a precious metal because of the difficulty of extracting it from its ore. The pure metal does not occur in nature. Its most common ore is Bauxite which is usually quarried from open-cast sites. The process required for the extraction of aluminium from bauxite differs from that of iron production in that the ore is first mixed with a caustic chemical solution in which the aluminium oxide dissolves. The remaining impurities are filtered out. This purified ore is heated to 1100°C to dry it and to produce a pure aluminium oxide from which the metal is extracted by electrolysis.

All other common metals are extracted from their ores in some such manner to give the large range of metals available to modern man. Iron and aluminium are however the most common of these.

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Types and Categories

Metals are classified as:- 1. FERROUS - containing a high proportion of iron
2. NON-FERROUS - containing no iron or iron in very small proportions.

FERROUS metals are again divided as a. IRONS, b. CARBON STEELS and c. ALLOY STEELS.

IRONS:- Crude iron directly from the blast furnace is rather impure and contains an unspecific quantity of carbon. It is termed PIG IRON.

This may be purified and the carbon content controlled (usually by addition of more carbon) to give CAST IRON of which MALLEABLE IRON is a variant. WROUGHT IRON is nearly pure iron with only about 0.1% carbon produced from pig iron by heating it to a temperature high enough to melt impure iron but not high enough to melt pure iron.

As the iron is purified by oxidation of the impurities in the liquid iron it forms into pasty mass which is then squeezed, hammered or rolled into lengths of wrought iron.

PIG IRON consists of 90%-95% iron with 3 to 4% carbon and small quantities of silicon, manganese, sulphur and phosphorous. It is never used for any purpose but as a source material for other irons and steels.

CAST IRON is as above with any gross impurities removed and the carbon content controlled by mixing pig iron from different sources. Generally speaking there are two forms of cast iron. That where the carbon is present as iron carbide is termed white iron and is very hard and brittle. Grey iron has its carbon content in graphite form and is much softer and less brittle.

The difference is produced by varying rates of cooling as, if the cast iron is cooled slowly, the carbon separates out as graphite. This property is often used in such items as cast iron cylinder blocks in motor cars where the parts subject to wear are cooled quickly and the remainder cooled slowly giving hard wearing surfaces in the cylinders but a reasonably tough and more easily machined material elsewhere.

If the cast iron is cooled very slowly indeed the carbon separates further into globular form giving malleable iron which has the same chemical nature as cast iron but has physical properties similar to those of mild steel.

Wrought iron also has very similar properties to mild steel and is very rarely used nowadays except as a source material for the various forms of steel.

CARBON STEELS

These are much stronger and more uniform in texture than wrought iron of which they are a purified and modified form. Carbon is added to give proportions of 0.05-1.5% and very small additions of manganese, silicon sulphur and phosphorous are made to bring traces present in the wrought iron up to controlled levels. All of these contribute to the hardness and strength of the steels but these properties derive mainly from the carbon content. Carbon steels may be further classified as:-

Mild or Soft Steel which contains 0.05-0.2% carbon. This is easily welded but it is not possible to harden it by normal methods. It can be case hardened where a soft steel with a very hard skin is required as in for example files. Bolts, nuts, nails, wood, screws etc. are normally made from mild steel.

Medium Carbon Steel 0.2-0.45% carbon. Weldable. Can be hardened to some extent by quenching. (i.e. fast cooling from red heat). Strong bolts, nuts, dressmakers pins and the majority of machine parts such as shafts spindles, axles, and rails are made of this.

Hard Carbon Steel 0.45-0.8% carbon. Difficult to weld. Easily hardened. Tools for hot work, some forms of reamers and taps and dies for screw cutting.

Very Hard Carbon Steel 0.8-1.5% carbon. Difficult often impossible to weld. Can be hardened to a glass hardness. The carbon tool steels belong to this class. Most applications where a hard but tough steel for cutting tools such as shears, drills, chisels, lathe tools, engraving tools, etc., and even some ball bearings and roller bearings.

The other constituents commonly present in carbon steels do not much effect their physical properties.

Manganese is often present in quantities up to 1.0% and behaves in much the same way as carbon in that increasing proportions promote increasing hardness.
Silicon increases hardness and strength but reduces ductility. It seldom exceeds proportions of 0.5%.
Sulphur slightly increases strength but makes the steel brittle and "red short" i.e. the ductility and malleability of the steel at red heat is much reduced.
Phosphorous acts much as sulphur and neither will ever be present in proportions exceeding 0.05% each.

Definitions of Some Technical Terms

Annealing = softening. The object of this process is to remove internal stresses caused by cold working (e.g. bending or hammering) the development of which are usually termed "work hardening". Annealing makes the metal suitable for further working without danger of these stresses developing into cracks and fractures. Steels are usually annealed by slowly heating to 700 or 800°C and then slowly cooling.

Normalising is an extension of the above process where the steel is heated to a higher temperature (900-1100°C) at which temperature it is maintained for about 15 minutes after which it is allowed to cool in the air. This process is quicker than annealing and leaves the metal in its best condition for machining or hardening.

Case Hardening is the addition of carbon to the surface layers of mild steel in order to make these layers hardenable. Parts made in this way are cheaper because of the lower cost of mild steel and because it is easier to machine than the hard carbon steels. They are also tougher because of their soft core, but they have a hard surface similar to that of parts made from steels with a high carbon content.

The oldest method of case hardening was to surround the mild steel with a high carbon material such as charcoal, anthracite or crushed bone etc., in an air tight container which was then heated to a high temperature at which it was maintained for a long time. Simpler, quicker methods employing molten sodium or potassium cyanide are now widely used in industry as are other medthods such as nitriding.

Hardening This is a process where steel is heated to yellow-red heat (800-850°C) and then cooled as quickly as possible by quencing in water or oil. This process leaves the steel in its hardest but most brittle condition. Cutting tools not subject to shock would have their hardest cutting edge in this condition. The hardness achieved will obviously depend on the carbon content of the steel - mild steel would not be hardened at all, very hard carbon steel would be extremely hard but brittle as glass.

Tempering is a method of reducing the brittleness of hardened steel with comparitive small loss of hardness. If the hardened steel is reheated to, say, 250°C and quenched it will lose some of its brittleness but remain extremely hard. If it is heated again to 500°C it will again be less hard but will be considerable less brittle. It is possible therefore to control both hardness and brittleness by a suitable choice of temperature.

For general purposes it is sufficiently accurate to judge the temperature of heated steel by the colour of the oxide layer on a clean bright surface.

| | | | |
|---|---|---|---|
| Pale Yellow | = | 220°C | (Scrapers) |
| " Straw | = | 225°C | (Scribers, turning tools) |
| Mid Straw | = | 245°C | (Screw taps and dies, scissors) |
| Dark Straw | = | 260°C | (Twist drills, plane irons, centre punches) |
| Purple | = | 280°C | (Table knives, cold chisels) |
| Blue | = | 300°C | (Circular Saw Blades) |
| Greenish Blue | = | 315°C | (Screw drivers) |
| Greenish Grey | = | 330°C | (Springs, wood saws) |

Colours of heated steel:-

| | | | |
|---|---|---|---|
| Black red (visible in dull light) | = | 370° - 430°C | (High speed steel temper) |
| Cherry red | = | 760° - 815°C | (Quenching of carbon steels for hardening) |
| Orange red | = | 960° - 1030°C | (Alloy steel quenching for hardening) |
| Yellow White | = | 1200° - 1260°C | (High speed steel quenching for hardening) |
| White | = | 1310° - 1370°C | (Welding) |

ALLOY STEELS This term applies to steels containing, in addition to the usual constituents of carbon steels one or more elements such as nickel, chromium, cobalt, vanadium, tungsten, molybdenum, copper or boron.

The addition of these elements even in small proportions affects the physical and mechanical properties of the alloy (i.e. mixture of metallic elements) to a marked degree. The principal alloy steels are:- nickel steels, nickel chrome steels, low-chrome steels, tungsten steels, stainless steels, heat-resistant steels, silicon steels, manganese steels and high speed steels.

These constitute a wide range of steels for a variety of applications which could not be covered by carbon steels. Many of the alloy steels have far greater mechanical strength properties than carbon steels.

Nickel (5%) increases the tensile strength and toughness of steel. Low chrome (2½%) increases the hardness considerably even in the annealed state. Tungsten (5%) considerably increases toughness and impairs resistance to distortion during heat treatment. Stainless (i.e. high chrome 12-20%) steels are harder but more brittle than ordinary steels but their main value is their comparative resistance to corrosion. Heat resistant steels (30% chrome 30% nickel with small additions of tungsten and titanium) retain their physical properties even at elevated temperatures.

Silicon (2%) steels are very elastic and are of particular use in the production of springs for which reason they are often known as spring steels. Manganese (14%) steels are extremely tough and non-magnetic and have great resistance to wear as they tend to harden under mechanical pressure. High speed steels are complex alloy steels devised for specific purposes such as twist drills or shear blades. Generally their properties include low expansion when hot and low magnetic properties combined with extreme hardness and toughness.

NON-FERROUS METALS Copper and its alloys

Copper is a malleable and ductile metal second only to silver in its high electrical and heat conductivity. It is particularly rich in useful alloys and these with iron, steels and aluminium are quite the most common metals in use today.

Copper is available as 1. <u>High Conductivity Copper</u>
(H.C.) which is about 99.9% pure and very expensive.
2. <u>Best Select Copper</u>
which is somewhat less pure and a little harder than H.C. and is the copper in most common use for fabrication purposes.
3. <u>Arsenical Copper</u>
which contains 0.5% arsenic as a hardening agent and is the commonest commercially used copper being that used for the pipes, strips and plates used by the building industry.

Copper is quite soft but when rolled, hammered or otherwise cold worked it hardens considerably so that soft copper bar drawn down to a wire may be very hard indeed. It is annealed for further working at 200-250°C unless thick sections are being dealt with when the temperature required may be as high as 500°C. The copper may be quenched in water or allowed to cool in the air.

<u>Copper Alloys</u>. <u>Brasses</u> are alloys of copper and zinc with from 63-90% copper. The most common brass is Alpha or Cartridge brass which contains 70% copper. Yellow metal (60% Copper) is quite common. There is a large variety of brasses for special purposes some of which contain other metals such as nickel to impart hardness and a degree of tempering hardness, or lead to make it free running for casting purposes or to make it easier to machine, ordinary brass tending to cause lathe tools to "chatter".

A curious property of most brasses is that of "hot shorness". This means that the metal has poor ductility when hot so that instead of bending, for instance, it breaks. Some brasses are specially alloyed to circumvent this tendency.

<u>Bronzes</u> are properly alloys of copper with tin but there are other alloys known as bronzes (e.g. aluminium bronze) some of which contain no tin at all.

Gun metal is one of the commonest bronzes containing from 85-92% copper, the rest being tin. In some gun metals a small amount of zinc is added. Gun metal is commonly used for strong castings and bearing bushes as it has a strength and resistance to corrosion greater than ordinary brasses.

When phosphorous is added in small amounts to molten bronze (copper-tin) it acts as a deoxidiser and makes the metal more fluid. It also increases the strength and hardness and results in a stronger metal than gun metal. Phosphor Bronze is usually 5-10% tin and 0.15-0.8% phosphorous, the rest being copper.

<u>Aluminium and its alloys</u> Aluminium is a good conductor of heat and electricity and is practically unaffected by ordinary atmospheric corrosion although it is attacked by sea water by caustic alkalis and by hydrochloric acid.

Under normal circumstances aluminium forms an oxide skin on exposed surfaces. This skin protects the metal underneath from attack by the atmosphere but it also, (it is very difficult to remove it), results in the aluminium being more difficult to weld than mild steel, copper or copper alloys.

The weight of aluminium is less than one third that of copper and slightly over one third that of steel. This is also true, more or less, of its alloys which contain up to 15% of other metals. As many of the alloys are almost as strong as mild steel they are becoming very important in modern technology.

Aluminium is usually supplied as "Commercially Pure" and can be obtained in various grades of temper which are obtained by work hardening and then reducing the hardness by annealing at various temperatures. Aluminium is easily hardened by working and just as easily softened by annealing at 380°C.

There are many alloys of alluminium made for special purposes - usually where light weight with strength or good conductivity are important as in the aircraft industry or in Internal Combustion Engine Parts.

They are, however, unlikely to replace steel as a structural material unless new techniques (whereby glass fibres are imbedded in the alloys) are improved. Their main disadvantage is their low fatigue strength where steel is some 50% stronger than the best light aluminium alloy for a given weight.

The most important alloy is Duralumin which is an alloy of aluminium, copper, manganese and magnesium. It has a peculiar property in that it "age hardens". This results in Duralumin rivets, for instance, hardening to an unusable extent within a very short time after being annealed.

<u>TIN PLATE</u>.MILD steel plates coated with a thin layer of Tin on either face are known as "tin-plates" which are used for a variety of pressed, stamped and soldered items.

This material is most familiar in the form of tin cans, canisters and other containers.

There are two grades of Tin Plate. Welsh tin-plates are the most common. They are manufactured by dipping cleaned and fluxed steel into molten tin. The Siemens-Martin process is similar but no flux is used the metal being thoroughly scoured and acid cleaned and the plates then left to soak in two successive baths of molten tin at different temperatures for longer periods. These are generally known as "doubles" and have a tin coating much thicker than Welsh plates.

AVAILABLE FORMS

All metals are available in a variety of forms and quantities.

Mild Steel. Plates can be obtained in thicknesses ranging from ⅛" (10 gauge) to 1" or heavier. Plates are rolled to thickness at red heat. This leaves a layer of black iron oxide (usually known as "mill scale") on the surface. Their thickness may vary quite considerably compared to sheet steel.

Sheets can be had in thicknesses from 38 Gauge which is 1/64th inch thick to 10 gauge which is ⅛" thick in 13 intermediate stages. These sheets are prepared by cold rolling from hot rolled plates which have been scoured to remove the oxide coat. Their thicknesses will be quite accurately maintained. Since their surfaces are very clean such sheets are very susceptible to rusting. They are therefore oiled immediately after manufacture.

The same principle applies to the other forms of mild steel though in these cases the two grades are known as black steel (produced by hot rolling) and bright drawn (produced by drawing the black through dies when cold). The bright drawn steel will dimensionally accurate within half a thousandth of an inch plus or minus.

Bar, Rod, Strip, tube and a variety of sections such as angle and channel are obtainable in such a large range that whatever is needed something very near it indeed can be had. As an example Bright Drawn Mild Steel Strips range from 1/16th x ½" to 1" x 4" in over 80 different combinations of sizes.

Brass is sold in a bewildering variety of qualities of which "Alpha" or "Cartridge", "Yellow" or Muntz" are the most useful (the former will be sent if one orders simply Brass). These are generally available in a variety of tempers ranging from soft via half hard to hard with various intermediary stages.

It is normally sold in round, square, hexagon and flats (which are sheets). The rounds for example run from ⅛" diam. to 3" diam. by ⅛" stages and half hard flats can be obtained from 24G. (0.022") to ⅛" in fifteen stages and in hard sheet up to 3/16ths" in about ten stages.

Aluminium is probably obtainable in a larger variety of forms than the rest put together. Certainly a large variety of qualities is obtainable. Soft, Quarter-Hard, Half-Hard, Three-Quarter-Hard and Hard sheets can be had in "mirror", "polished", "Satin", "Frosted" and a variety of other finishes in thicknesses from 30 Gauge (0.0124") to 1" in about 60 stages. It is also possible to obtain an almost unending variety of sections, some manufacturers catalogues containing up to 100 pages each page showing perhaps 30 different sections and each section available in a dozen different sizes and each size in half a dozen finishes.

Copper and Other Metals. These are generally limited in range compared to any of the above. It is usually possible however to obtain a range of sheets, bars, wires and tubes.

METHODS OF WORKING

The methods of working metals by hand may be divided into three groups:-

1. Casting
2. Hot working or forging
3. Cold Working (which includes machining).

1. Casting:- This will be dealt with in a separate paper.

2. Hot working:- Steels are usually more easily formed when at red or white heat. When heating the metal care should be taken that the temperature is not raised so high as to melt or burn it. Normally the best temperature is between 920 and 1030°C (that is an orange red colour) though some steels and very heavy sections may require higher temperatures.

At these temperatures steels may be bent or beaten or cut to shape on an anvil with a hammer and special anvil tools. Thin sections and non ferrous metals do not normally require heating.

3. Cold Working:- Mild Steel rod under ⅜" and sheet steel under ⅛" may be, usually, formed cold by hand or with simple machinery. Non ferrous metals are almost always worked cold.

Metals being cold worked tend to harden due to the compression of the grains of metal and also to develop internal stresses which may become fractures. For this reason it is essential to anneal the metal periodically as described earlier.

This of course does not apply when metal is being drilled, cut, turned or ground by machine as these processes do not involve compression.

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METHODS OF FABRICATION

Folded metal joints. A method of joining thin sheet metals by folding over, interlocking and flattening the adjoining edges. This method is very widely used in mass production techniques applied to metals when special machinery provides a quick, cheap and strong method of joining. It is commonly used on tin cans when the joints are often soft soldered.

Nuts and Bolts. It is of course possible to join metals with nuts and bolts when the instructions given later under rivetting as to placing and size of holes should be followed.

Apart from the ordinary nuts and bolts there exist a variety of joining methods based on their principal which are of interest.

Speed Nuts. Self tapping screws

These present a very quick, easy and cheap method of joining where the article must be taken apart again. There is no need for locking nuts (these or self locking nuts are normally required with nut and bolt joints) as this joint is vibration proof. It is often used in the motor industry where assembly can only be made from one side as when attacking components to box sections. The nut is essentially a strip of spring steel with one or more thread engaging portions pressed upwards.

These are called speed nuts because the majority of the screw can be pushed through with a hammer only the final half turn having to be made with a screwdriver.

Self tapping screws are a variation on this idea where the screw is designed to cut threads for itself when screwed into a hole of the correct size. They are of two types both having a tapered shank and one having a pair of rectangular slots cut in the end. The latter is designed to cut threads in the wall of the hole. This type is not very effective unless the metal into which it is being screwed approaches ⅛" in thickness. The second type has rather coarser threads and depends for much of its strength on these overlapping the far side of the metal. It can be used on thinner sheets.

The former type and indeed ordinary machine screws can be used on thin sheet if the hole is punched out to provide lengths of thread for tapping.

Rivetting This is a jointing method which has been used since very early times and results in a permanent joint as opposed to bolting on screwing which are temporary.

Holes are drilled in the two pieces of metal and into these are pressed rivets of slightly smaller diameter. Pressure is then applied to the plain ends to expand them to heads over the plate.

This process presses the two plates firmly together. The rivets must obviously be fairly soft or they would not hammer over but not too soft or they would break under stress. Mild steel, copper and aluminium are the most common materials.

In order to obtain the strongest possible joint the rivets are often heated. The rivets can then be hammered over much more quickly as as the rivet cools and contracts it pulls the plates even more tightly together. This tightness of the plates contributes considerably to the strength of the joint.

There are strict conditions fixing the size of rivet for the job it is to do and also the spacing and positioning of the rivets.

There are a large variety of rivet types in use but the most common are cup head, pan head and countersunk.

The length of the plain projection beyond the two plates should always be 1½ times the diameter if cup heads are required, 2-2½ times for pan heads and equal for countersunk.

The diameter of the rivet itself should be twice the thickness of the thickest plate to be joined except when aluminium rivets are being used when the next largest size available should be taken.

A wide variety of riveted joints have been developed.

Aluminium must always be riveted with aluminium rivets as any other material causes the surrounding metal to corrode.

Bifucrated Rivets are rivets with divided shanks enabling the TWO ends to be riveted over quickly. They are not as strong as plain rivets.

Tubular Rivets are again a quicker way of riveting than plain rivets and have the advantage that all the work is done from one side only of the joint.

Two processes typical of the many types of tubular rivets are "Chobert" and "Pop".

The rivet and mandrell are placed in the hole and whilst the rivet is held firmly in place (the mandrell is drawn out expanding the rivet to leave a head on the far side and also to fill the holes.

Modern versions of this have dispensable mandrells the head of which breaks off in the hole and fills it.

Mild Steel "Pop" rivets have now been almost entirely superceded by the "Chobert" type which are almost invariably (but wrongly) referred to as "Pop" rivets. Aluminium "Pop" rivets are still occasionally used.

SOLDERING. One of the most widely used methods of joining metals is soft soldering, where a low melting point alloy is fused between the surfaces of the metals to be joined forming an alloy at the surfaces. Most metals can be soldered with one or more of a large variety of solders and most of the common ones including iron, steel, brass, bronze, copper, nickel, lead, pewter and zinc can be soldered with normal "tin man's solder".

Tin Man's solder is an alloy of lead and tin. Lead has a melting point of 325°C and tin of 232°C but certain mixtures of the two metals melt at temperatures lower than either of these.
A solder which is 63% tin and 37% lead, for example melts at 183°C which is the lowest melting point solder. Good tin man's solder is about 65% tin and lead/tin solders are available varying from almost pure lead to almost pure tin to suit a variety of purposes. Plumbers solder is usually about 30% tin as in these proportions the solder melts at 260°C but remains in a paste-like state until it has cooled to 183°C. All mixtures (except that containing 63% tin) have this property to some degree enabling them to be modelled.

Before a sound joint can be obtained the metal must be clean and bright. It is therefore first mechanically cleaned with a wire brush and/or emery cloth. It is then chemically cleaned with a flux which removes any traces of dirt, grease or oxide and prevents the reoxidisation of the surfaces. Most fluxed also promote fluidity in the molten solder.

The corrosive fluxed are based on zinc chloride (Baker's fluid is an example) and these are very good on steel, iron, copper and its alloys. All traces of flux must be removed after soldering to prevent further corrosion.

Non-corrosive fluxes such as resin, tallow and olive oil are generally used for electrical purposes where subsequent defluxing would be difficult. These fluxes are often contained in tubes of solder (Flux cored solders).

Soldering Technique

If the surfaces are thoroughly cleaned and the correct flux and grade of solder is used little difficulty should be experienced. The surfaces should first be "tinned":- apply flux, melt a little solder onto the surface, heat until solder becomes fluid, wipe quickly with clean rag so that a thin film of solder remains.

As large a soldering iron as possible should be used, consistent with the size work. The iron should be just hot enough to cause the solder to run readily into the joint. If the iron is not hot enough pasty solder will merely be daubed on the work. If the iron is too hot a crystaline and brittle joint will ensue. Electrically heated soldering irons are designed to maintain the correct temperature. When flame heated soldering irons are used they should be at the temperature which just turns the flame green. All irons should have their tips tinned before use.

Soldering Aluminium

It is generally thought that soldering aluminium is impossible. This in fact is not the case. The difficulty lies in that there exists no satisfactory flux to remove the oxide layer. If, however, after preliminary cleaning the aluminium is heated until the solder melts upon it the molten solder can be made to adhere by scraping with an old hack-saw blade or other scraper. Once the film is broken it cannot reform under the solder and alloying takes place between the tin and aluminium.

When the surface is fairly well covered with molten solder the adhesion is improved by rubbing with a wire scratch card thus breaking up any remaining traces of oxide. Solders for aluminium usually consist of zinc and tin but a reasonable job can be made with ordinary tin man's solder.

Reaction soldering of aluminium is a newer development. There the solder is a chemical mixture which is spread on the parts to be jointed and then heated to about 200°C. A chemical reaction taken place which results in the deposition of pure zinc in a molten state on the aluminium surfaces to be joined. The zinc flows readily and forms an excellent joint which is much more permanent that those obtained by the process above.

Hard Soldering. This process resembles in its general principles that of soft soldering but it uses solders known as silver solders having much higher melting points and greater strength than solt solders. There are three standard silver solders containing silver, copper and zinc. (the third contains also cadmium). Grade A is molten between 690 and 735°C, Grade B between 700 and 775°C and Grade C between 595 and 630°C.

These are commonly used with a borax flux mixed to a paste with water which serves the same purpose as soft soldering fluxes. The surfaces are fluxed and then placed in position and heated with a blow torch or oxy-acetylene torch. When heated sufficiently the solder (in rod or strip form) is applied to and melted into the joint.

Iron, steel, brasses, bronzes, gold, silver and their alloys may be satisfactorily silver soldered.

Hard Soldering Aluminium (Also known as Aluminium Brazing) Here the solder consists of an alloy of aluminium melting between 500 and 600°C. The processs is the same as above except in so far as a special flux similar to that used for aluminium welding is used.

BRAZING This is an extension of hard-soldering where the two pieces of metal are joined with a high melting point alloy though this point is still below that at which the metals to be joined melt.

With steels and iron brass is used for the filler rod. The metals are heated to red heat and then the brass rod and a borax flux melted together into the joint. The work must of course be clean. The flux hardens to a glass on cooling and it is best removed with a wire brush after the brass has hardened but whilst the flux is still soft.

Aluminium brazing has already been described under hard soldering.

Copper may be brazed with special rods which do not need flux. These are supplied by British Oxygen as Cuprotectic rods.

Copper itself may be used as a brazing filler for steel where extra strength or heat resistance are required though nickel bronze rods are usually sufficiently strong for most purposes.

WELDING. This is the amalgamation of the parent metal of the two pieces to be joined. A filler rod of the same metal is used.

If two pieces of iron or steel are heated to white heat and then hammered together the two pieces, being nearly at their melting point will fuse together. This is the historical method of welding which is still occasionally used particularly in the manufacture of large wrought chains.

More modern processes are Flame welding and Electric welding.

Soldering and brazing processes rely on alloying the solder or brazing material with the surfaces of the higher melting point metals and the strength of the joints are thus lower than those of the base metals themselves. Welding processes actually fuse the joining surfaces together and the strength of such joints is practically that of the base metal.

Among the metals which can be welded satisfactorily by modern processes are wrought iron, carbon and alloy steels, cast irons, copper, brasses, bronzes, nickel and nickel alloys, aluminium and its alloys and some magnesium alloys.

Flame Welding. This is widely used welding method utilizing the heat of combustion of such gasses as coal-gas, acetylene, hydrogen, propane, butane etc., when burnt with oxygen. Of these coal gas and acetylene are the most common.

In oxy-acetylene welding the gasses are mixed in correct proportion in a torch and ignited to produce an intensely hot flame. This is used to melt the edges of the metal to be joined and a filler rod of the same metal. These flow together to make a strong joint.

With metals up to $\frac{1}{8}$" thick no edge preparation is required it being only necessary to leave a slight gap (half the thickness of the metal) to allow access to the lower part of the plate. With thicker plates it is usually necessary to prepare the edges in some way to allow this access or to adopt unusual methods of welding which give greater penetration.

Brass can be flame welded using the brass rod and flux normally used for brazing mild steel. An oxidising flame (that is one with an excess of oxygen) is required.

Aluminium and cast iron can be flame welded using special fluxes and rods of the parent metal.

Electric or Arc Welding

Arc welding requires an electrical transformer which converts the supply to provide a variable amperage, the amperage required depending on the thickness of the Electrode (Flux coated welding wire). The principal of the working operation is that the negative lead from the transformer is clamped to the base plate of the job in hand; the positive lead ends in a clip holder which secures the Electrode and this, when touched or struck on the base or job, creates an electrical resistance which in its turn produced a high amperage arc and this in turn generating an intense heat of approximately 6000 to 7000°C.

Again as in Oxy-acetylene welding this is applied to the joint to be secured and the operator carries the electrode along the seam which simultaneously to melting the parent metal edges, melts away itself and acts as a filler to the joint.

As against Oxy-acetylene welding, Electric Arc is a more intense and instantaneous heat, the advantage of this being that is is less likely to distort the metal and does not necessitate pre-heating of thick metal as in gas welding.

WARNING The Ultra Violet rays emitted by this welding process are dangerous to the eyes which should be protected at all times by a welding screen. It is also important to hide the welding area by screens in order that others working in the vicinity may not be exposed to flashes from the welding operation.

Argon Arc Welding

This type of welding requires a more elaborate kind of equipment but is similar in operation to that of Electric Arc Welding, but it also includes a process wherein the arc when struck and held in operation is surrounded by a pocket of Argon Gas.

The advantage of this is that the weld or the molten metal is completely protected against Oxidisation which removes the necessity of using a flux for non Ferrous metals etc. Fluxes sometimes form a pocket within welds which eventually set up corrosion.

Electric Spot Welding

A process much used in the sheet metal industries.

It is similar to arc wleding but using higher amperages still but intermittently and at a point.

The two pieces to be welded are clamped between two copper electrodes through which a current is passed for a very short time.

This current, in overcoming the resistance of the steel, aluminium or brass being welded results in a high temperature spot in the metal immediately between the clamping electrodes. This is of a high enough temperature to fuse the two pieces together at this point.

General Aims and Policy

1. Within a diverse but balanced pattern of general education, the creative activities which we traditionally refer to as art should play a vital and constructive role.

2. Although we should aim to stimulate innate creative ability we should also develop the child's sensibility and educate its capacities as a whole.

3. At the same time as we stimulate and develop individual creative ability we must foster a collective creative attitude; we should consider the importance of shared experience, integrated activities, and collective creative endeavour.
(The collaboration of individuals in spite of the diversity of individual language and divergence of points of view makes creative art education of increasing significance in eradicating the conflict between men. Diversity and difference of language and form of expression can lead to recognition, respect, and understanding rather than insensitive incompatibility).

4. We should be concerned with educating for a more creative way of life for all rather than giving undue over-attention and advantage to those who are "artistically" inclined or presumed to be specially "gifted", by framing courses which are based on elite skill concepts.
(There has been a great deal of confusion concerning the "artistic" and "creative" processes. It would be as well to remind ourselves that our responsibility should be to provide a creative education rather than merely carry on a programme of "doing Art").

5. The implication of the pupil in his own education should be made a fact whenever possible. At all levels of education the child should be informed of the aims and objectives of the work in hand, and in the long term, be given some explanation of the principles that are involved in his education.
Whenever possible the child should exercise choice and selection; choose his own aspect of research, invent his own problem as well as answer other people's questions.
(A sense of personal responsibility and control is engendered by the special "gestalt" characteristics of the creative art process - the youngest child or the most gifted adult is equally responsible for a "total" situation. This is a necessary balance to the fragmentary character of much other education).

6. Selection, expression, commitment in both personal creative endeavour and constructive problem solving should lead to meaningful personal standards and judgments. Practical experience can lead to confidence, both physical and emotional by achieving the effective realisation of aims. We must teach so that the child can demonstrate his ideas; we can learn to objectify the dream, make a vision or concept into a precise concrete reality.

7. More and more knowledge is achieved visually, so the importance of this discipline continues to increase and every effort must be made to extend its influence in the curriculum, in the life of the school and in education and life generally. It is necessary to understand that this discipline is as profound, complex and significant as any other; the role of poor-sister subject, in terms of time, timetabling, staffing and finance is no longer acceptable.

(Neither is the role of "additional cultural fringe benefit" acceptable or even the role of "artistic service department" unless it involves integrated activity or collaboration and consultation at a worthwhile creative level).

8. Teaching should establish visual and plastic literacy, achieved by formal understanding, practical experience, and intellectual consideration. Fundamental processes involved should include research, observation, analysis, organisation and development, but not necessarily in a 'linear' or formal method; opportunities must also be provided for instinct, insight, incident, accident, inspired visual and mental concepts.
There is no place for uncreative "exercises" in creative education. (Observation is not to be limited to the eye, even with mechanical aids - observation should include the penetration of the object, problem etc., at many levels - physical, physiological and psychological. Research should be open-ended - towards an unknown rather than a preconceived end.
The teacher should have a considered understanding of what can be taught and what must be discovered for oneself. This should be open to readjustment. Education should be seen as a formative and expressive process not merely for the so-called "formative years" - but rather as a continuous self-development).

9. Creative art education should deal effectively not only with work in two and three dimensions, the area between these and extensions of them, but also with the development of ideas which involve intersensory or "intermedia" activity. In this way we open up new areas of possibility, new modes and tools of expression.
(There is still a tendency to accept convenient forms and labels (e.g. Painting and sculpture, drawing etc.) without considering their implications and recognising that there have been considerable developments between, around, and beyond these historically recognisable definitions. Any art education which restricts itself to standard routines, pre-conceived reactions and academic formulae should be considered inadequate).
Equally, any processes or techniques taught at the level of uncreative handicraft should give way to a more creative technology in which the child contributes personally, dominating process and material; mind and mental processes "freed" by technology and machines not enslaved by them).

10. The creative processes, the development of constructive aptitudes, and functional problem solving should be integrated with intellectual, historical and academic aspects of the subject.
(Just as we are not concerned with training unique, elite artists we should not be concerned with training specialist art historians and isolating yet another discipline - nor must we pour bucketsfull of culture over our children in a short-term, misplaced hope of achieving conformist good-taste).

11. The child should be instructed and given opportunities to deal adequately with his own sensibility, to explore and elucidate the worlds of seeing, knowing and feeling, so that he can develop a secure and meaningful personal psychological orientation and contribute creatively to the collective social situation. Many of the most significant concepts of our time and culture cannot be adequately dealt with by direct observation and representation from a fixed point of view. Our self-conscious role is to go deeply into the nature of the problem - and the problem is man.

General Notes on Creative Art Education
with particular reference to Secondary
Schools.

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This material while expressing my own point of view about some general aspects relevant to all education, is more particularly aimed at providing a new statement to assist the teacher in secondary education.

Tom Hudson.

## Photographic Preparation for Screen Printing

### Types of Originals

The following is not an exhaustive classification but some main types of work and a guide to the operations carried out before making a stencil for screen printing.

Photographic negatives of half-toned subjects.
operation No. 1 to 20.
Photographic positives of half-toned subjects
operations No. 1 to 7, then No. 14 to 20.
(subject to certain reserve in the case of colour slides)
Transparent positives of line subjects (of suitable size)
operations No. 14 to 20.

Opaque half-tone subject (e.g. newspaper picture) can frequently be photographed, copied "dot for dot", then
operations No. 14 to 20.

Opaque line subjects (e.g. lettering) can be photographed, then
operations No. 14 to 20.

Opaque subjects having tones (e.g. a painting, a flower or a piece of ceramic) can be photographed in the usual manner, then operations No. 1 to 20 apply, or under certain circumstances may be photographed on "Autoscreen" Ortholfilm and then operations No. 14 to 20 will apply.

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### List of Operations

1. By projection the negative is enlarged to the required size on to Kodak Kodalith Autoscreen Ortho Film, which incorporates a half-tone dot pattern of 133 lines per inch.

The "required size" will most likely be near 5" x 4", but not always therefore advice should be obtained. If the original is a 5" x 4" negative it can be contact printed on to Autoscreen film. In this case all subsequent operations remain unaltered.

Darkroom Safelight - Kodak "Wratten" 1A.

Exposure, whether it is for enlargement or contact printing, is by the same method used in paper enlargement, i.e. make a test strip.

2. Flashing exposure. This is given to modify the dot size and contrast, and is made <u>after</u> exposure under the enlarger or contact, and <u>before</u> development.

It is done by placing the film four feet from a Kodak "Wratten" OB safelight fitted with a 25 watt bulb. The average exposure is 10 seconds. Longer exposure reduces the contrast.

3. Development is in Kodalith Developer, made up one part solution A one part solution B, and one part water. Use at 68 degs. F. The total time in the developer is three minutes. The first two minutes the developer is agitated, and for the final minute it must remain still.

4. Stop bath. 10% Acetic acid in water leave film in for about 10 seconds.

5. Fixation. May and Baker's. "Amfix" high speed fixer made up as directed for lith. film. Time required; note how long the film takes to clear and continue fixing for double that time (total is usually about 90 seconds.).

(1970.)

6. Wash film in running water for ten minutes.

7. Dry film. This will take about an hour in a warm room. Try and avoid dust.

The operations so far have produced an half tone positive having 133 lines per inch. This is far too fine for screen printing. It must be enlarged at least x3 to reduce the number of lines per inch to 44⅓. This number is in the usable area for screen printing.

As enlargement is essential, the next step must be to make a dot negative from the existing dot positive.

This may be done by contact printing the positive on to another piece of film. There may be reason for doing this by further enlargement. Contact printing is described.

8. Take the dot positive on Autoscreen film and place in intimate contact with a piece of Kodalith Ortho Type 3 film. This may be done by placing the two pieces of film between glass and clamping the end of the glass with bulldog clips. The films should be emulsion to emulsion.
Darkroom safelight Kodak "Wratten" 1A.

Focus the enlarger on the baseboard, but without a negative in place.

Place the two pieces of film in between glass on the enlarger baseboard.

Exposure is assessed by the same method as used for paper enlargement - i.e. make a test strip. Times will vary according to conditions, but the "best" exposure will be in the order of 10 seconds.

To expose: switch on the enlarger lamp and count or time.

9. Development of Kodalith Ortho Type 3 film is done in Kodalith developer, made by mixing equal parts of the A and B solution. At 68 degrees F. development time should be about 1½ minutes.
Agitation of the solution should be constant. For about the first minute no observable change will take place in the film; then the image will arrive quickly. During the next 15 to 30 seconds the decision must be made when to remove the film. That is when it has reached its correct density. This is most easily judged by the "waste" film around the edge of the image, when this is dense black optimum development is either very near or reached.

Should the image be chiefly line development should be stopped just when black is reached: further development will degrade the line.

10. Place film in stop bath of 10% Acetic acid and water for about 10 seconds.

11. Fixation in May & Baker's "Amfix" high speed fixer made up as directed for lith. films. Note how long it takes for the film to clear, then double this time to continue fixation (total time will be about 90-120 seconds).

12. Wash in running water for about 10 minutes.

13. Dry film. This will take about an hour in a warm room, avoid dust settling on film while drying.

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The last series of operations have produced a dot negative from the dot positive by contact.

Whatever the size of the dot negative if it is a contact copy of the Autoscreen positive (produced by operation 1 to 7), there will still be 133 lines to the inch which is too fine for screen printing.

The next step is enlargement of the dot negative on to Kodak TM material to the size required for screen printing. This has a dual function. First the required size is achieved, second the number of dots per inch is reduced by enlargement to a coarseness suited to screen printing.

It can be calculated by using the value of the linear enlargement of the negative as the divisor of 133. The result is the lines per inch in the enlargement.
Example a 5" x 4" Autoscreen negative is enlarged three times, to 15" x 12" ... i.e, x 3. Divide 133 by 3 = 44⅓, which will be the dots (lines) per inch in the enlargement.

The calculation has another use it demonstrates that an 'Autoscreen' negative must always be enlarged at least three times for screen printing, because 45 line screen is about as fine a screen that can be expected to print under general workshop conditions.

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14. The dot negative produced by the last series of operations is placed in the enlarger in the usual manner. The enlargement is made on to Kodak TM (translucent material) which is suited to coarse half-tone screen images. (for certain work Ortho Type 3 film is better).

Safelight - Kodak "Wratten" 1A.

Exposure - time is assessed by means of a test strip. TM material has similar characteristics to Ortho Type 3 film, and it will be found that with a dot image exposure changes from useless to a short range of usable exposures.

15. Development is in Kodalith Developer, equal parts of A and B solutions at 68 degs.F, with constant agitation. Time should be 2¼ minutes, therefore exposure should be adjusted to allow this optimum development time.

16. Stop Bath - 10% Acetic acid and water for about 10 seconds with constant agitation.

17. Fixation in "Amfix" high speed fixer made up as directed for lith. film. Time is double that the material requires to clear. It will take between 2 and 4 minutes total time. At all times the TM material must be covered by the fixer and constantly agitated. This material is liable to stain therefore directions for fixing must be followed with care.

18. Washing:- wash in running water for five to ten minutes. Do not over wash, as this will contribute to possible drying marks and failure to dry flat. Both flaws make stencil production impossible. Do not over wash TM material.

19. To minimise drying marks (and speed drying), either pass the material through a bath of wetting agent, and/or wipe with a soft viscose sponge.

20. <u>Drying</u>:- Hang by <u>two</u> clips and air dry. Excessive heat must be avoided, e.g. electric fires, or drying over a radiator. If any heat is used it must never exceed 120 degs.F. and be for a short period of time.

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Notes on the Photographic Techniques mentioned on Page One.

"Dot for Dot" copying:- where an original is already halftone screened it is frequently possible to copy this by photographing on to a high contrast film.

To achieve this requires a view camera, with double extension, the correct sheet film for the work, suitable developer and technique. Usable results cannot be expected from 35 mm. or 2¼ sq. cameras.

Opaque Subjects having Tones:- This is a very large classification which can be photographed in the usual manner, and preparation for screen stencil making carried out as instructed.

If the subject is truly static it can be photographed directly on to Kodalith "Autoscreen" Orto Film in a view camera. This will shorten the number of operations to making a screen stencil. There are disadvantages which usually off-set the shortened preparation. They are these; the object must be truly static, because the film is slow and exposure long, the film being Ortho it only gives a reasonable translation of colour into monochrome, for example red comes out too dark.

Colour Slides as Positives:- If a slide is used as an original for making a screened negative, good results are uncertain. Distortion may arise in two directions. The balance of the slide may be upset, because two colours separated by colour change may record as the same orsimilar tones. Tone balance will certainly change because of the limited response to colour inherent in an orthochromatic emulsion like "Autoscreen".

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INTAGLIO: All the previously described techniques may be used as an intaglio preparation method. Except that a negative TM is required, therefore steps 8 to 13 are omitted. A much finer halftone image may be employed, usually with success.

CARDIFF COLLEGE OF ART

TECHNICAL COURSES STONE DIP.A.D.

Natural form of the material

The basic groups of stone are as follows:-

A. IGNEOUS ROCKS These have been formed by the heating and cooling of subterranean masses. The colour range is very wide and the stone is usually hard and difficult to work. The group includes such rocks as Granite, Basalt, Diorite and Obsidian.

B. SEDIMENTARY ROCKS These are formed by deposits of sediment in layers. The sediment may be sand, grit or oolite (minute spherical shells). In colour the stone is mainly yellow to brown or grey and, apart from the sandstones and gritstones, is soft to medium hard and easy to work. The group includes all limestones and alabaster.

C. METAMORPHIC ROCKS These are mainly formed from the above two groups through volcanic action and are very variable in colour, hardness and workability. The group covers marbles, steatites and slate.

Most stones are soft and more easily carved immediately after quarrying, becoming harder and liable to fracture the longer they are exposed to the air. Freshly quarried stone is termed "green". Almost all stones, of whatever natural colour, texture or hardness tend to become greyer with weathering and to lose their colour. The "bed" of a stone is its natural stratification and any large block should be "base bedded", in that the strata should lie horizontally. This applies particularly to sedimentary stones with marked layer formation and to slates. Stone used with the strata vertical is said to be "face bedded". A "free" stone is a fine grained easily sawn limestone o sandstone. Stones weigh from 120 to 140 lbs. per cube foot, though granite and other igneous rocks weigh more.

Available Varieties and Forms of Material

ANCASTER A yellow to pale brown limestone. Fine grained and easily worked.
Gregory Quarries Ltd. (Head Office - Mansfield) Ancaster, Nr. Grantham, Lincs.

BATH STONE A white to cream limestone. Fine grained, generally soft but variable.
The Stone Firms Ltd., Moor Park House, Moor Green, Corsham, Wiltshire.

COTSWOLD White to creamlooltic limestone. Fine grained, soft and easily worked.
The Stone Firms Ltd.,

PORTLAND White to grey limestone. Generally fine and even, especially whitbed.
Medium hard and easily worked. The Stone Firms Ltd.

HORNTON A brown or blue-grey sandstone. Fine grained, medium hard and works freely.
Hornton Quarries Ltd., Edge Hill, Nr. Banbury, Oxon.

ALABASTER A translucent white limestone. Fine grained and soft. Does not weather well out of doors. Alabaster Industries Ltd., Weston, Staffordshire.

FOREST OF DEAN A pale or blue-grey sandstone. Medium to coarse grain, hard but workable when green. Forest of Dean Stone Firms Ltd., Parkend, Nr. Lydney, Glos.

HOLLINGTON STONE A white to red sandstone. Average grain and free working when green
Hollington Quarries Ltd., Lombard St., Lichfield, Staffs.

ABERLLEFENI WELSH BLUE SLATE Blue grey and free from veining. The Wincilate Group, Aberllefeni, South Merioneth.

CAST STONE

Reconstructed or artificial stone (Powdered stone used as an aggregate in concrete).

Cast stone may be carved in exactly the same way as natural stone and has the advantage of being free from sand pockets, beds and other defects. In preparing a piece of cast stone for carving the materials can be moulded to the required shape and size thus following the practice of sawing natural stone to approximate shape. The block thus made is carved by the same methods and with the same tools as are used for natural stone.

1. The Atlas Stone Co. Ltd., Artillery House, Artillery Row, London, S.W.1. (Types - Portland, Clipsham, Bath, York, Ham Hill, Cornish Granite)
2. Constone Ltd., South Wigston, Leicester.
3. Naybro Stone Ltd., Longton, Stoke-on-Trent, Staffs. (Types - Portland, Bath, Darley Dale, Runcorn)
4. Bristol Stone and Concrete Ltd., Holcombe, Nr. Bath, Somerset.

Stone compounds made up from natural stone powders with various resins are now being used in various ways in industry - some stone-resin compounds can be accurately machined and worked as for non-ferrous metals and used for precision work such as matching dies.

METHODS OF WORKING

Splitting stone is a simple operation but, like all work on stone, requires care and patience. Large blocks may be split by using "feathers and wedges". This is done by drilling a series of holes in the stone along the dividing line, inserting the feathers to protect the drill hole and between them placing the wedges. These are then hammered down in sequence, going up and down the line until the stone breaks in two. It is easier to split stone along its bed than across it. Another method for removing smaller amounts of stone is to cut a deep groove around the stone keeping an iron bar in the underside groove so that the stone is angled away from the floor and the weight of the stone will help to fracture between the grooves.

Large blocks of stone will by their own weight remain steady when being carved but smaller ones need to be held by a wooden frame fixed to a carving bench. An alternativ method is to fix the block to a heavier horizontal block with Plaster of Paris, making sure to wet the two stone surfaces thoroughly before applying the plaster. Another method for use with small blocks is to use a box filled with sand into which the stone can be wedged and the impact taken up by the sand. This method enables all the different "faces" or sides of the block to be easily changed during carving.

Soft stones, free from silica or grit, can be blocked in by the use of saws but all others need to be worked with pitchers or points or picks.

The final form can be arrived at by carving or by abrasion or by a combination of these methods.

CARVING This is the knocking away of the surplus stone by driving a hardened steel tool into the surface of the stone in such a way as to control the amount of stone removed by each blow. The tool can be hit with a wooden or iron mallet. The main tools are:-

1. The Point A sharp ended pointed tool which bursts away the surface. The angle of the tool to the stone will depend upon the type of stone but a rough rule is that the harder the stone the more perpendicular the angle. The thickness of the point increases with the hardness of the stone.

2. The Claw A serrated flat chisel for semi-rough work. The method of working is the same as for the point except that the claw chisel is not used to remove large amounts of stone and is more of a shaping tool.

3. The Chisel A plain flat chisel for removing the final surface and for detail work.

All tools must be kept well tempered and sharp. Hard stones such as sandstones quickly blunt the chisels. These tools are either "mallet-headed" for use with wooden mallets and light (1-1½lb.) iron mallets or "hammer-headed" for use with heavier (2 - 4 lb.) iron mallets.

ABRASION This is the removal of stone by the consistent pounding of the stone in order to break down the surface to a state where it can be given a final shape by rubbing, using rasps, rifflers or carborundums. The surface can be removed by using a point and hammer or by means of a "Bouchard" hammer. This is a tooth-faced hammer which is the equivalent of a series of point heads working together. When the final form lies just below the surface this can be taken down by the use of rasps and rifflers, except in the case of sandstones and gritstones which wear away the teeth of the tools. Carborundum blocks or wet and dry emery papers can also be used. A very smooth surface can be achieved by using snake stone, pumice powder or alumina.

Stone can also be worked by the use of power tools, drills etc. Pneumatic tools worked by compressed air are available with both heavy and light interchangeable carving chisels. These can be useful on the harder igneous varieties of stone but the control is not as delicate as that obtained with hand tools.

SUMMARY OF TOOLS

1. Drill. Hand or electric. Used for making holes prior to aplitting stone or for roughing out deep incisions. Also with attachments for grinding and polishing.
2. Pitcher. For roughing out flat surfaces.
3. Point. For roughing out more detailed surfaces.
4. Claw Chisel. For Semi-rough work.
5. Flat Chisel. For detailed work and finishing.
6. Lump Hammer. Iron mallet from ½ lb. to 4 lb.
7. Dummy Hammer - Found light lead hammer for small detail.
8. Wooden Mallet. Beech or Lignum Vitae. 3" - 5" radius.
9. Rifflers and rasps. For Surface Work.
10. Abrasives. General.
11. Tungsten Tipped Chisels. For use on very hard stones.
12. Bouchard Hammers. ½" to 1½" Square Heads.
13. Stone Saw. For very soft limestones and Alabaster.

BOOKS AVAILABLE IN THE COLLEGE LIBRARY

| | |
|---|---|
| The Technique of Sculpture | John W. Mills |
| Stone Sculpture | Mark Batten |
| Stone Work | T. B. Nichols |
| Methods and Materials of Sculpture | Jack C. Rich |

C A R D I F F   C O L L E G E   O F   A R T

TECHNICAL COURSE | DIP.A.D.

## Printmaking

## SERIGRAPHY OR SILK SCREEN PRINTING

Serigraphy is a stencil process and in origin of great antiquity (possibly the oldest form of repetition technique).

The technique of printing by silk screen was developed late in the 19th Cent. The scope of the medium was extended by the use of photostencils introduced between 1915 and 1920, and a marked improvement in the quality of prints over the last twenty years by the development of thin film inks.

### Qualities and limitations of the medium

Rich, brilliant, colour is easily obtained. Precision of edge, precision of area - not merging or fading. With photostencils linear work is practical and the optical blending of colours. When the screen is made by hand drawing fine line work is very difficult.

### Screen Materials

Screen cloth is usually silk or nylon, sometimes wire gauze. Other materials are used but may have disadvantages, which have to be weighed against their (usually) cheaper initial cost.

Screen cloth varies in weave and the number of threads per inch, giving rise to variation in the size and number of apertures through which the ink can pass.

The coarser the cloth (i.e. bigger holes) the less precise the edge of the stencil aperture. The materials are identified by number. Silk and Nylon have different numbers. These tend to be arbitrary. Accurate comparison can only be made when the number of threads per inch, and the size of the thread is known. A percentage figure is often quoted based on the free area per square inch (i.e. ink passing area) from which working comparisons can be made.

Bearing in mind the foregoing - cloth numbers for nylon of interest to printmakers are:-

| | |
|---|---|
| 40T | General work, but inclined to leave a slight surface texture when used with thin film ink. |
| 68T onwards. | Good for hand cut stencils having fine detail. Photostencils depending on the amount of fine detail. Finer detail - higher cloth number. 68T cloth is about the coarsest that can be used for the tusche method of stencil making. A higher cloth number will give greater control of the image. |

### Stretching the Screen Cloth onto the Frame

This requires skill resulting from experience. The screen cloth must be drum tight. Less tension is useless.

When using silk up to a 20" x 30" screen frame may be stretched by hand with perfect results. About half this size when using nylon.

When stretching nylon or silk, if larger than the size given above, it is usual to use a mechanical stretching frame. The main requirement with a mechanical frame is that the cloth is attached evenly before tensioning, and that as silk and nylon have a usable extension of between 4% and 6% in both directions, too great tension is not used.

### Squeegee

The screen ink is forced through the mesh of the screen cloth by means of the squeegee. A great deal of the success of printing depends upon the squeegee being well made and in good condition. The rubber (or similar) must be straight and with a true edge.

Preparation of the Screen before making the Stencil
It is assumed the screen is free from ink or dirt.

Before making a hand drawn stencil on the screen, or attaching a 'Profilm'-type or photostencil the screen cloth must be free from grease. This is essential and must be done thoroughly.

A solution of Natrii Hypochlorosi (NaOCl) is very effective (but must not be used with silk). A common form readily available is "Domestos". When supplied Natrii Hypochlorosi may have an active concentration of between 13-16% Chlorine. For cleaning screens and removing photostencils the liquid should be diluted to give a strength of 4-5% active chlorine.

The most efficient method of degreasing screens is an application of a 20% caustic soda solution. Leave the screen for 5-10 minutes in the solution.

Then with both methods of degreasing hose down with cold water very thoroughly to remove any trace of "Domestos" or caustic soda.

In the case of degreasing by caustic soda neutralize with a solution of 5% acetic acid, and wash out with water again.

Note: Caustic soda is dangerously corrosive and Natrii Hypochlorosi is corrosive. Never mix with other substances and always use with great care.

Stencil Making - Hand Drawn Methods
A stencil is made by painting out those parts not required to print by means of designers gouache white, or poster colour. The consistency should be adequate to block the mesh with paint, not just stain it. There should be no ridges of paint when finished.

A thin layer of glue (water soluble) is spread over the whole screen. When dry the parts required to print may be sponged away with warm water. This stencil method is not accurate, but gives a soft indefinite edge.

Lithographic writing ink or tusche, made up to a thicker consistency than used in lithography, is painted on the screen to fill the mesh - not just stain it. When dry the whole of the screen is covered with a thin layer of water soluble glue by means of a squeegee. When the glue is dry, turpentine substitute is used to dissolve the tusche out of the screen, leaving the glue stencil unchanged. This technique will give an autographic stencil and with practice it is possible to achieve quite a fine brush drawn line.

Lithographic crayon can be rubbed on to the screen and then the screen covered with glue and processed as described above. It requires some experience to 'draw' with litho. crayon to effect, but if the screen is placed over a surface which is uneven and the crayon rubbed - in the manner of rubbing a coin - surprisingly accurate results can be obtained.

Cut Stencils
These are paper stencils. The essential requirements are that the paper shall be thin, resistant to the penetration of ink, and must not ripple or pucker under the initial pressure of the squeegee.

Good quality newsprint answers these requirements for the artist printmaker who would not expect to take more than fifty prints.

Preparation is simple. The area required to print is cut away, or may be torn to give a varied edge. The cutting knife must be sharp and it is important to cut on a good surface as this influences the edge.

One problem with this type of stencil is dealing with an 'island' - for example like the inside of the 'O'. If these parts are not too small and complete accuracy is not essential they can be placed on the screen. If complete accuracy is required a cut paper stencil should not be used.

Pro-film type stencils; various commercial products having a variety of names are of this type. The material is composed of three main layers. The backing paper fixed to a thin stencil paper and then on to this is coated an adhesive, usually shellac or fish glue.

The object when using this material is to cut through the adhesive and thin stencil film only. When completed the parts not required are stripped off leaving the stencil still attached to the backing paper.

Simply stencils can be cut easily, but practice is required to achieve intricate work.

When complete the 'Profilm' is damped either with water, or spirit (according to the adhesive) then ironed on to the screen. After this the backing paper is stripped off leaving the stencil attached to the screen. Note that the problem of the "island" in a stencil and its correct position is solved by this stencil method.

The mechanical problem of attaching this type of stencil requires practice and "knack". A screen totally free from grease and drum tight is essential. It is unwise to use too large a stencil for a given screen size. Space around the edge of the stencil is a great help in correct adhesion.

Although the type of stencil described is still in use, a much improved plastic material is now available. Both the "Profilm" company and the J. Ulano Company of America, make a range of material for various work. The structure of the film is the same, except the material is a plastic, and heat is not required to fix the stencil to the screen. A special adhesive solvent is required. Generally these plastic films cut more easily and fix more efficiently and print better.

<u>Photostencils</u>
Are 'light-made stencils' and not necessarily stencils reproducing photographs - although this can be done if required. Making photostencils does not require a dark-room.

If the artist can draw or make the image on paper - usually a photostencil can be made. An advantage of the photostencil is its ability to accommodate images of many origins at one time, on one stencil.

Photostencil films are sensitive to the blue and ultra violet portion of the spectrum. Therefore they may be handled in subdued room light.

Stencil film is light sensitive gelatine attached to a plastic backing sheet.

Where no exposing light falls on to the film the gelatine remains soft. Where the light strikes the film the gelatine hardens.

If an image is drawn or made from a light-proof substance (i.e. will stop blue and U.V. light), then placed in intimate contact with the <u>back</u> of the stencil film, where the image is no light will reach the film, and it will not harden. Where the light can reach the film it will harden.

The film is then immersed in a developer, or perhaps more strictly a "hardening" solution. This consists of a mixture of one part 5 Volume Hydrogen Peroxide and one part water. There will be no apparent change in the film.

After hardening the stencil film is washed down with warm water at 110 degs.F. The warm water will remove the galatine that is soft, but will leave unchanged the hardened gelatine.

When washing is complete the gelatine stencil remaining on the plastic sheet is attached to the back of the screen. First by laying it gently in position on the back of the screen, then, from the inside of the screen using a sheet of newsprint press down very firmly until no free gelatine is removed by successive sheets of newsprint. This part of the process fixes the stencil firmly to the screen.

The screen with the stencil attached is now dried. When totally dry the plastic backing sheet may be peeled off leaving the stencil firmly in position.

Because the sensitive gelatine was in fact stuck to the plastic backing sheet in manufacture, any remnant of glue in the clear areas of the stencil should be removed by cellulose thinners before printing.

Two stencil films are in common use in the United Kingdom one is coloured red called Autotype "5 Star" the other coloured green called "Super Prep" and made by the J. Ulano Co. Inc. Both films are handled in the same manner only the time of exposure etc. varies.

No details are given as to exposure time etc. as this varies with individual work.

Full working instructions are given in another set of technical notes on the conversion of photographs into stencils.

There are plastic films described as 'stripping films' allowing a stencil to be cut. The result may then be used as an original from which a photostencil is made. Where work is of a geometric nature these film improve accuracy and save time.

Screen Printing Inks
These are obtained ready prepared. There are special inks such as flourescent ink, ink for printing on plastic,metallic inks, and suitably prepared "ink" (which is enamel) for ceramic material and enamelled metal surfaces.

The prime feature of most of these commercial products is that they are usually opaque or semi-opaque in character. A notable exception being the trichromatic set for four colour half-tone printing, which are transparent.

The quality of commercial inks - chiefly colour - is improving as screenprinting becomes widely used.

Transparent inks, or slightly translucent inks, are prepared in the printmaking workshop by mixing off-set lithographic ink with Coates Bros. Alka Transparent Base P.48708 and turpentine substitute.

It is difficult to make rules as to the consistency and proportion of litho ink to base. However general guidance can be given that the consistency should suit the mesh of the screen, the fineness of the detail in the stencil, the paper on which the image is screened. And as a general guide the pigment should be the minimum required to be added to the base, because the pigment and the pigment binders tend to retard drying.

The best practical way to mix ink is to take the Alka base and the turpentine substitute and stir together in a tin to the screening consistency. This will be probably about 40% base, and 60% turps. subs.(by mass).

Some of this mixture should be taken from the can and the litho. ink mixed into it on a glass or metal sheet. When well mixed on the sheet it should be stirred into the can of base and turpentine. This method will prevent streaky ink mixtures which cause insurmountable trouble in printing. It will be noted that only a small amount of ink pigment is required - usually about 10 to 15% of the mixture.

Opaque inks tend to give (or can give) lightness but not 'Brilliance'.

Transparent ink when printed on white paper give brilliance of colour - but not always lightness of tone.

Any colour can be made either opaque or transparent, but obviously a transparent black will not read "black", similarly an opaque red, may be pink (by the addition of white). It will be discovered that all inks have a balance between opacity and transparency - when their maximum colour quality is printable.

Paper for Screen Printing
It has been said with some truth that you can screen print on anything. The worthwhile observation on paper is that, for maximum colour quality the whitest paper, with a smooth surface, and moderate ink absorption is ideal. This does not discount other papers and surfaces which give other effects.

Print Drying

Screen prints are more liable to damage than most prints until bone dry.

When a print is taken from the screen table its surface must not come in contact with another until the ink is dry.

The time required for drying varies according to the humidity of the atmosphere, the ink and the paper or surface on which it is printed. Usually with paper or card about an hour is allowed in the drying rack for the prints to become 'stack dry' - meaning they may be taken from the rack. This might not indicate that the print is ready to receive another colour.

Cleaning Screens - Removal of Ink and Stencils

In the printmaking workshop it is always assumed a screen will be used many times, due to their high original cost. This is not always done in a commercial operation. Certain very fine meshes can not be cleaned by hand.

Organisation of Printing

An essential feature of screen printing is its speed and the fact that once the operation is started it must be continued in a rhythmic manner. Any hesitation will cause loss of print quality.

Printing can be done single handed but it is better to work as a team of three. One person to feed the paper, one to squeegee, and the third to rack the prints.

It is essential that before commencing to print every thing is ready and at hand.

Print Designing

Making a print is not a substitute for another activity. It should be a creative process - not a matter of copying an existing piece of work.

Printing ink has a special quality which should be exploited.

The printed mark has a quality - it is almost impossible to simulate in another medium.

The repetitive nature of printing opens both physical and abstract possibilities.

Bearing in mind the three qualities mentioned will probably suggest how they may be exploited to your personal ends.

# CARDIFF COLLEGE OF ART

TECHNICAL COURSES — CERAMICS — DIP.A.D.

Ceramics may be defined as the art and technology of creating objects or articles from earthy raw materials which are subsequently chemically changed and made permanent by the application of heat.

The term Ceramics includes not only pottery and tableware, but also brick and tile and other structural clay products, firebricks and refractories, laboratory porcelain, sanitary wares of all sorts, dielectric porcelains, glass and vitreous enamels on metals.

The basic material of most ceramics is clay, which is formed by the geological disintegration and decomposition of felspathic rocks (granite). Clay in a theoretically pure form has a composition of 40% Alumina, 47% Silica and 13% chemically combined water. Kaolin or China Clay may contain as much as 95% of this 'pure clay' substance, but most clays do not contain much more that 50%; the remainder is made up of various other minerals, such as Iron, Magnesia, Potash and Lime. These impurities modify the colour and texture of the clay and the fluxes they contain lower its melting point.

There are two basic geological categories of clay.

1. PRIMARY CLAYS

These are residual clays formed on the site of parent rocks and they are relatively pure and free from contamination with non-clay minerals. Most Kaolins are primary clays, they are white, seldom plastic and highly refractory (melting point above 1800°C.).

2. SECONDARY CLAYS

These are clays which have been transported away from their source of origin, and are more complex in composition because of the various impurities they have collected. They are classified as Refractory, Vitrifiable and Fusible clays.

Refractory clays- Fireclays, usually grey and coarse-grained with a vitrification point above 1500°C. Typical products are firebricks and industrial refractories.

Vitrifiable clays- Ball clays and Stoneware clays. White, ivory, buff or grey in colour. Usually very plastic and fine-grained in texture. Vitrification point above 1300°C.

Fusible clays- Common surface clays buff, red or brown in colour. They are usually very plastic and have considerable shrinkage during drying and firing. They all vitrify below 1200°C. Fusible clays include all natural earthenwares and terra cotta clays. Typical products are common bricks, flowerpots, etc.

Clays are selected for use according to the particular qualities required in the end product and also by their suitability for fabrication by a specific method of manufacture.
Factors which determine their suitability are -

Porosity
Density
Plasticity
Shrinkage
Texture
Colour
Range and temperature of vitrification
Fit of glaze

CLAY BODIES

Obviously natural clays have a wide range of properties and character, and many clays are extensively used without modification of any kind. However, when a natural clay does not have the qualities required for a particular purpose it may be mixed with other clays or have other materials added to it.

Any such mixture is known as a 'body', and the chief ingredients other than clays, are refractory materials and fusible materials. The composition of a body may be thought of as

1. Plastics - Clays
2. Fillers - Flint, Quartz, Sand, Grog, Calcined clay
3. Fluxes - Felspar, Cornish Stone

The first provide workability, the second enable clay to dry out, decrease shrinkage and control warping and cracking, the third control fusion and vitrification at the right temperature.

SAMPLE RECEIPES FOR CLAY BODIES

White Earthenware Bodies 1100°C

| | | |
|---|---|---|
| Ball Clay | 25 | 30 |
| China Clay | 25 | 20 |
| Cornish Stone | 20 | 15 |
| Flint | 30 | 35 |

Opaque white bodies suitable for use with moulding techniques

Porcelain Bodies 1280°C.

| | |
|---|---|
| China Clay | 55 |
| Felspar | 25 |
| Quartz | 15 |
| Bentonite | 5 |

| | |
|---|---|
| China Clay | 45 |
| Felspar | 25 |
| Ball Clay | 17 |
| Quartz | 13 |

White translucent bodies. Porcelains are extremely difficult to form by throwing owing to their non-plastic nature. The inclusion of more plastic materials in the form of Ball Clay and Bentonite help to overcome this lack of plasticity.

NORMAL SEQUENCE OF CERAMIC PRODUCTION

1. Selection and preparation of suitable clay or body.

2. Fabrication. Hand Building - modelling
   carving
   coiling
   slab construction

   Hand moulding - press moulding
   slip casting

   Machine forming - throwing
   turning
   extruding
   jigger and jellying

3. Drying. Length of time required for drying depends on size, thickness and complexity of structure.

4. First firing. Biscuit firing - usually to temperature 1000° - 1020°C. Firing Cycle normally takes place over three days. Kiln packing - actual firing - cooling.

5. Glazing. Application of glaze by dipping, pouring, painting or spraying.

6. Second firing. Glaze or Glost firing to temperature required to mature body and glaze. Firing period as for biscuit.

7. A further firing is sometimes carried out to achieve a particular quality, for example a high key colour or special surface effect. In these cases the fired glaze surface is coated with low temperature enamels or metal lustres and fired to 750° - 800°C.

METHODS OF FABRICATION

The nature of the materials used in ceramic manufacture and the extreme stresses they are subjected to during drying and firing create particular problems with regard to fabrication at all stages of the process. Thorough preparation of all materials is absolutely essential whatever method of forming is being used or whatever sort of structure is being made.

Hand Building Methods

Modelling - small articles may be modelled directly from solid lumps of clay. Larger forms are better constructed hollow to facilitate firing. A clay containing 20% - 30% fine or coarse grog, depending on the texture required, would be suitable.

Coiling - A method of building using ropes of clay to construct a hollow form. Building proceeds by adding coil to coil and ensuring each successive coil is firmly welded to the previous one. Quite large forms are easily constructed by this method. Plastic clays may be used with the addition of sand or grog as a filler.

Slab construction - Slabs of clay are easily formed by rolling out clay to a uniform thickness and subsequently cut to required shape, tiles, etc., or slabs cut, folded or joined to each other to form a structure. Joining of pieces must be carried out before clay hardens. Coarse-grained clay required to assist drying and reduce shrinkage.

Carving - May be used as a finishing process to any method of construction or as a direct process using solid pieces of hard or dry clay.

Moulding methods.

Press moulding - A means of making a series of identical forms using a single or two-piece plaster mould. Simple relief forms are reproduced by pressing a prepared slab of clay into or on to a plaster mould. Hollow forms entail the use of a two-piece plaster mould. Each half is lined with a layer of clay and the two pieces of the mould firmly pressed together forcing the leading edges of the clay to join. In each case the drying action of the plaster allows the extraction of the form within a reasonably short time. Coarse or fine grained clays of low plasticity would be suitable.

Slip Casting - Another method of producing identical forms using plaster moulds. The mould may be of two or more pieces depending on the complexity of the form to be produced.

The process involves the filling of the mould with slip and allowing it to remain there until the slip in contact with surface of plaster has hardened. Surplus slip is poured off leaving wall of clay around inside of mould. Thickness of wall required depends on size of article - average suitable thickness ¼". Clay form remains soft for considerable time and is not extracted until some shrinkage has occured. Slips made from clays of low plasticity give best results.

Machine Processes

Throwing and Turning - Production of forms on wheel from plastic clay and finished in that state or subsequently modified by turning on wheel or lathe when clay has hardened.

Jigger and Jollying - A mechanical means of rapidly producing identical forms. A special machine or power wheel fitted with a cup head or chuck is used. A plaster mould placed in the chuck is covered with a sheet of clay and the finished form is produced by a profile acting on the clay surface.

Extrusion - Clay may be formed with various sections by being forced through a die fitted to a pug-mill or wad-box.

Colouring PIGMENTS

All colours used in ceramics are derived from metals. In the form of oxides or salts these metallic pigments may be applied in a variety of ways - to colour clays, slips and glazes, or applied under or over the glaze.

Basic oxides with colours produced under normal firing conditions;

| | | |
|---|---|---|
| Antimoniate of Lead | - | yellows in combination with Lead glaze. |
| Cobalt Oxide | - | produces blues in all types pf glazes. A powerful colourant ¼% - ½% gives strong blues. |
| Chrome Oxide | - | extremely versatile colourant - produces red, yellow, pink, brown or green depending on the type of glaze and temperature. |
| Copper Oxide | - | produces greens in lead glazes and turquoise or blue in high alkaline glaze. Percentages above 6% give dark metallic lustre. |
| Iron Oxide | - | amber yellow to warm brown according to amount used. Percentages over 8% produce dark brown or black. |
| Manganese Oxide | - | brown in lead glazes and purple in alkaline glazes. Used in combination with iron and cobalt to give blacks. |
| Nickel Oxide | - | provides range of muted greens and greys. Grey-blue in leadless glaze and greens in tin glaze. |
| Uranium Oxide | - | varied range of colours - orange red in soft lead glaze and yellow and green with an admixture of cobalt. |

In addition to these basic oxides, pigments specially prepared for specific purposes are available in the form of glaze Stains, Slip and Body Stains, underglaze and on-glaze colours, enamels and lustres.

GLAZES

Ceramics are fired over a wide range of temperatures, according to the composition of the body and the temperature required to mature it. In practice any given glaze is only suitable over a temperature range of about 30°. Apart from providing an impervious and easily cleaned surface, glazes are a means of achieving colour and a variety of surface qualities. Glazes may be transparent, opaque, bright matt, opalescent or crystalline depending on their composition and firing temperature.

The same two minerals that together make up approximately 80% of the volume of clay - Silica and Alumina - also comprise some 50% of the weight of most glazes. A third agent called a flux or base is necessary to form a glaze and cause it to melt and adhere to the ceramic during firing. These fluxes have the property of dissolving the Silica in the presence of Alumina when heated to certain temperatures and mixed in definite proportions.

The fluxes commenly used in glazes are lead, soda, potash and calcium. These are introduced into glaze recipes in their various forms, though mainly as frits (fired and ground mixture of Silica and soluble flux) or in combination with other elements.

Typical recipes for transparent glaze.

| | | | |
|---|---|---|---|
| 1060°C. | 54 | Lead Oxide | flux |
| | 19 | China Clay | alumina/silica |
| | 27 | Flint or Quartz | silica |
| 1060°C. | 75 | Lead Bisilicate | flux/silica (Frit) |
| | 19 | China Clay | alumina/silica |
| | 6 | Flint | silica |
| 1200°C. | 13 | Whiting | flux |
| | 72 | Felspar | flux/silica/alumina |
| | 7 | China clay | silica/alumina |
| | 8 | flint | silica |
| 1280°C. | 12 | Whiting | flux |
| | 70 | Felspar | flux/silica/alumina |
| | 13 | China Clay | silica/alumina |
| | 5 | Flint | silica |

| | | | |
|---|---|---|---|
| 1260°C. | 50 | Wood Ash | flux/silica/alumina |
| | 50 | Cornish Stone | flux/silica/alumina |

List of books for further information on Ceramics - availabe in College Library.

| | |
|---|---|
| Clay and Glazes for the Potter | Daniel Rhodes |
| Stoneware and Porcelain | Daniel Rhodes |
| A Potter's Book | Bernard Leach |
| The Technique of Pottery | Dora Billington |
| Pottery and Ceramics | Kenneth Clark |
| Modern Ceramic Practice | A. J. Dale |
| Ceramic Colours and Pottery Decoration | Kenneth Shaw |
| Dictionary of Ceramics | A. E. Dodd |

Cardiff College of Art

Technical Course

Dip.A.D.

INTAGLIO PRINTMAKING

Metal Engraving - Etching - Aquatint - Dry Point

The term 'intaglio' embraces a number of printmaking techniques having the common factor of the method of printing.

The fundamental is that the print is made from below the surface of the metal plate.

Marks cut, scratched, or eaten by acid into the smooth metal plate can be filled with ink. Then the smooth metal surface is polished clean leaving the ink only in the marks. If a piece of paper made pliable with moisture is laid on the metal plate, and together they are passed through a roller press, the pressure of the rollers forces the paper into the incisions which hold the ink. The ink adheres to the paper and a print will result.

Considering the extent of European Art History intaglio prints were a late development from other techniques. Engraving on metal (i.e. to print) derived from the work of goldsmiths in the early 15th Cent. Etching which sprang from techniques used by armourers date from the 16th Century. Aquatint was invented by the French engraver J. B. Le Prince in 1768.

Before about 1860 many prints made by these techniques were reproductive. There were notable exceptions, Durer, Rembrandt and Goya to name the three chief. In the period following 1860 artist began to use intaglio printmaking creatively - particularly Degas and C. Pissarro.

A factor in the changed function of intaglio prints, reproductive to creative, was that in the 1870's etching and aquatint coupled with photographic techniques became the basis of the system described as 'Process Reproduction'. Nearly all illustrations in books, newspapers and magazines to-day are by "Process Reproduction" or photolithography.

.................................

Materials - Metal Plates.

The usual metals for making plates are Zinc or copper. Both iron and steel have been used in the past and are of use to-day for special purposes (e.g. colour printing).

The usual thickness of the metal is just over 1/16th. inch No. 16 Standard Wire Guage (.064"). Thicker or thinner metal should be used with caution. A thinner plate will curl in the press, the thicker plate will always burst the paper at the edges of the plate.

Acids for Etching

Warning ...... you are reminded that great care must be taken when using acids or strong alkalis.

When mixing acid and water - the water must be put in first and the acid added slowly and with great care.

It is not permitted by the Authority to keep acid in plastic containers.

Etch for Zinc, Copper, or Steel:-

| | |
|---|---|
| Full Strength Nitric Acid | 3 parts. |
| Water | 5 parts. |

........................

or Ferric Perchloride
approx 80% solution with water.

........................

Etch for Copper only:-

This mixture is commonly called 'Dutch Mordant'

| | |
|---|---|
| Hydrochloric Acid | 10 parts by volume. |
| Potassium Chlorate | 2 parts by volume. |
| Water | 88 parts by volume. |

use at a temperature of between 65 and 75 degs.F.

Action of acids:-

General; the action of all the acids or mixtures given is much slower when more water is added, The reduction of the amount of water will speed the corrosive action, but this should only be done with caution, because so much heat may be generated that the etching ground will blister and float off.

Zinc, copper or iron respond differently to the acid. In general terms zinc etches more coarsely than the other two.

Nitric acid is fast and tends to produce a rough edge with zinc and copper.

Ferric Perchloride is very slow and smooth in action with little tendency to increase the width of the line or area.

Dutch Mordant for copper is of moderate speed (at 65 deg.F.), much faster when warmed. Smooth in action with some tendency to undercut with extended application.

Timing work in the Acid.

It is not the usual practice to time work in the acid, with the exception of aquatinted plates. The time required is assessed by eye.

Preparation of Plates for Working.

For all processes, except engraving and dry point, a plate must be degreased. This is done with the following mixture:-

| | |
|---|---|
| Liquid Ammonia | 1 part |
| Water | 5 parts. |

add to make a thin paste to Whiting.

The thin paste is rubbed over the plate with a rag, and then washed off with water.

To test degreasing - if the water remains in an unbroken film over the surface of the plate it is free from grease for the purpose of etching.

Etching Grounds

These are the acid resisting substances put on to the plate surface and through which the artist draws.

Grounds are usually purchased ready made, however the basis of all practical recipes is beeswax.

Hard or Dark Ground for etching

| | |
|---|---|
| Beeswax | 1½ oz. |
| Asphaltum powder | 2 oz. |
| Burgundy pitch | 1 oz. |

Soft ground

1 part Hard Ground.
1 part Tallow

Aquatint Ground

The ground is usually powdered Mastic Resin, but sometimes powdered Asphaltum.

Stopping-Out Varnish

When a resist is used and not drawn through it is termed 'stopping-out'. For example the back of the plate which has to be protected from the action of the acid is covered with stopping-out varnish. Or if one part of the work on the plate has progressed far enough it is coated with this varnish - it is 'stopped-out'.

| | |
|---|---|
| Powdered Mastic Resin | 2 parts by volume |
| Powdered Shellac | 10 parts |
| Genuine Turpentine | 2 parts |
| Methylated Spirit | 60 parts |

The amount of spirit is not critical, but must be sufficient to make the mixture brushable but nt too fluid.

Etching Techniques

Deep etching is where large areas of the plate are removed by the acid. Areas larger than those normally described as a line are considered as deep etched.

The particularly quality associated with Deep Etching is that the deeper and wider the area the lighter it will print, with a characteristic darkening at the borders of the area. Carried to a logical conclusion - the ultimate working of the acid will make a hole in the plate, which on printing will appear white (because it will hold no ink - see top of Page one).

Controlled deep etching will give a unique quality.

Line etching is the traditional tehnique and what many people mean when they say 'etching'. It is very flexible. The results may range from a rich Rembrandtesque gloom to the thin mobile line of Matisse.

The plate is covered with Hard Ground, which forms an acid resist. With an etching of the acid to those parts of the metal exposed by drawing.

Soft-Ground Etching was invented for the purpose of simulating drawings done in pencil or crayon. There are two major ways this technique can be used - the traditional or the contemporary method.

Traditionally after the soft ground had been laid on the plate it is pressure sensitive, and over it was placed a piece of paper. When the paper was drawn up on the pressure of the pencil made the ground adhere to the back of the paper in direct ratio to the pressure applied. Because the paper was not smooth, the ground adhered to it unevenly producing holes in the ground similar to the pencil mark on paper. Although frequently the plate looks unimpressive before printing, it is suprising how faithfully the mark of the pencil or crayon is reproduced in the print.

Although this technique is traditional it is by no means without validity to contemporary artists.

The contemporary manipulation of soft-ground etching is based on the fact that is is pressure sensitive, therefore any object having texture when pressed in to it will reproduce.

Thin rather pliable objects such as lace, a feather, stockings, a strand of wool, some embossed wall paper, plastic objects, damask, leaves, all produce first class impressions.

Aquatint. Is a technique invented to simulate tone, which it does well, and far better than any other etching technique. Basically a dusting of finely powdered resin is laid on the metal plate. The plate is gently heated until the resin melts, and runs together to form small globules. The plate then cools. An aquatint ground looks rather like fine beads of sweat on the arm in Summer.

The resin prevents the acid from etching the plate, therefore the acid can only act between the globules of resin, etching small pits. According to the time the plate is in the acid the pits vary in depth.. The variety of their depth controls the amount of ink they can hold and deposit on the paper.

The tone simulation on printing depends upon many or few, deep or shallow pits depositing ink at a given place on the paper. Because these are very small the eye reads them as tone - like a newspaper photograph.

An aquatint ground can be laid in two ways:-
Hand sifting - if mastic resin is sifted through four or five layers of fine mesh (nylon stockings do this well) on to the plate, the resin on the plate may be heated and a coarse ground will result. This technique is not well adapted to simulating tone, but produces a robust image.

Aquatint Dust Box - the plate is placed in the dust box which lays a fine controlled ground, and gives results likely to be most serviceable to the majority of requirements.

Working Control of Aquatint:-

There are two major methods of control. A test strip is made for both.

The test strip is a narrow plate with an aquatint ground laid on it similar to the one is use on the production plate. The test is immersed in the acid for 5, 10, 15, 25, 35, 50 seconds until about 120 to 150 seconds is reached. When printed this test strip will tell how long the plate should be immersed in the particular acid to obtain a particular tone.

The first method of control is to select the lightest part of your design and immerse the plate for the time shown on the Test Strip. Then stop-out all the lightest parts of the design. Next select the next darkest part of the design and put the plate in the acid for the time required to reach this. Then stop-out the part of the design which were next to the lightest. The process is carried on until the darkest part of your design is achieved.

The second method of aquatint control is by lift ground, some times called 'sugar aquatint'. With this method proceeding from the lightest to darkest tone is still required, but as the marks are always positive it has advantages.

Designers white or zinc white watercolour paint is mixed with sugar syrup to a convenient brushable consistancy. The major part of the mixture should always be the paint not the syrup.

With the mixture the part required is drawn on the aquatinted plate. With practice hair-lines can be drawn. The paint is allowed to dry. Then the plate covered thinly with varnish made from equal parts mastic varnish and pure turpentine.

When the varnish is dry the plate is immersed in water. The part drawn in the paint mixture will float away exposing the aquatint ground. This will be the only part of the plate to react to the acid. The remaining part covered with varnish will be protected from the action of the acid.

The procedure may be repeated foo the number of tones required; however after about four coatings of varnish the plate becomes slow drying therefore this is about the practical limit.

For very exact work the process described may be carried out on the metal plate and the aquatint ground laid after the paint has been floated off in water. This is the best system for delicate aquatinted line drawing.

........................

Printing - Monochrome Print - Method

The fundamental process is described at the top of page one

Paper:- White or slightly cream paper is usual. The reason for this is well founded and will be demonstrated.

There are no 'special' papers for intaglio printing, but the useful range is restricted (and tending to become more restricted), because useable paper must meet the following requirements:-

paper must have wet strength because it will be used damp.
no coated or filled paper is usable.
it should not be excessively sized or resin bonded.
the paper must not have excessive texture or surface irregularity. Plates could be designed to print on such paper but it is a matter for experiment.

Paper preparation:-

Paper is too inflexible when dry, therefore it is damped. It is essential that the dampness and consequent pliability is complete and evenly distributed through the sheet before printing.

To achieve this state paper must be prepared well in advance of use. With some thin papers this might mean twenty four hours, with thick heavy paper a week or more will be required.

Detailed instruction will be given on how to prepare paper.

Printing ink:- In the case of intaglio are of simple composition. [illegible] a pigment, or pigments, an oil varnish in which they are ground. In most instances black ink is made up in the workshop. Other colours are purchased ready ground.

The common black inks are,

| | | |
|---|---|---|
| Vegetable Black | - | printing the blackest |
| Frankfurt Black | - | printing a warm, slightly brown black |
| Heavy French Black | - | printing a cool, slightly grey black |
| Light French Black | - | printing a silvery grey black. |

It is possible to mix oil varnishes of different viscosity, and a varying proportions of the blacks listed. It might seem unlikely but the variation can be detected in the prints.

Briefly for this reason; when an intaglio is printed the ink is deposited on the paper in varying amounts. A very thin deposit is transparent, a heavy deposit is opaque. The light is reflected back from the paper through the ink, where this is thin, but not where it is thick. The colour of the ink as perceived by the eye varies accordingly. It follows that in intaglio printing a 'black' print in fact takes on subtle variation of colour which can be muted by the use of one black pigment, or enlarged by a mixture of black pigments having varied characteristics. The extent of the variation is further enhanced by a mixture of oil varnishes of different viscosities.

Making the print:-

First the plate must be clean front and back surfaces. It is then placed on the heater and warmed a little above blood heat. Then printing ink is rubbed into the image on the plate. This must be done with care so no part is missed. If the image only occupies part of the plate surface the whole plate must be ink (the exception is in colour printing).

The whole surface being covered with ink requires to be cleaned until the unetched surface is clean metal, leaving ink in the image only. To what extent this cleaning is carried out is dependent upon choice. Whether the metal is polished to the point that only a virtually undetectable film of ink is left (e.g. Picasso suite 'The Sculptors Studio'), or a tone of ink is left in moderation but clearly seen must depend up on the artist.

The cleaning is done by a thin gause called printing canvas. It is usual to use three pieces, dirty, fairly clean, and done practically free of ink. These pieces are used in turn, and changed as the plate becomes free of ink.

A firm direct wiping action is used, having at all times the plate on the jigger (a box) beside the plate heater. If this is not done uneven wiping will take place.

When the plate has been wiped clean with the printing canvas, it can be further cleared of ink by wiping with the palm of the hand. The hand should be first wiped on a block of whiting. Too much whiting on the hand will spoil the print.

It should be noted a small plate can be prepared for the press in a few minutes, a larger plate takes considerably longer.
A plate about 17" x 12" could easily take half an hour to ink and wipe. This procedure is repeated for each print.

The inked plate is laid on a sheet of tissue paper on the bed of the press, over it is laid the printing paper, then another sheet of tissue paper. The press blankets are carefully laid down, making certain they are true and flat. The press is operated, and the print removed.

................

Printing in Colour

First a general observation: an intaglio print in colour where the image is representational and the desire is to represent three dimensions is usually an aesthetic failure.

Historic examples where the colour was printed from plates (i.e. not hand tinted) show few successes in presenting a homogenous aesthetic sensation. It was not until other aesthetic possibilities were investigated in the 20th Century that the true resources of the intaglio colour print were realised.

At the time of transition two artists did achieve a limited success by skilful compromise - Mary Cassatt (USA. 1845-1926) and Tho. A. Steinlen (Swiss 1859-1923).

It is in these 'other' areas of aesthetic sensation and expression that colour intaglio printing offers a valuable resource to the artist, because it will give colour qualities unobtainable by other printing methods.

The fundamental reason is simple: intaglio prints on to the paper a skin or strata of ink that can vary in thickness. The variation is quite obvious to the touch. In other printing processes the variation in ink thickness is minute.

The variation in ink thickness produces a unique optical quality - which to be appreciated must be seen, not read about - however an example will make the point clear. A Monastral type blue can be printed intaglio to give an optical sensation varying between blue/black and pale blue/grey. By other methods of printing due to the physically different way of depositing ink on the paper, a similar colour transition is an optical fact (the property of Dichromism), hence the special colour quality of an intaglio print.

Intaglio Printing Inks

Because the property of Dichromism is chiefly noted in transparent colours and diminishes to extinction as opacity increases, most of the effective range of intaglio printing inks are transparent. Opaque inks may be used but the particular optical quality referred to is diminished.

Both transparent and opaque inks may be used in the same print.

High grade offset lithographic inks may be used if they are thinned with copper plate oil to lower their viscosity. But it is better to use intaglio printing inks.

It is useful to remember that artists quality dry pigment may be ground by hand in copper plate oil to make coloured ink in the way that black ink is made.

A note is required on Yellow printing inks. Theoretically these should only be printed from iron or steel plates, because of a chemical reaction between the pigment and zinc or copper plates, which turns the pigment grey. It will be found that if you work from a perfectly clean zinc plate and do not leave the ink standing on the plate good yellow can be printed. The point might have to be considered if the plates were being handed to a printer to make an edition.

Inking-up a Plate for the Press

The working procedure is the sáme as for printing in black (see previous pages) except for one change in method of work.

The difference is that when applying coloured ink you keep this to the incised part of the plate - the object being to keep the plate surface as free of ink as possible.

When wiping the plate the surface must be as clean as possible (at least for most work), otherwise the next colour will be tinged on printing.

A fresh piece of wiping canvas is used for each colour, and usually the pieces are smaller than used for black printing.

Colour Registration in the Press

These notes can only deal with some of the possibilities brought into being by a variety of designs for colour prints. The two basic lines of approach are given in detail. Variation to suit the particular work in hand should be based on them.

Throughout it is assumed that the separate plates have images which can in fact be printed in register. Many students fail to realise that if this is not so, the highest standard of press work will not produce register.

Colour registration of designs that require both precision of registration and are complex in form, require a high standard of production techniques from the start. This type of design should be carefully considered before the work is started.

It should be likewise be remembered that prints of the greatest seeming complexity are of-ten the easier to produce; much depends upon the method of making them.

These matters are part of using the medium creatively and a subject of for the students personal investigation.

Colour Prints from One Plate

It might be imagined that from such restricted means, which avoids any registration procedure, will imply a simple colour image. This far from the possible results.

Two coloured inks may be used. One to fill the incisions, the other to be rolled on the surface of the plate. If a hard roller is used the ink remains on the surface. If a soft roller is used where the roller sags into the larger incised areas an amalgamation of the colours take place (N.B. not a mixture). It should be remembered that the variations of colour in the incisions is controlled by their depth and width: the rolled colour on the surface is constant, but where the roller sags and amalgamation takes place the colour will vary.

In the description above it has been assumed that two colours are used for the whole of the plate, but it is easy to visualise designs where more than one colour is used to fill the incisions, and some where more than one colour could be rolled on to the surface of the plate.

Using this method the plate only goes through the press once.

Printing from more than one plate

Two problems beset printing intaglio from more than one plate and they are insoluble, therefore a choice has to be made between them when designing the print.

The first method is to have all the plates to be used inked-up in their appropriate colours and then pass them through the press one after the other to achieve the colour print.

One of the problems - the snag with this method - is that at least some ink is offset with each passage through the press, except the last plate. This loss of density, in practice, is usually not serious except that it bars heavy deposits of colour. The heavy deposits of ink can be avoided by using aquatint and/or soft ground etching, for all except the last printed plate. But it cannot be overlooked that there is the disadvantage of offsetting.

—

The second method has the problem of difficulty of registration, although the ink film is undamaged. The first colour is printed and then left to dry. This may well take more than a week. The paper must then be re-damped to permit printing the next colour. Because the paper was stressed on passing through the press on the first printing, on re-damping it is unlikely to regain its exact dimensions. This will lead to registration difficulties with the second and subsequent colours.

A subsidary method of production is to print on dry paper by silk screen, lithograph or letterpress and then damp the paper to print intaglio. This is not a production method giving accurate registration, but is able to provide passable registration, and interesting combinations of printing methods.

For most artists prints the best production method is the first one described.

Both methods require all plates to be the same size. This is most important, because any error will destroy registration.

<u>Press Work</u>

As the plates are required to be exactly the same size this is used to achieve registration on the press.

The printing paper must be larger than the plate and the margins required around the print; further there must be an allowance at each end for the roller of the press to stand on the paper. If the margins around the printed area are fairly generous it is possible to use these for the roller to rest on. This is an important matter. It will be realised that it can control the size of the plate to be printed on a particular press, with particular sheets of paper. Check <u>before</u> making the plates.

First - ink-up all the plates to be printed in colour.

Next take a piece of thin paper (e.g. tracing or detail paper) and put this on the bed of the press. It should be the same size or larger than the printing paper.

A piece of thick paper or thin cardboard should be prepared. The size of the printing paper and in it an aperture is cut the exact size of the plates. The position of this aperture is to be where the image should print on the printing paper (having regard to margins etc.). It is essential that the paper or thin cardboard should be slightly thinner than the plates. That is when the plate is placed in the cut aperture it should stand proud of the card or paper. This piece of thick paper or thin card is now placed on the bed of the press.

The arrangement on the press is:- thin paper, then inked plate, over which is fitted the card so the plate comes through the aperture, next the printing paper and backing tissue paper. The whole of this 'sandwich' should be aligned and entered under the press roller. It is wise to check that all is in order once the 'sandwich' is under the roller.

The proof is pulled in the normal way, except that the bed is only allowed to travel far anough to clear the plate and margin, but stopped <u>while still holding</u> the thin paper on the press bed, the card and the printing paper.

CARDIFF COLLEGE OF ART

TECHNICAL COURSES | LITHOGRAPHY | DIP.A.D.

# A COMPLETE METHOD OF PROCESSING

1. DRAW IMAGE

Fan dry and dust image with french chalk.

2. GUM UP

Gumming Up Solution

Wipe and polish gum to a thin film, the image should have the gum gently 'polished' off.

It is imperative that the gum is dabbed on with a sponge or the flat of the hand so that the gum is well set around the image.

The drawn image can with advantage be left for 24 hours to enable the grease to be absorbed into the texture of the plate.

3. ETCH ONE

Victory Etch: One Part
Water: Four Parts

Flood on etch and keep it moving over plate, watch fine parts of image; leave on approximately two minutes.

Pour excess etch.

Dab to an even layer.

Fan almost dry.

4. GUM UP

This can with advantage be gum etch

See above for technique of gumming up. (2)

If gum etch is used, do not delay polishing to a thin film especially over delicate work.

5. PREPARE BLACK INK FOR ROLLING UP

6. WASH OUT

Pour a pool of turpentine (genuine) on the plate and add an equal amount of wash out solution.

Using a dry cloth, wipe the image to a grey film of grease; the black pigment of the image is dissolved by the turpentine and the washout ensures that the image is kept charged with grease.

Wipe dry.

Wash in sink.

The water will dissolve gum and so float off the film of grease from the gum 'stencil' covering the field.

7. ROLL UP BLACK

Remove excess water after washing by use of sponge and/or blotting paper.

Apply ink with roller when plate is MATT DAMP.

The plate must ALWAYS be MATT DAMP when inking up, special attention to be paid to the dampness of the EDGES of the image.

A trial print can now be taken, if this is done re-roll up black.

8. ETCH TWO

Victory Etch: One Part
Water: Two Parts

Flood on etch.

Leave two or three minutes.

During this time blemishes can be removed by circular motion using splinter of wood or etch stick, do not destroy the texture of the plate.

Watch fine parts of image.

Pour off excess etch.

Fan almost dry.

9. GUM UP

See above for technique of gumming up (2).

10. PREPARE INK FOR PRINTING

11. WASH OUT

See above for technique of washing out (6)

12. PRINT

Remove excess water by sponge and/or blotting paper.

Keep plate MATT DAMP.

It is advisable to damp the plate after two passings of the roller over the plate, particular attention being taken of the edges of the images.

Before printing fan dry.

Before examining the print, damp plate.

N.B. If there is trouble in printing, gum up before proceeding further.

If plate is left for more than 20 minutes, gum up.

If plate is left for a day or more, wash out colour and roll up in black and gum up; it is often useful to etch after rolling up black and before gumming up.

CARDIFF COLLEGE OF ART. FOUNDATION DEPARTMENT. SESSION 1967/68.
TERM 2.

INTEGRATION COURSES. INTRODUCTORY TECHNICAL COURSES. FINE ART/3D DESIGN GROUPS.

nese courses, timetabled for evening sessions, are to introduce simple nderstanding of material, tools, handling and limited fabrication. The ollowing notes are thus brief and should not be thought of as exhaustive.

) TIMBER.

imber, a natural fibrous material, comes from trees which are called xogenous, i.e. they increase in girth each year and this growth is shown s rings in cross section of the log. There are two main types of xogenous trees;

) Needle leaf/temperate zones: these yield Softwoods, having a tructure of mulitudinous elongated cells: Fir/White Pine/Poplar/Bass ood/Cedar etc.

) Broad Leaf/warm-tropical zones: these yield Hardwoods, having widened nd elongated cells strung in continuous tubes: Ash/Oak/Mahogany/Beech etc.

ach type of wood has its own characteristics and usage, in the main we hall be dealing only with softwoods.

he felled log is converted at the sawmills into desired units, usually utting either at a tagent, longtitudinally} quarted radially; or eeled for the production of ply boards. Freshly felled timber contains a igh % of water, this is reduced before the timber can be workable and table; Natural Seasoning is a reliable but slow process, today nearly all imber is seasoned by Kiln Drying. Although seasoned timber continues to eact to atmospheric humidity and expansion across the grain is considerabl ut negligible along it.

here are specific ways of ordering timber the following applies only to oftwoods

) Rough cut from the saw, if 2" x 1" is ordered it will be the stated size
) Planed, or Planed Square Edge (P.S.E.) if 2" x 1" is ordered it will be undersize approx. $1\frac{3}{4}$" x $\frac{3}{4}$". in both cases the timber will be available i lengths of 10-15 ft.

election and Ordering

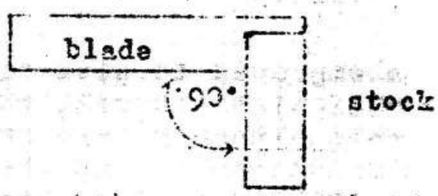
) Determine the most suitable type of timber for the job.
) Assess size and whether rough cut or PSE is required.
) Calculate total length required and allow for wastage in cutting. Calculate the total of unit lengths that you want to cut and order the most economic available lengths to avoid shortage or wastage.
) Check timber for obvious grain splitting, highly resinous grain, knots etc.
When seasoned timber may have warped, check by sighting along grain against one eye, reject all unsuitable material.
) Prior to cutting check the timber for square across the grain with a ry Square. Mark out the positions of units to be cut avoiding all knots etc joints.

arking out.

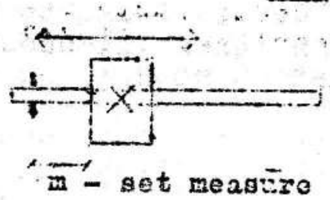
arking out is first indicated with a hard pencil, and ruler and try square re employed to give right angle divisions. 45° and other angles can be arked with a Bevel, which is an adjustable 'square'. After marking with encil, lines should be heavily scored with a stanley knife as this will liminate splitting when sawing, and also serves as a planing guide. hen timber is found to be out of square, one side should be marked, sawn a laned and then all subsequent marking out taken from this true side, which s marked as such.

or certain marking jobs a Marking Gauge is used, this can be set at the esired measurement, locked and then drawn down or across a true edge cribing a mark, which saves calculation and error.

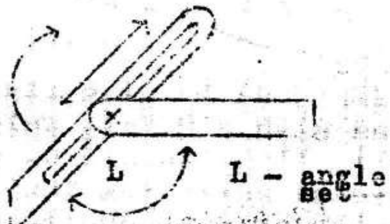
**Try Square**: Metal blade locked into wood stock to 90° used by working off true edge and ensuring that stock is firmly pressed to edge. When checking surface sight under blade to look for daylight indicating uneveness.



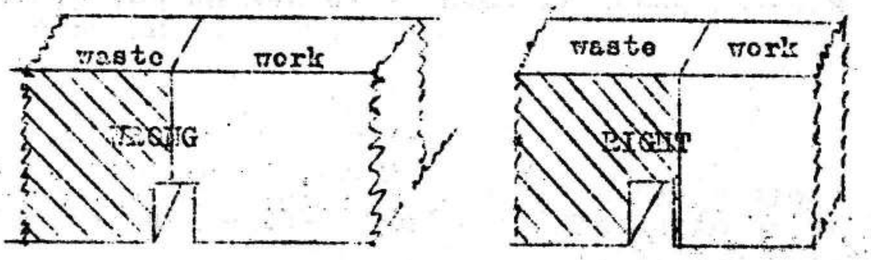

**Marking Gauge**: Beech construction, stock along which a sliding block runs which can be locked in any position. From the stock a pin projects required required measurement is set off from pin to block. When set it is drawn deliberately and firmly down a true edge. Mortice Gauge Has two pins.




**Bevel**: Metal blade pivoted in wood stock, blade can be locked in any desired angle by thumb screw.

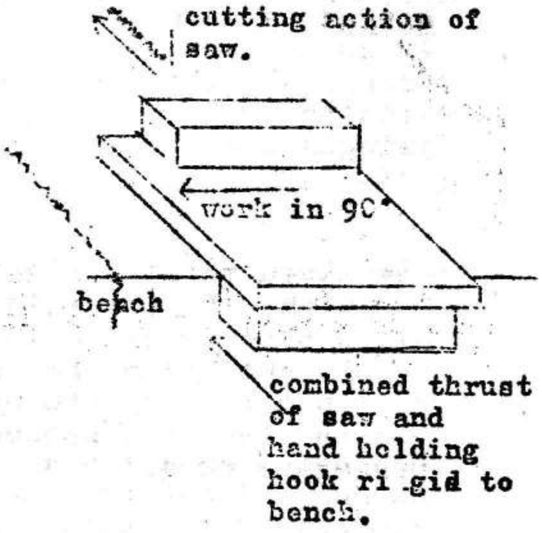



Cutting diagram:




saw cut on or inside work line will result in work being under required size.

cut outside work line will ensure accurate work measure, any waste planed off.



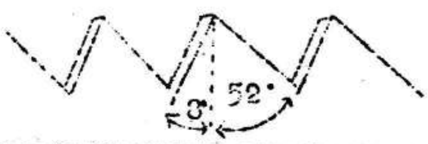

## Sawing.

The saw blade will have a thickness, saw outside the marked lines leaving approx. 1/16th" outside the line, this can be removed by planing.

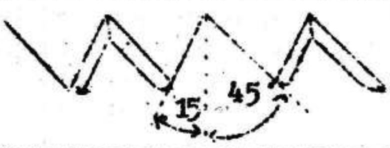
When sawing, planing or chiselling it is essential that the timber is locked in a firm position to the working surface, either by clamping with G Clamps, holing in the vice, or holding against a bench block, this will improve efficiency, accuracy and will be safer. Make certain that long hair and trailing clothing are not getting in the way,

**Saws.** All saws have a certain number of teeth per inch called t p i

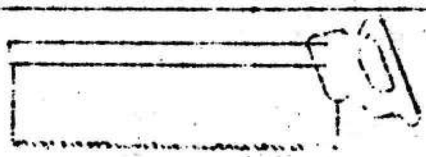
a) Rip Saw: used for cutting down the grain cuts on the forward stroke, and should be held at approx. 60°-45°. Rip Saws have few tpi and cut fast but coarse.



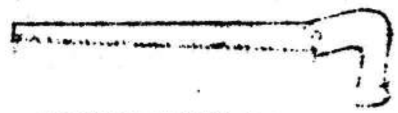

b) Cross Cut Saw: used for cutting across the grain, cuts on forward and back stroke, held at approx. 45° has pointed teeth usually more tpi. thus cuts slower but finer.




c) Tenon or Back Saw: rectangular blade with very fine teeth, used for cutting along or across the grain, held horizontally.



d) Pad or Compass Saw; flexible blade set in removable handle; used for cutting curves or circles. Held to work either vertically or horizontally.



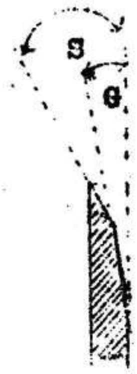
e) Fret Saws: Narrow blade held in tension in metal frame, fine teeth, used for cutting out contained forms, and for fine cuts.

Mechanical Saws. Only to be used under supervision.

The electrically powered saw cannot stop itself and is potentially lethal, precautions must be taken before using. No student will use the circular saw

a) Circular Saw; electrically powered set in frame, with adjustable guides, can be fitted with rip or cross cut blades and is only used for bulk cutting.

b) Jig Saw; narrow flexible blades with range of tpi. held either at one or two ends and electrically powered cuts with or across grain, should be used on light materials only, ½" max. will cut curves of large radius.

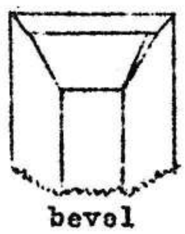



CHISELS


Blades of hardened and tempered steel set in ash, beech or boxwood handles. come in range of sizes usually ⅛"-1½".

a) Firmer Chisel: parallel rectangular blade for all general joinery jobs. used for cutting with the grain or across.

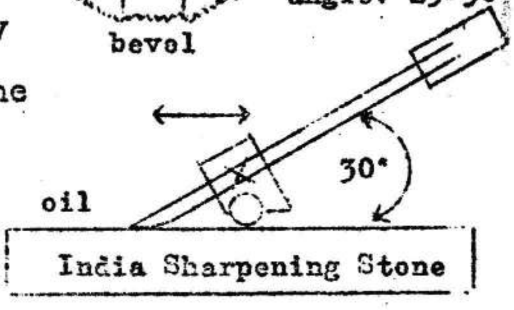
b) Bevel Edge Chisel: Angled sides to blade allowing clearance for fine working. For use with or across grain.




S- Sharpening angle. 30°- 35°

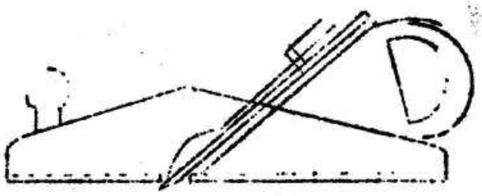
G- Grinding angle: 25-30°

Chisels will only function efficiently if they are sharpened exactly. The grinding angle is prepared on the grindstone and ensures that the cutting edge is at 90°, unless the edge is severely damaged this need not be touched. The cutting angle is ground on a sharpening stone, with oil, using a sharpening gauge, this should be ground before each job, and the burr on blank face removed.
A sharp chisel will cut with hand pressure alone on light jobs, for the removal of heavier material a mallet (wooden) is applied to the stock.



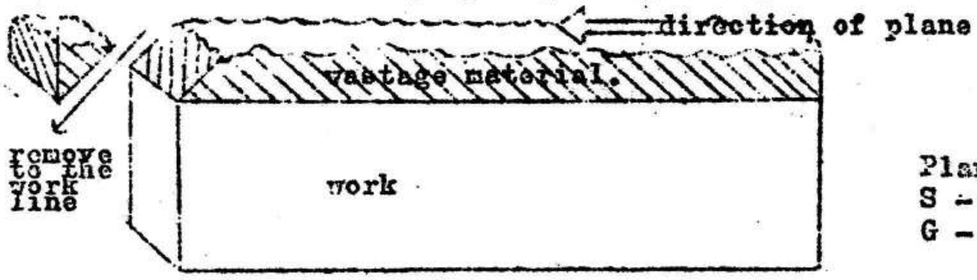

PLANES.

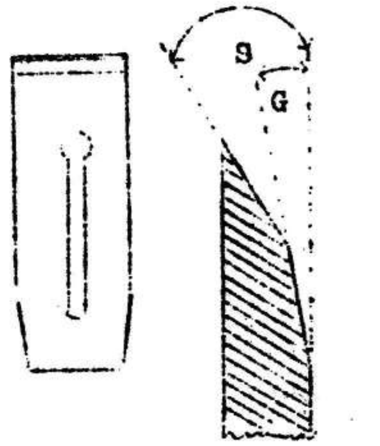
A smoothing plane is essentially a wider chisel blade mounted in a rectangular wood or metal frame, allowing the blade to be advanced or withdrawn, and tilted to give light or heavy cuts. Plane Blades should be sharpened as above. Light cut is used to finish planing job. The plane should always be laid on its side otherwise the blade may be chipped. When planing across the grain material should be beveled off at the end to which the plane is working to avoid splitting the down grain.



There are various other forms of plane, Rabbet Plane, Grooving Plane or Combination all designed to cut grooves, or remove material to controlled width and depth.

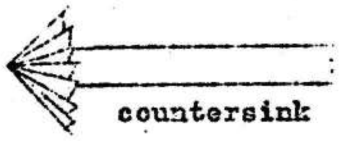
Like the chisel a plane blade should be examined before each job and the blade set square to the bed with correct cut, by sighting along bed.



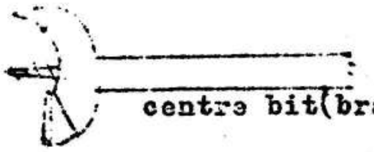




Plane Iron.
S – Sharpening Angle : 30°
G – Grinding Angle : 25°

<u>Drills</u>: For drilling holes, ensure that drill bits are sharp and are located in the centre of chuck which is tight. A sharp bit will not need excessive down pressure. (Do not take top off chuck as jaws and springs will fly out).

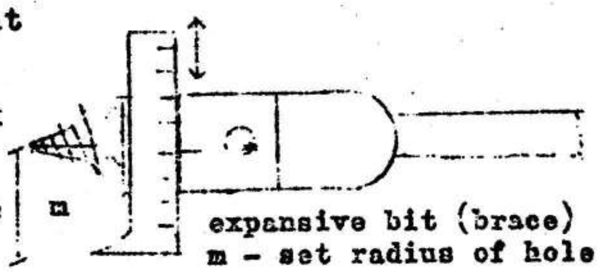



<u>Electric Drill</u>: Ensure that the bit is securely held in chuck which is tightened with an Allen Key or patent geared key. Do not over tighten. Put drill off when changing bits.



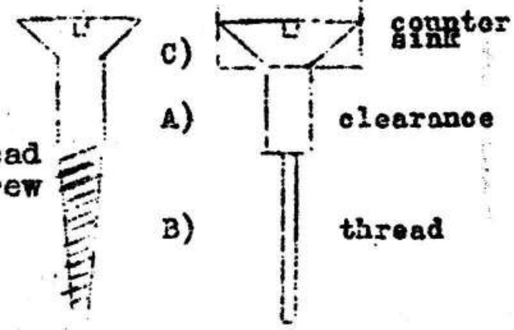

<u>Pedestal Drill:</u> (use under supervision).

see above, make certain that table height is correct and clamp waste material to bed with work clamped on top of this. When using any drill make sure that work is held rigid.




<u>Brace</u>: used to bore larger holes, centre bits, twist bits and expansive bits can be used.

<u>Screws and Drills</u>: screws are driven into drilled holes; two sizes of drill are needed
a) Clearance Drill, into which the top of the screw passes,
b) Thread Drill, slightly smaller than the thread so that it can bit into it. Consult a drill/screw chart.
c) Countersink, to angle off clearance hole so that head will be flush with top surface.




There are various methods of joining wood, nails, screws, dogs, dowel, jointing. in association with glues, or on their own. As a general rule screws or nails driven into the cross grain of wood will be weak and will cause splitting.

<u>Screws</u>: usually conntersunk or round head, simple slot or Phillips cross head.
<u>Nails</u>. Wire Round Head/domed/panel pins/panel pins with conical head enabling them to be driven in flush.
<u>Glues</u>: <u>Croid Hot Water Glue</u>, good for firm joints where job can be clamped up to dry.
<u>Resin W.</u> PVA Wood glue, cold, again clamping up ensures firm bond.
<u>Uni Bond</u>.PVA as above
<u>Evostick</u>: Impact Adhesive, light pressure forms permanent bond,useful for laminating sheets together, useless for small joints.

While glue is setting work should be clamped up or lightly pined in position.

## Available forms of timber and boards.

PSE: Rough Sawn: Available in a range of stock sizes.

Plywood consists of three or more layers of wood peeled from the log, and cemented together with the grain of successive sheets running in opposite directions. i.e. Very flexible sheets which can be curved/steamed into position or thicker stable sheets. available from 1/64"-¼"

Mutiply core is built up from narrow strips, faced with continuous sheets available from ¼"-1"

Block Board: core made up from narrow spacer strips faced with continuous sheets, cutting often reveals inferior cores.

Weyrock Composition Board made from compressed wood chips and dust glued together, available ¼"-1" very fibrous and tends to chip when cut.

Veneers : Available in many types of wood, peeled from tree and very thin, flexible and light to cut/usually show figure of timber clearly.

Dowel : Available in stock diameters, planed through dies, useful as solid method of jointing members with or without glue.

'Moulded Sections': Available in a range of types, planed from lath , use obvious! depends on type e.g. rebate for framing etc.

## ELEMENTARY WORKSHOP ORGANISATION :

1) SELECT A FIRM BENCH TO WORK ON/CLEAR OFF JUNK/SWEEP DOWN.
2) DRAW FROM STORE TOOLS REQUIRED FOR JOB/RETURN TOOLS YOU HAVE FINISHED WITH TO AVOID CLUTTERING BENCH.
3) PLACE TOOLS IN CENTRE WELL OF BENCH: CHISELS OTHERWISE ROLL ONTO FLOOR ETC. ALWAYS LAY PLANE ON ITS SIDE TO AVOID DAMAGING BLADE.
4) ENSURE THAT ALL TOOLS ARE SHARP/ENSURE THAT WORK IS HELD FIRMLY AT ALL TIMES DO NOT WANDER ABOUT HOLDING TOOLS / CUT AWAY FROM YOURSELF.
5) POWER EQUIPMENT MUST ONLY BE USED UNDER SUPERVISION.
6) WHEN YOU HAVE FINISHED WORK RETURN ALL TOOLS TO THEIR APPROPRIATE PLACE IN STORE/MAKE CERTAIN THEY ARE SIGNED OFF/ CLEAR WORKING SURFACE/STORE WORK.

EACH TOOL CUPBOARD IS FULLY EQUIPPED, IT IS THE COLLECTIVE RESPONSIBILITY OF THE GROUP OF STUDENTS WORKING AT ANY TIME TO REPLACE ANY LOST OR SEVERLY DAMAGED TOOLS OR EQUIPMENT.

cs foundation 1968

# CARDIFF COLLEGE OF ART

TECHNICAL COURSES | Plaster Casting | DIP.A.D.

## Natural and available forms of the material

Plaster is a natural rock (Gypsum) or Alabaster) whose natural christaline structure has been broken down by dehidration - firing to a red heat 750°C. The calcined gypsum is powdered and additives mixed to control setting speeds.

The material commonly used by sculptors is a superfine white plaster (Dental Plaster) which sets in 10 minutes.

There is a wide range of plasters manufactured which vary in hardness, setting speed, rate of expansion during setting and cost. British Gypsum Ltd., Newark will supply information.

## Methods of working

Different types of plaster require different treatment, Coarse Plaster requires less water. This article deals with Superfine Plaster.

Equal parts (by bulk) of water and plaster will give a weak mix. (Low mechanical strength when set). The usual method of gauging the mixture is to add plaster to water spreading the plaster rapidly and evenly over the surface of the water. When the water is saturated and the plaster is seen above the water level, the mixture should be stirred thoroughly.

It should be noted that if the plaster proves to be too weak after mixing more plaster cannot be added. If however the plaster is too strong water may be added to give the correct strength. The tendency should therefore always be to make too strong a mix.

Colouring materials and other additions should be non-soluble.

## Methods of Fabrication and Production

### Moulds

Where only one replica is required the mould can be chipped away from the casting, this is known as waste moulding. When several castings are required moulds can be made from Gelatine, rubber or wax. Plaster piece moulds are used normally in the Ceramic processes.

### Waste Moulds

The mould will be applied in pieces and the number and arrangement determined by the following considerations:-

1. The pieces must come away from the model without breaking and be easy to clean.
2. Access to all parts of the mould must be possible for filling.

The parts of the mould are separated by fences. These can be made from Brass cut into lengths about 2" x 1". The fence is constructed by passing the brass strips into the clay and overlapping each piece.

Where perfect points are necessary the mould should be divided with clay walls. In this process only one piece can be made at one time. Before adding the next piece the clay wall is removed and the exposed seam painted with a thin wash of clay to ensure separation.

It is always useful to colour the first coat of plaster. When chipping off the mould one watches for the coloured plaster and is warned that one is nearing the casting. Any metal oxide is suitable.

The mould is usually built up in layers. The plaster being covered should always be thoroughly wetted. Depending upon the size of the piece the thickness of the mould will vary from ½" to 1" with a quarter thickness at the seams.

When all the pieces have been applied to the model it may be necessary to re-inforce large pieces. Black mild steel or timber is used.

The re-inforcement is tied back to the mould with scrim dipped in a plaster mix. The scrim should be used economically and kept away from the joints. Scrim is an open hessian, with ⅛" to ½" mesh.

It is sometimes necessary to re-inforce narrow, pieces of mould and in this case galvanised iron wire of ⅛" or ¼" diameter is used. The galvanisation inhibits rusting which would cause weakening and crumbling of the plaster. Thoroughly shellaced mild steel may be used. This type of re-inforcement is applied alter the first layer of plaster and is held in place only by succeeding layers.

To remove the mould insert thin blades (table knives, paint scrapers etc.) into the seam and feed water into the opening. This operation should never be rushed. Rock the knives in the seam and pump in water.

When the pieces have been removed they should never be left lying flat as warping may occur. The pieces should be re-assembled and tied together.

Preparing the moulds

The mould should be washed and a parting agent applied. Victorian craftsmen first soaked the mould with a soft soap solution, after soaking thoroughly the mould was highly oiled with nape oil. There are now patent parting agents obtainable from Tinans' but probably the best parting agent is a thin clay wash.

Filling - (Plaster)

Where necessary re-inforcements must be included. There should be a suitable section of iron, well proofed against water either with shallock on a varnish paint or by the use of galvanised iron wire.

The metals are fixed to the mould before assembly and distanced away from the surface with plaster. These metals must be placed so that they do not prevent assembly of the mould. The plaster ties should bearranged at points where they will not interrup the flow of plaster when filling.

Models of a reasonable section can be filled as solid castings (up to 3" section) Larger works should be filled hollow ½" to 1" thickness. The usual practice is to pour plaster into the mould and rotate the mould slowly. Usually it is necessary to apply several coats.

Chipping off the mould

Never carve the mould away. The chisel used should be blunt and held at right angles to the cast. This action bursts the mould sideways and it is advisable to work away from fragile projections.

Filling Plaster Moulds with Cement Fondu

Cement Fondu is a quick setting, black material with good weathering qualities and great mechanical strength. It is usually used in combination with glass fibre.

Mixing — Water is added to the cement to achieve a creamy consistency. It is very easy to add too much water. Stir whilst adding water and add water slowly.

Application

Where it is possible to reach the entire mould through the bottom, the mould should be tied together and the seams re-inforced with scrim. The mould is prepared as for plaster casting by soaking and applying a parting agent. If the mould is dry it can be given two coats of shellac (instead of soaking). When the shellac is hard apply a coat of P.V.C.

We have found that a thin clay wash on a well soaked mould gives good results. (Note on separations) As the cement sets heat is generated by chemical action. Parting agents must resist heat and strong alkaline action.

Filling Large Moulds

Where it is impossible to reach the interior of a mould the pieces are filled separately and assembled when hard.

Application of cement. Brush on first layer taking care to eliminate air pockets. When this layer is firm (½ hr.) apply a layer of glass fibre and cement again eliminating air pockets.

Coatings of cement and glass fibre are applied until the desired thickness is achieved.

Re-inforcements. Iron rods should be coated to prevent misting if they are to be exposed to weather.

Joining Casting

When the pieces of the mould are filled they should be assembled dry in order to test the seams. If the seams have been kept clean and warping has been prevented the mould should 'go together' perfectly.

The pieces should be thoroughly soaked, the seams thickly coated with a strong mix of cement, the mould reassembled and bound together. Ideally there will be a thin flash, or seam projection.

The mould is chipped away as in plaster casting.

Cement Fondu, though usually black, may be obtained in a variety of colours including white. It is also possible to obtain special preparations like Terrosa Ferrato - a plaster like cement of a terra-cotta red colour.

Ordinary green cement may be used with sand or stone chipping aggregate (a mix of 1 cement to 4 aggregate is usual) to give an imitation stone finish.

METAL CASTING GENERAL

Moulds can be made from any material which:-

a. resist the pressure of the metal at the temperature of the molten metal.
b. is capable of reproducing a perfect surface.
c. when exposed to molten metal temperatures will remain inert and not give off gasses which would destroy the casting.

Metals The choice of metal is determined by such factors as cost, strength, resistance to atmosphere and asthetic considerations.

The metals in general use are:-

| | Casting Temperature | Price lbs. | NOTES |
|---|---|---|---|
| Iron | 1250°C | 1/- | Requires special melting process. Castings can be made by taking mould to Foundry. |
| Phosphor Bronze | 1100°C | 7/- | Casts well. Ductile. Weathers well. |
| Gum Metal | 1100°C | 5/- | Rather Viscous. Ductile. Very strong |
| Brass | 1050°C | 4/- | Viscous. Brittle. Attractive when machined |
| Silver | 900°C | costly | Easy to cast. Ductile |
| Aluminium | 650°C-750°C | 4/6 | Runs well. Easy to cast Resists atmosphere. |
| Zinc | 450°C | 4/6 | Hard and strong. Runs well. Usually die cast |
| Lead | 400°C | 4/- | Soft. Ductile. Casts easily. |

Moulds can be divided into three main groups:-

SAND MOULDS - used for simple repetition work without undercoats.

INVESTMENT MOULDS - A wax model is surrounded by moulding material and fired to remove wax. This is the usual method used in Art Bronze Foundries.

FOAM PLASTIC REPLACEMENT. The model is made in Polystyrene. The model is surrounded by sand. The hot metal vapourises the plastic and fills the cavity remaining.

DIE CASTING - an industrial process used in mass production. The mould is made in steel and is automatically assembled and filled.

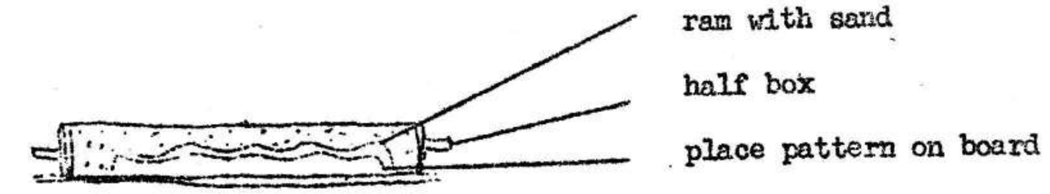
SAND MOULDING - the most common industrial method of casting.

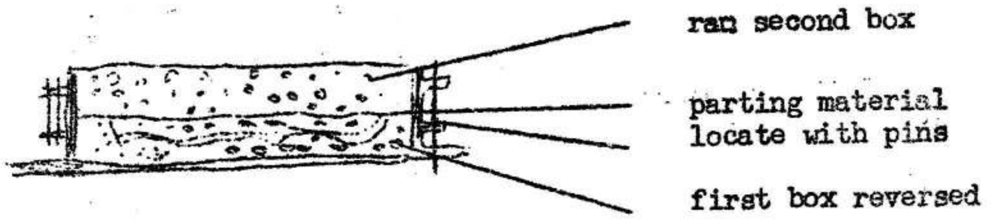
The SAND is often a natural material which has been deposited by rivers flowing through sandstone country. It is approximately 85% Fine Silica sand, 7% clay and 3% iron and vegetable matter. In condition for moulding it would contain 5% water.

Synthetic Sands are manufactured which give a finer surface and have greater bonding strength. There are a mixture of fine sand and bentonite (a special clay having very fine particles). The water is replaced with oils.

METHOD

The pattern must taper not less than 5°





Melting and pouring Bronze

The melting temperature of copper 1150°C, in order to reduce melting temperature and increase fluidity tin and phosphorous are added. Tin melts at 650°C and vapourises at 1000°C. Phosphorous is unstable. In order to retain the low temperature elements the bronze must be melted rapidly and poured immediately casting temperature is reached. The volatile elements can be retained and oxygen excluded if a layer of glass is floated on the metal.

Pouring. The spout of the crucible should be as close as possible to the runner to reduce cooling and oxydization. Pouring should be constant and steady.

Melting Aluminium. Aluminium will absorb gas when molten. Castings from such metal are porous and brittle. The metal should not stew, but should be brought to casting temperature rapidly and poured immediately. Degassing chemicals are available and are used when castings are to be machined.

Metal Casting from Investment Moulds

Investment moulds are made from a mixture of Plaster 40% and Grog 60% (Grog is clay which has been fired and then crushed to a powder). A hard setting plaster is used - Coarse Casting plaster is suitable. (Superfine should not be used). The Grog is introduced to reduce shrinkage during firing.

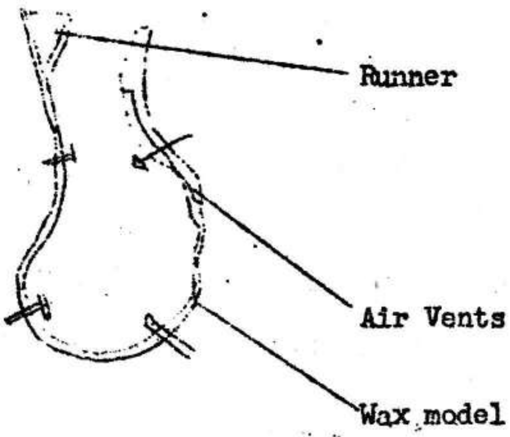
The mixture when set must be dried in order to remove the face moisture. When dry it must be fired for not less than 8 hrs. at a temperature of 700°C to remove chemically combined moisture. If all water is not removed the heat from the molten metal will generate steam. When the mould is filled and this steam will, at these temperatures, expand violently, even explosively, causing the molten metal to be expelled from the mould. The mould has no mechanical strength and should be moved with care and is usually packed in a box of sand to prevent bursting when it is filled.

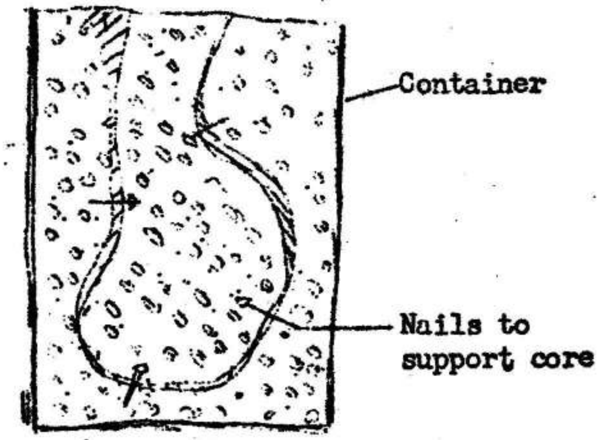
WAX MODEL

Throughout history bees' wax has been used, but micro-crystaline wax is suitable and very much cheaper. Petroleum jelly should be added to increase plasticity. No filler should be added, this would leave a deposit in the mould.

Runners and Air Vents

The metal should be ducted freely to all parts of the mould and vents arranged to allow air to escape.




Place in suitable container and pour investment mixture
Vibrate to remove air pockets

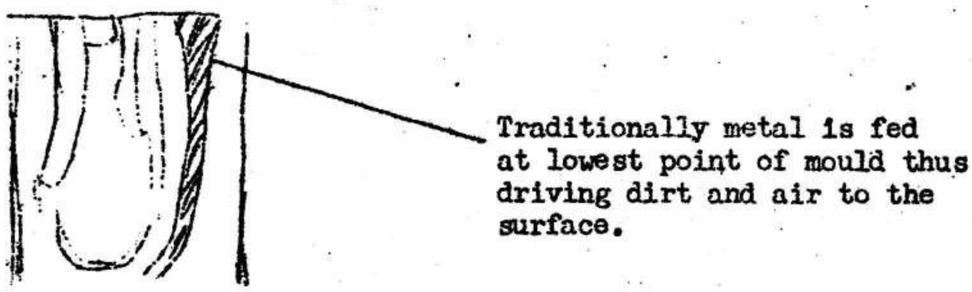
The investment mixture should be as thick as the job will permit. Add plaster and grog to water and adjust for strength.

If the model is first dipped in a wetting agent (dilute detergent) this will help to prevent air pockets forming.

When the mould is set (15 minutes) it should be placed in a kiln arranged so that the wax will pour out. Trapped wax will vapourise leaving no deposits.

Firing time will depend upon the section of the mould - 2" thickness will require 5 hours at 700°C. Above 700°C the plaster will shrink rapidly and crack.

When cold remove the mould from the kiln and arrange in a container and support with sand.




INVESTMENT DIRECT FROM CLAY

The investment mixture is applied immediately to the clay model as in normal plaster casting.

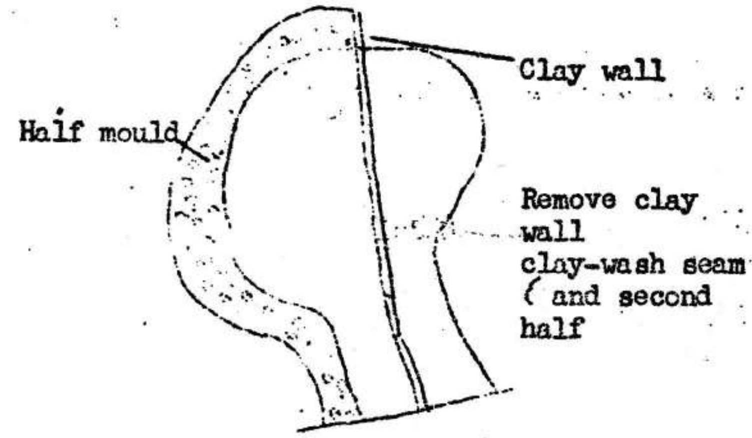
The proportion of grog to plaster should be consistant from piece to piece and layer to layer.

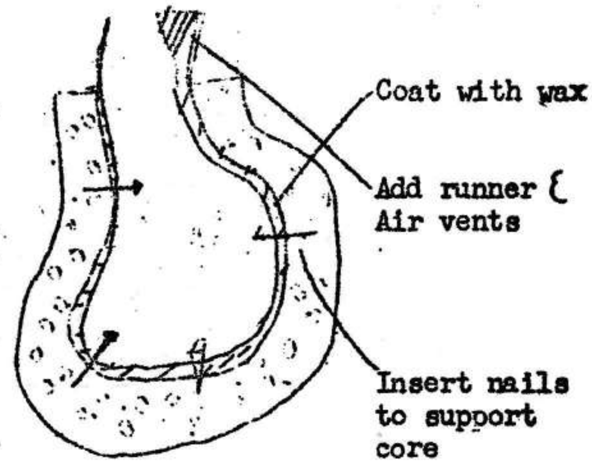
Clay walls should be used to part pieces, not metal fences (see earlier section on piece moulds).

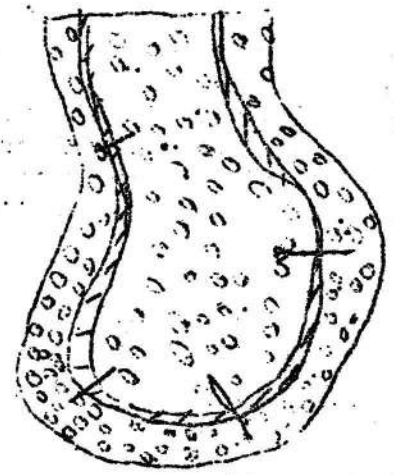
The investment mould is removed from the model and washed. A layer of wax applied to the thickness of the final bronze casting.

When the wax lining is completed, runners, risers and air vents are added. Nails are driven through the wax into the mould to support the core.

While the core is poured and extended to enclose runner and risers. At the same time the seams should be coated to hold the pieces together.

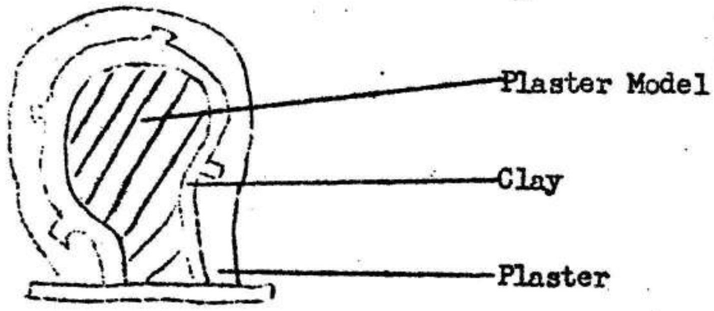


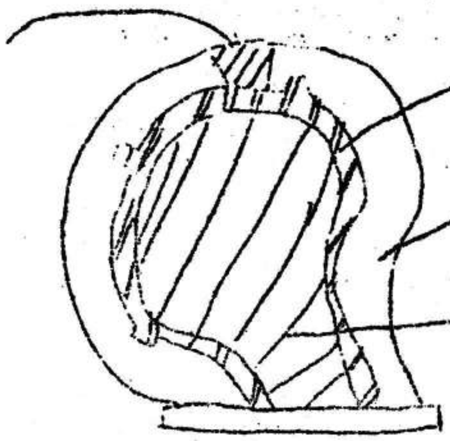




Investment from plaster or other rigid material

It is sometimes possible to carry this out with a piece mould as from a clay model but it is more usual to convert the plaster to wax by gelatine moulding. In this case the model is first covered with a half inch layer of clay which is then covered with a two or more piece mould in ordinary plaster.




The clay is then removed and the model cleaned and the space previously occupied by clay filled with gelatine (or P.V.C.).




The exterior mould commonly called "the jacket" is removed the gelatine cut through along the seams and removed from the model and placed in the jacket. The inside of the gelatine is painted with wax to the desired thickness and the parts removed from the gelatine and welded together. This gives a wax version of the original model which is afterwards treated as previously described to convert it to a metal version.

We can present theories and experiments to explain colour phenomena and human perception thereby focussing on particular characteristics which go to make up overall documentation. Theoretical information, especially that dealing with apparently simple propositions, often proves difficult to assimilate if seen in isolation. We need to make connections between theory, ourselves, the environment and what specific interpretations and outcomes we see. In this sense it is only when we begin to 'structure' with information that it becomes more applicable to us personally and takes on significance beyond that of abstract and universal information; structuring takes place on many levels all of which depend to some degree on the type of stimuli and perceptual awareness.

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VISION IN MOTION L.MOHOLY NAGY. Theobold (Library)

CHEVREUL ON COLOUR (Library)

THE LAWS OF CONTRAST OF COLOUR M. CHEVREUL (Library) 1859

ON COLOUR JOHANNES ITTEN (Library)

THE THINKING EYE PAUL KLEE LUND HUMPHRIES (LIBRARY) £7.17. 6.

ART AND ILLUSION E.H. GOMBRICH. Phaidon Ress (Library)

SCIENTIFIC AMERICAN May 1963 (OSTER AND NISHIJMA ON MOIRE PATTERNS)

SCIENTIFIC AMERICAN SEE INDICES FOR MANY EXPERIMENTS IN VISUAL PERCEPTION. Afterimage/Field Resolution/Phosphenes etc., (Back numbers un college library).

Chris Shurrock. 1966 revised 1968 revised 1970.

## APPENDIX 1

### BRIEF NOTES ON EARLY OPTICAL TOYS:-

STROBOSCOPE or PHENAKISTASCOPE: Invented in 1832 by Plateau and Stampfer. Disc with radial slots is superimposed on disc with a series of images, when revolved images appear to move. Various forms exist with mirrors and variations.

ZEOTROPE: Invented c.1834. Similar to above but in form of drum with image on interior, and slots in edge.

PRAXINOSCOPE: Patented by Reynaud 1877. Revolving drum with images on inside, reflected onto a central polished speculum with the same number of sides to reflect corresponding images.

THAUMATROPE: Attributed to Dr. J.A. Paris. c 1826. Disc with 2 related images on each face, the disc is strung on a double loop of string and spun in a vertical plan. Images merge through the persistence of vision.

### BRIEF NOTES ON PHYSICAL ETC.. DEALING WITH COLOUR/PERCEPTION EXPERIMENTS

| | |
|---|---|
| SNELL | 1621 One of the first mathematicians to investigate laws of refraction. |
| DESCARTES | 1596-1650 1632 published standard work in refraction of light also investigations into size and shape constancy. |
| HUYGENS | 1629-1695 Theories on wavelengths as pulses through the ether. |
| NEWTON | 1642-1727 First to explain composition of 'white' light as the spectrum. Published in his 'Optik'. |
| ROEMER | 1644-1710 Calculated the speed of light, which was over estimated. |
| KEPLER | 1571-1630 Early experiments with retina of eye. |
| MAYER | 1723-1762 Devised three colour triangle. |
| LAMBERT | 1728-1777 Invented colour pyramid. |
| GOETHE | 1749-1823 Afterimage experiments, subjective measurement of colour proportions, based on feeling. |
| YOUNG | 1773-1829 Proposed that colour is sensation and evolved the three colour receptor hypothesis of vision. |
| RUNGE | 1777-1810 Invented colour sphere to explain colour-pigment orders. |
| CHEVREUL | 1786-1889 Chemist, research into pigment and dye lead to classic work on the Laws of Simultaneous Contrast of colour perception. |
| SCHOPENHAUER | 1788-1860 Further described colour as sensation. |
| FECHNER | 1801-1887 Experiments with stimulus/sensation (Weber/Fechner Law). |
| HELMHOLTZ | 1821-1894 Physiological Optics experiments. |
| OSTWALD | 1853-1932 Originator of the Ostwald Colour system, now looked on with some suspicion, (still employed by Winsor and Newton). |
| MAXWELL | Founder of theory of Electro Magnetic Spectrum. Disc Experiments. |

| | |
|---|---|
| HERRING | 1934-1918 4 complimentary colours with black and white could produce all colour derivatives. |
| MUNSELL | 1856-1918 Organisation of system to fix colour, value and chroma in scales. (Munsell Reference system). |
| PAUL KLEE | 1879-1940 Theoretical writings of colour and experiments at Bauhaus. (Thinking Eye etc., ). |
| ITTEN | 1888-19 Writings on colour systems and experiments also taught at Bauhas. (See On Colour). |
| ALBERS | 1888-19 Writings and experiments with colour relationship and Structure. (see book Colour and his own paintings |

APPENDIX 2

MARCEL DUCHAMP. 1887 -

These notes concerning experiments with kinetics of form and colour carried out by Duchamp should not be thought of as isolated phenomenae but as connected with the first manifestations of his interest in time/space/movement with human/machine participants as seen in the early paintings "Sad Young Man in a Train", "Nude Descending a Staircase" 1911-16 etc., and the project for the Jura-Paris Road. Through the numerous inter-related stages of the "Bride Stripped Bare by Her Batchelors, Even' (The Large Glass) and associated works.

REVOLVING GLASS.

The first actual machine which Duchamp created in New York early in 1920 was called the "Apparcil Rotatif, Optique de Precision". It was made of five glass plates of the same width, but of graduated lengths, mounted on a common centre at distances along an axis which was turned by an electric motor, "When the white and black lines drawn on the glass plates were set in motion and 'were seen from a distance of one metre' they seemed to form continuous circles" Made with the collaboration of Man Ray.

Size: 47½ x 72½ x 39½. Exhibited "Fantastic Art, Dada, Surrealism", Museum of Modern Art 1936.

ROTARY DEMI-SPHERE.

Made in Paris in 1925. Demi-Sphere with white spirals painted on a black ground, the demi-sphere is set in a flat disc covered with black velvet; this can be covered by another disc in copper, to which a convex glass (now cracked) is fitted, protecting the demi-sphere. Both demisphere and disc rotate via electric motor at base. The two circles revolve above each other on different centres generate spirals which appear to revolve about a third centre, which according to Duchamp must be looked at with one eye. The following year Duchamp with Man Ray and Marc Allegret made a film ANEMIC CINEMA (Anemic: an anagram of Cinema) which used 10 discs bearing spiral imagery, alternating with 9 discs inscribed with puns; white relief lettering on black ground 11⅜" dia. "The original spirals of the demi-sphere are multiplied tenfold and in expanding they produce analogeous forms which evoke, like a double image, astonishing objects which immediately disintegrate in order to let other equally ephemeral ones appear. As always in Duchamps work these forms are laden with sexual allusions through the calculated succession of contractions and dilations"

ROTORELIEFS (OPTICAL DISCS)

1935 Paris. 6 Cardboard Discs with coloured figuration on both sides each 7⅞" diameter.

The Rotoreliefs first appeared in the film Anemic Cinema. Duchamp subsequently changed all the drawings except two and published 500 sets of 6 printed discs which he exhibited at the Concours Lepine in 1935 in his capacity of 'benevolent technician! @The discs should be placed on a record player according to the following instructions: "these discs turning at an approximate speed of 33 r.p.m. will give an impression of depth and the optical illusion will be more intense with one eye than with two". This presented an original experiment in perception, and the illusion of the third dimension is due to a psychological transformation of the impression of speed into that of distance.

A second edition of 1,000 was published in New York in 1953. (The original discs are now in various collections).

(Rotoreliefs were also used by Hans Richter in his film "Dreams that Money can Buy 1946/7 where they appear in colour, and by Jean Cocteau in Le Sang du Poete 1931).

@ H.P. Roche in Souvenirs of Marcel Duchamp recounts the following:- Several years later in Paris (1935) he decided to try what he called a "direct contact" with the people. He had just completed twelve Rotoreliefs, optical discs which, when placed on the turntable of a phonograph, produced the illusion of motion in perspective. He rented a tiny stand among the inventions at the Concours Lepine near the Porte de Verseilles and waited for the crowds to come. I had to go and see that. All the discs were turning around him at the same time, some vertically, others horizontally, a regular carnival.... but I must say that his little stand went strikingly unnoticed. None of the visitors, hot on the trail of the useful could be diverted long enough to stop there. A glance was sufficient to see that between the garbage compressing machine and the incinerators on the left and the instant vegetable chopper on the right, this gadget of his simply wasn't useful. When I went up to him, Duchamp smiled and said, "Error, one hundred percent. At least its clear".

Notes from M ·CEL DUCHAMP by Robert Lebel (trans GH Hamilton) TRIANON PRESS 1959 which gives full bibliography and plates.

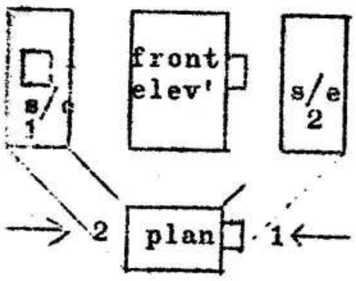
CARDIFF COLLEGE OF ART. GENERAL NOTES ON PROJECTIVE SYSTEMS OF DRAWING. DIAGRAMS

September 1966 es

## 1 LINE CONVENTIONS (B.S)

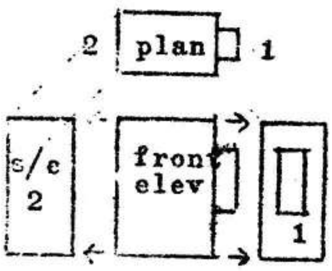
a Continuous thin: projection lines/also dimension lines/extension lines/section lines/leader lines for notes/revolving sections. VERY LIGHT
b Continuous thick: Visible outlines, usually inked.
c Short dash thin: Hidden portions or parts to be removed.
d Long chain thin: Centre lines/path lines for indication of movement.
e Long chain line thick: cutting/viewing planes.
f Short chain line thin: Developed or false views/parts in front of cutting plane/alternative positions.
g Continuous wavy thick: Irregualar boundary/short break.
h Ruled line with short zig zag: Long break lines.

## 2 FIRST ANGLE ORTHOGRAPHIC PROJECTION.



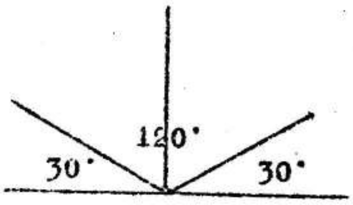

Plan appears below, front elevation directly above plan, side elevation 1 appears on left side of front elevation(seen from direction of arrow1. Side elevation 2 appears on opposite side of front elevation. Until recently the most widely used system in G.B. Disadvantage: information has to be carried to opposite side always.

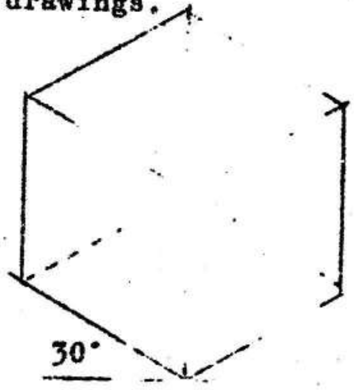
## 3 THIRD ANGLE ORTHOGRAPHIC PROJECTION.




Plan appears above, front elevation directly below, and side elevations 1 & 2 on the respective sides directly to the side of front elevation. Accepted system in U.S.A. becoming more current in G.B. especially in forces and international companies. Third angle projection is stated on drawings.

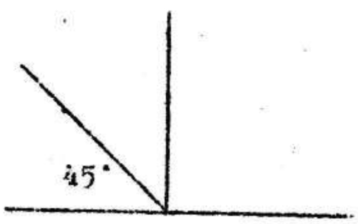
## 4 ISOMETRIC PROJECTION.

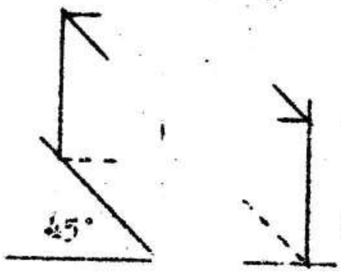


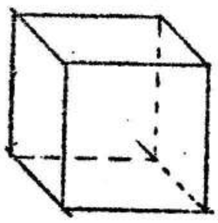

Construction on two exterior angles of 30° verticals remain vertical, all sides parallel. All measurments are full scale and can be measured off on axes of height/width/depth. No diagonal measurments can be made. Any object can be projected into basic box to contain its greatest dimensions.

## 5 OBLIQUE PROJECTION.



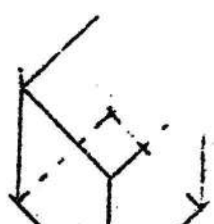




5.1



5.2

## 6 AXONOMETRIC PROJECTION.


Oblique: Construction on 45°angle from horizontal, verticals vertical, all sides //el at 45°. The use of full scale depth measure causes distortion(5.1) To avoid this half depths are used(5.2) Crating system used as in iso'.
Axonometric: Construction on 2 45°angles using actual plan, verticals vertical and true length

# CARDIFF COLLEGE OF ART

## GENERAL NOTES CONCERNING PROJECTIVE SYSTEMS OF DRAWING

The various systems listed are all objective in that they seek to convey information concerning things as we think we know them to be by the use of perception and reasoning. Statements about any three dimensional object can be set down on a two dimensional surface giving via the appropriate system and conventions, information which is accurate, concise and readable, so that it communicates information to the draughtsman/designer/worker. It is important that each problem should be assessed and planned before it is begun, and that on a purely technical level, efficiency in the handling of instruments and the process of making marks should be developed.

1. LINE CONVENTIONS

A system of lines currently used in orthographic projections in this country is illustrated in diagram 1.

2. SCALES AND DIMENSIONING

Scales are used to ensure that information is drawn to a constant and manageable size. Drawings may be at actual size where suitable, in which case this is stated. Large objects, e.g. architecture, is reduced in scale to a suitable size, while miniature objects are increased in scale so they can be seen. Scales are expressed as the representative fraction (R.F.) the ratio between the scale unit and what this represents in actuality. (e.g. 1" represents 12' R.F. 1/144.) Scale should be stated on drawing, and drawn up if accurate measurements are to be taken from it. Where appropriate, drawings are dimensioned, i.e. the actual dimensions are marked against appropriate parts of the drawing following an ordered system.

3. ORTHOGRAPHIC

(Ortho - from Gk Orthos: straight/right, Orthogonal: right angle) Orthographic projection employs vertical and horizontal projection planes which are joined at right angles to each other, and imagined as flattened onto the working surface. If these planes are imagined to be the six faces of a glass cube, the position of any point suspended within the cube can be found relative to each face by projecting imaginary lines from the point to all six faces. If a brick is imagined to be suspended within the cube and projectors are taken at right angles from the corners to intersect the faces of the cube at the perpendicular, these points when connected on each respective face will trace the actual measurements of the appropriate surface of the brick. When the glass cube is folded out flat the respective faces of the brick will lie on one plane, with information concerning each face capable of being linked with the others by parallels at right angles.

Projection produced by lines perpendicular to the horizontal plane gives the PLAN which is concerned with length and breadth.

Projection produced by lines perpendicular to first vertical plane gives the FRONT ELEVATION which is concerned with length and height.

Projection produced by lines perpendicular to second vertical plane gives the SIDE ELEVATION which is concerned with breadth and height.

Usually these projections are taken from an object lying in parallel with the projection planes, they are set out as diagram 2. If there are details which are not apparent from the three already given then AUXILIARY plans and elevations can be taken off at any angle required to show such details.

There are two main systems of laying out orthographic projections. FIRST ANGLE which is current in G.B. and THIRD ANGLE which is used in U.S. to avoid confusion when third angle is used it is labelled as such, or directions of projection indicated. See diagrams 2 and 3.

The obvious adwantages of Orthographic projection are that true lengths are given in each projection and objects can be fabricated from this information.

4. <u>DEVELOPMENTS</u>

A development is the projection of the total surface area of any object onto the single plane of the paper. All creases folds or bends are flattened and the resulting projection used to calculate the area of material required, or as a plan from which the form to be fabricated is drawn up on sheet material prior to bending and folding.

5. <u>ISOMETRIC</u>

(Iso - equal, isometric equal measure)

Isometric is a convenient system of showing three faces of one object in a single projection, actual measurements are used and all parallels are parallel but it is assumed that all right angles are represented by a dihedral angle of 120' (exterior 30' each side of horizontal) Construction is thus very simple and can be carried out with a 60'/30' set square, and Tee square. Isometric is employed when a constructed and accurate, but semi-pictorial' drawing is required. The same conditions of scaling apply, but measurement is only possible along three axes, and not on any diagonals. See diagram 4.

Any objects from simple rectangular prisms, to complex curvilinear forms can be projected in Isometric if they are first 'crated' in an imaginary rectangular box, and all the subsequent characteristic plotted relative to this box, and then transfered to the box drawn with dihedral angles of 120' on the paper. Isometric projections are used in conjunction with orthographic to show the total aspect of the object.

6. <u>OBLIQUE</u>

The uses of oblique projections are the same as isometric, the essential difference is that the rectangular box for projection is orientated with the one elevation parallel and the other at 45' exterior angle to the horizontal see diagram.... Oblique projection is not as versatile and considerable distortion is shown especially in depth measurements which are usually halved. Certain orientations of the object are confusing in projection and these must be carefully chosen. DIAGRAM 5.

7. <u>AXONOMETRIC</u>

Axonometric projections are developed from plans placed on the drawing board with axes of width and depth at 45' to the horizontal, true lengths are used for plan and verticals which are true height. Parallels remain parallel and verticals remain vertical, measurements can be taken on three axes. Axonometric projections are employed extensively in architecture. DIAGRAM 6.

8. SECTIONING

To explain the nature of a form at points which would not be shown in any projection in orthographic, sectioning planes are imagined to be passed through the form. As in the case of shipbuilding where sections are taken at a graduated series of vertical and horizontal planes perpendicular to each other along the length of the form. Sections can be superimposed and clearly coded or set off at a convenient distance from the projection. A section can be taken at any required angle and gives the true shape for that angle of cut. Sections are usually hatched with 45° lines, unless this obscures internal detail.

9. CUTAWAY PROJECTIONS

On orthographic projections hidden details appear as dotted lines, there may be need to cut a portion of the outer skin away to reveal these, but cutaway projections are more frequently applied to Isometric/oblique/and perspective projections, where areas of the surface casing are removed to show the inner mechanisms; the entire surface casing may be removed, or only part. See good industrial examples, car manufacturers etc.

10. EXPLODED PROJECTIONS

Exploded projections are used where the cutaway method still obscures the exact description of inner parts and assembly. Exploded projections can be in any system which is required. The mechanism is imagined to be split into all the component parts, and these are laid out at a suitable distance from each other on the axes of depty/width/height, e.g. in isometric the axes would be one vertical, two at 30° If the object is of a very complex nature there may be need of more axes to show the breakdown of some sub assembly, these are set off at the appropriate point following whichever axia is suitable. The final drawing should demonstrate that although every part is separately drawn they can be imagined to collapse together along the appropriate axis to form the whole form.

PERSPECTIVE

Perspective projections are employed when it is required to represent three dimensional objects on a plane surface so as to give the same impression of relative positions and magnitudes as do the actual objects when viewed from a particular position. Perspective is concerned with apparent form and position of actual true lengths and differs from systems previously listed.

There are three types of perspective projection.

a. Parallel perspective (one point) in which the projection or picture plane is imagined to be parallel to the axis of height and width of the object, only one vanishing point is used for lengths, horizontals remain horizontal and verticals remain vertical.

b. Angular perspective (two point) The picture plane is parallel only to the axis of height, verticals thus remain vertical. Widths and lengths appear to vanish to two vanishing points.

c. Oblique perspective (three point) The picture plane is at an angle to all three axes, e.g..standing at an angle to a building looking up, widths lengths and heights hafe separate vanishing points. This construction most nearly represents the object as seen under normal conditions of human vision.

There are various methods which can be employed to construct all three perspective orientations. Industrially perspectives are usually set up on commercial grids, graded to show any orientation of the object to observe The systems listed will be investigated in the studios.

IS IMPERATIVE THAT EVERY STUDENT HAS HIS OWN SET OF DRAWING INSTRUMENTS IN WORKING ORDER BEFORE THE COMMENCEMENT OF THESE COURSES.

# ESCOLINHA DE ARTE DO BRASIL - 1971

# CURSOS PROGRAMADOS POR TOM HUDSON

I — EDUCAÇÃO CRIADORA:
criatividade, educação e tecnologia para professôres de crianças e pré-adolescentes; de 2 a 6 de agôsto, de segunda à sexta-feira.

II — EDUCAÇÃO CRIADORA:
criatividade, educação e tecnologia para professôres de adolescentes (de escolas normais, ginasiais) e de professôres de nível universitário; de 9 à 13 de agôsto, de segunda à sexta-feira.

TOM HUDSON foi, especialmente, convidado para dar êsses dois cursos, na Guanabara, pela sua forma original de focalizar e motivar a criatividade no processo educativo.

A ESCOLINHA DE ARTE DO BRASIL, trazendo TOM HUDSON, por um mês, a fim de dar cursos no Rio de Janeiro e fazer conferências em outros centros universitários do país, promove o inter-relacionamento de experiências no campo da educação criadora e espera estimular essa forma de educação necessária ao nosso desenvolvimento tecnológico.

O GRUPO FINANCEIRO TAA contribuiu para a realização dêste curso e demais atividades comemorativas do 23º aniversário da ESCOLINHA DE ARTE DO BRASIL.

# TOM HUDSON–Artista e "Creative Educator".

Nasceu em Durham, em 1922

Estudante de Pintura na Escola Superior de Arte da Universidade de Sunderland; em seguida, quando em "King's College" da Universidade de Durham, interessou-se por História da Arte.

1950-51 Pós-graduação em História da Arte, no Instituto Courtauld, em Londres.

1951-56 Formou-se professor de pintura (Master) pela Escola de Arte de Lowestoft. Conselheiro de Escolas (de ensino): no campo da Pesquisa do Desenvolvimento Estético da Criança.

1956-60 Conferencista da Escola Superior de Arte da Universidade de Leeds, dedicando-se ao Desenho Básico.

1960-64 Diretor da "Foundation Studies", na Escola Superior de Arte da Universidade de Leicester.

Desde abril de 1964 Diretor de Estudos da Escola Superior de Arte da Universiidade de Cardiff.

Dedicou-se especìficamente à educação através da arte — "acreditando que todo indivíduo tenha uma capacidade inata para criar uma linguagem estrutural própria."

Fêz inúmeras conferências, tanto na Inglaterra quanto nos Estados Unidos, acêrca de diversos temas, incluindo Educação, Tecnologia, Côr, História da Arte etc.
Exerce também a função de consultor na aplicação de materiais sintéticos.
Foi membro visitante dos Departamentos de Arte das Universidades de Newcastle, Reading, Leeds, Londres, Instituto de Estudos Superiores de Arquitetura, Universidade de York etc.

Foi artista visitante na Universidade de Sheffield, entre 1965-66.
Dirige cursos de verão (cursos de férias), realizando trabalhos experimentais bidimensionais, tridimensionais e em outras áreas — "O Processo Criador" — em Barry, Gales.

Membro permanente da Comissão de Exposições Nacionais de Arte Infantil, tendo organizado exposições didáticas especiais, sôbre: Técnicas Mecânicas, Linguagem das Estruturas, Geometria Criadora, Exposição Especial da Côr, Tecnologia Criadora etc.

Representante nacional e vice-presidente da Sociedade Nacional de Arte e Educação.

EXPOSIÇÕES RECENTES

1964 — Artistas Drian — Galerias Drian, Londres, janeiro
— A Imagem interior — Galeria Grabowski, Londres
— Galeria de Artes Visuais, Nova Iorque

1965 — Tendências e Seguidores de Tendências — Galeria Howard Roberts, Cardiff.
— Nova Tendência — Iugoslávia
— Cinco Posições Criadoras, Galeria Glynn Vivian, Swansea

1966 — Escultura Britânica — Centro de Artes Hampstead, Londres

1967 — Hudson-Setch — Galeria Grabowski, Londres
— Exposição Especial da Côr — Galerias do "Royal Institute", Londres.
— Aprendendo a Desenhar (Arts Council) Exposição Móvel
— "Estruturas" — Exposição do Conselho de Artes de Gales
— Escultura ao ar livre, Edimburgo.

1968 — Aliança pela Arte, Washington, E.U.A.
— Hudson-Baldwin, Galeria Grabowski, Londres
— A pintura se torna escultura, Cambridge
— Centésima Exposição Grabowski, Londres
— Grupo de Gales 56 — Excursão Irlandêsa e Galesa

1969 — Grupo 56, Galeria Gales-Grosvenor, Londres
— Grupo 56, — Excursão Escocêsa
— Exposição dos Meios Mistos — Museu Nacional de Gales

## EXPOSIÇÕES DE ALUNOS E ESTAGIÁRIOS

1957 — Festival Hall, Londres pela Arte Para a Sociedade de Educação

1958 — Galerias R.B.A., Londres "Escultura Mecânica" — Para o Domingo da Pintura

1959 — Instituto de Arte Contemporânea "O Processo de Desenvolvimento", em colaboração com V. Pasmore, Alan Davies etc.

1962 — Galeria Drian, Porchester Place, Londres "A Aventura Visual"

1963 — Festival Internacional, Bromsgrove

1963 — Exposição Especial de Ferramentas e Máquinas Artesanais — Galerias R.W.S., Londres (Exposição circulante: Grã-Bretanha e exterior).

1964 — "Arte-na-Educação e Individualidade", Museu Ashmolean, Oxford (para a Sociedade de Arte da Universidade de Oxford)

— "A Aventura Visual 1964" Escola de Artes Visuais, Nova Iorque

— "A Linguagem das Estruturas", Galerias R.W.S., Londres

1956 — Upper Whitechapel Gallery, Londres

1967 — Exposição Especial da Côr, Galerias R.W.S., Londres

## CURSOS

Organizados para várias entidades especializadas:
Escolas de Verão (Cursos de Férias), Scarborough, em colaboração com H. Thubron e Victor Pasmore, 1956-57.

Curso para Professôres Especializados em Madeira e Metal — North Riding, Arte e "Design", teoria e prática, 1956-57.

Escola de Inverno (Curso de Férias), Leeds 1958-59. Desenho e Escultura, para a Comissão de Educação de Leeds.

Cursos para conferencistas, para o Ministério da Educação em Bedfordshire, Cambridgeshire, Isle of Ely, 1956, para Especialistas em Arte.
Escolas de Verão (Cursos de Férias), para a Comissão de Educação Glamorgan — Pintura, Escultura e Construção, a partir de 1959, "O Processo Criador".

Outros cursos para Cheshire, North Riding, Shropshire, Suffolk etc.

## CONFERÊNCIAS

Realizadas para várias organizações educacionais e públicas, incluindo:
"Treinamento Estético para Engenheiros", Curso Nacional do Ministério, Loughborough — para diretores de Colégios Técnicos e de Departamentos de Desenho Industrial.

"O Uso Construtivo de Materiais por parte de Crianças" — Curso de Educação do Instituto de Cambridge.

Conferência sôbre Educação da Região Norte, Southport

"Bases Históricas e Filosóficas da Educação através da Arte" — Universidade de Manchester.

"A Imagem e o Individual na Educação através da Arte"

Linguagem Criadora do Século XX — para a Associação de Professôres Universitários de Durham, e para a Conferência de Estudos Liberais de Oxford, em colaboração com Nicholas Pevsner, Loughborough, para Midlands N.S.A.E.

"Estudos Liberais na Escola Superior de Arte" — para o Encontro Anual da Sociedade Filosófica da Universidade de Sheffield, novembro 1960.
"Êste é o Futuro" — "Royal College of Arte", Londres; também para a Escola Superior de Arte de Leeds.

"Criatividade e Anti-Arte", para:

a) Professôres de Londres, Escola Superior de Arte de Hornsey
b) Conferência Anual do N.S.A.E.
c) Instituto de Arte Contemporânea

"Marion Richardson Memorial Lecture", Londres, 1968.

"O Uso Funcional e Escultural dos Plásticos" — Universidade de York — Conferência para Arquitetos e para a Indústria de Plásticos, e para a "Royal College of Art", Londres.

"Técnicas de Pintura e Escultura do Século XX" — Departamento de Belas Artes de King's College", Newcastle-on-Tyne (uma série de palestras para o último ano de graduação).

"Materiais do Século XX, Trinity College, Cambridge.
"Os Problemas da Arte Moderna" — Escola de Gravura e Desenho Gráfico de Londres.

"Arte dêste Século" — Academia Real de Música, Londres.
Sôbre Arte e Educação, palestras para outras Escolas Superiores de Arte:

R.C.A., Londres; Liverpool, Leeds; Birmingham; Hornsey; Manchester; Coventry; Loughborough; St. Martin's, Londres; Stoke; Newcastle etc. Também para outras Universidades, incluindo: Oxford, Cambridge, Durham, Sheffield, Londres, York, Nottingham, Essex etc.

Para Estagiários dos Departamentos de Arte das Universidades de Newcastle e Reading, Instituto de Estudos Superiores de Arquitetura, Universidade de York etc.

## CONFERÊNCIAS NOS ESTADOS UNIDOS DA AMÉRICA

Escola de Artes Visuais, Cidade de Nova Iorque.
Departamento de Arte do Museu de Brooklin, Nova Iorque.
Douglas College, Rutgers, The State University, New Brunswick, Teacher's College, Universidade de Colúmbia, Nova Iorque etc.
Outras conferências em Lousiana etc.
Universidade de Illionois, Chicago.
Universidade de Illionois, Champaign
Academia de Artes, Memphis.

## ATIVIDADES DIVERSAS

Programas de Arte em Rádio e Televisão; autor de numerosos artigos, revistas, pesquisas publicadas etc.
Seminários e Palestras sôbre Arte e Educação e trabalho pessoal no Instituto de Artes Contemporâneas, em Londres.
Membro do Congresso Mundial de Arte e Educação (I.N.S.E.A.) — Nova Iorque, 1969; Coventry, Inglaterra, 1970.
Curso de Desenho Criador, na Universidade de Toronto, Canadá.

# CURSO Nº 1: EDUCAÇÃO CRIADORA:

criatividade, educação e tecnologia
Dedicado especialmente, a professôres de crianças e pré-adolescentes.

PERÍODO:

curso de uma semana, de 2 a 6 de agôsto, de segunda à sexta-feira, das 9,00 às 18,00 horas.

PALESTRA GERAL INTRODUTÓRIA:
educação criadora

## Primeiro dia, 2 de agôsto, segunda-feira

TEMA: "A UTILIZAÇÃO CRIADORA DE MATERIAIS POR PARTE DA CRIANÇA"

a) Percepção, resposta e relacionamento.
b) Atitudes e classificação de materiais.
c) Do jôgo criador ao ato criativo.
d) da exploração ao desenvolvimento.
e) Capacidade da criança e tecnologia.
f) Adaptação e dinâmica no ensino.

Trabalho prático com materiais variados — qualquer material disponível, incluindo material usado. Papel, tecido, madeira, metal etc.

## Segundo dia, 3 de agôsto, têrça-feira

TEMA: "CÔR E CONCEITO"

a) O mundo cromático.
b) Aspectos físicos e psicológicos.
c) A elaboração da côr.
d) Organização e exploração.
e) Côr natural / Côr artificial.
f) O homem — seus objetos e seu meio.

Trabalho prático com materiais diversos. Papel, coloração, tintas de todos os tipos. Todos os tipos de formas pré-fabricadas.

## Terceiro dia, 4 de agôsto, quarta-feira

TEMA: "MÉTODO E PROCESSO CONSTRUTIVOS'

a) Reconhecimento e compreensão.
b) O mundo fenomenológico e a organização natural.
c) Os processos construtivos do homem.
d) Geometria criadora.
e) Linguagem das estruturas.
f) Linguagem pessoal e organização.

Trabalho prático com materiais diversos — papel, cartolina, madeira, metal, arame, tiras etc. — utilizando formas simples de unidades padronizadas.

## Quarto dia, 5 de agôsto, quinta-feira

TEMA: "MUNDO SENSORIAL E INTELECTUAL DA CRIANÇA" (Vendo, conhecendo e sentindo).

a) As coisas tais quais são ou como parecem ser.
b) O que vemos, chegamos a compreender e o que sentimos acêrca do mundo que nos cerca.
c) Como lidamos com as situações.
d) O funcionamento das coisas.
e) Transformação do mundo observável.
f) As idéias subjacentes ao mundo da aparência.

Materiais para desenhar diagramas e imagens. Qualquer tipo de papel, tintas, pincéis etc. Lápis, carvão, qualquer material que risque.

## Quinto dia, 6 de agôsto, sexta-feira

TEMA: "INTEGRAÇÃO E RELACIONAMENTO"

a) A capacidade da criança para a experimentação.
b) A capacidade da criança para a pesquisa.
c) A capacidade da criança para a integração e desenvolvimento.
d) Como conhecer-se a si mesmo e compreender os outros.
e) Um lugar no mundo que nos cerca.
f) A mente criadora para o trabalho.

# CURSO Nº 2: EDUCAÇÃO CRIADORA:

Criatividade, educação e tecnologia. Dedicado especialmente a professôres de adolescentes (de 13 anos em diante), e àqueles que trabalham no campo da formação de professôres, como professôres de curso normal, escolas de arte, e de universidade.

PERÍODO:

curso de uma semana, de 9 a 13 de agôsto, de segunda à sexta-feira, das 9,00 às 18,00 horas.

## Primeiro dia, 9 de agôsto, segunda-feira

TEMA: "EXPERIÊNCIA, ANÁLISE E DESENVOLVIMENTO NA EDUCAÇÃO DO ADOLESCENTE"

a) Experiência pessoal e problemas subjetivos.
b) Trabalho de grupo e intercâmbio de experiências.
c) Desenvolvimento de amplas e livres possibilidades.
d) Organização programada ou sistemas pessoais.
c) Linguagem e método formais e aformais.
f) A educação como revelação.

Trabalho prático em côres — coloração. tintas. materiais coloridos, papel e qualquer tipo de material.
NOTA: Se possível, a côr deverá ser o tema central dêste trabalho em particular.

## Segundo dia, 10 de agôsto, têrça-feira

TEMA: "TECNOLOGIA CRIADORA"

a) O uso construtivo de materiais.
b) Gás, líquido, partículas, sólidos.
c) Materiais rígidos e flexíveis.
d) Resposta, intuição e raciocínio.
e) Processos — a máquina e o homem.
f) Processos para a libertação da mente.

Trabalhos práticos com quaisquer materiais disponíveis, como taliscas de madeira, arame, tiras de metal e, se possível, uma sala vazia para a participação do grupo; para esta experiência, um pouco de areia, papel e varetas de madeira (uma para cada pessoa).

## Terceiro dia, 11 de agôsto, quarta-feira

TEMA: "MATERIAIS NOVOS E NOVAS ATITUDES"

a) Materiais sintéticos.
b) As infinitas possibilidades de aplicações.
c) Treinamento seletivo e escolha pessoal.
d) Novas estruturas mentais — novos métodos.
e) Construção e destruição nas idéias criadoras.
f) Pensamento conceitual e atitudes criadoras.

Trabalho prático — idêntico ao dia anterior, mas se possível, utilizar resina de Polyester, nesse caso, precisaríamos ter os necessários preparados químicos para catalisar e solidificar as resinas líquidas, bem como uma pequena quantidade de agente liberador ou desagregador. Se não fôr possível a obtenção dêstes elementos, serão utilizados outros que estiverem disponíveis.

## Quarto dia, 12 de agôsto, quinta-feira

TEMA: "O ÔLHO INTELIGENTE — NOVAS ATITUDES NA OBSERVAÇÃO E RESPOSTA"

a) Imagens e objetos.
b) Resposta Física e meio ambiente.
c) Como responder às idéias?
d) Tomada de consciência do meio social.
e) Meios e métodos.
f) O problema da informação complexa.
g) Seleção (escolha) e resolução de problemas.

Trabalho prático — ambiente para desenho, cavaletes ou mesas, com a utilização de qualquer tipo de papel e lápis, pincéis, e outros instrumentos de desenho, incluindo côres.

## Quinto dia, 13 de agôsto, sexta-feira

TEMA: "AS IMPLICAÇÕES DE UMA FORMA DE VIDA CRIADORA"

a) As implicações da arte e do meio.
b) Um plano para aprender a criar.
c) Um projeto para a vida e o lazer.
d) Nova visão psicológica.
e) Integração social e criadora.
f) Organização curricular e atividade.

Trabalho prático — nas mesmas condições sugeridas anteriormente para o terceiro dia.

| | |
|---|---|
| COMPLEMENTARY DISCORD | Discord relationship established between pairs of colours lying diametrically opposite on the COLOUR CIRCLE. |
| ALTERNATING DISCORD | Discord relationship established between alternate colours. Blue-Yellow etc. |
| SIMULTANEOUS CONTRAST | Of perception: the ability of the eye to generate the complementary colour of any given colour stimuli, thus an area of colour will appear to have a complementary edge.<br><br>If a series of grey areas are placed within areas of saturated colour, the eye will invest the grey with a tendency towards the appropriate complementary. |
| AFTERIMAGE | Physiological reaction within the eye after receptors of its retina have been exposed to a range of intensit of light or colour, the receptors so exposed become fatigued and their photo pigment is temporarily bleached producing a complementary image within the Afterimage can also be produced from direction and movement. |
| INTERACTION | Elements or forces which act reciprocally, act on each other descriptive of certain colour situations. |
| REACTION | Respond to stimuli; undergo change due to some influence. |
| CONTRAST GENERAL | Set up relationship between elements: opposition which allows comparative effects to be judged. |
| INTENSITY | Measure of degree of quality (sometimes used in conjunction with SATURATION). |
| GRADUATION | Measure of quantities: scale or progression demonstrating this. |
| NATURAL ORDER | Relative positions of subtractive colours, in saturated state to inherent light/dark characteristics also logical organisation as in COLOUR CIRCLE. |
| COLOUR CIRCLE | Organisation of subtractive colours in continuous ring to chart relationships between them. See Diagram. |
| COLOUR SPHERE | Organisation of subtractive colours in the equator of a sphere, with grey in the core, and white and black at the poles. Allowing the charting of Harmonics/ Tints/Shades etc., See Diagram. |
| CHROMATIC | Of the full saturated colour spectrum, derived from Primary/Secondary/Tertiary ranges. |
| ACHROMATIC | Free from colour: transmitting light without decomposing it. |
| MONOCHROMATIC | Of one wavelength (colour) only, range limited to one hue. |
| QUALITATIVE | Concerned with, depending on quality, hence discrimination of degrees of characteristics of colour |

| | |
|---|---|
| QUANTITATIVE | Measured or measurable by, concerned with quantity, amount etc., hence: comparison of scale and area of colour, sometime linked with CONTRAST OF EXTENSION. |
| CONTEXT<br>CONTEXTURAL | Observation of a part seen relative to associated and/or related elements, relationship in which one thing is affected by the other. |
| JUXTAPOSITION | To place things side by side, may involve placing one element in differing contexts to observe its relative appearance. |
| PHYSIOLOGICAL | Science of the phenomena and functioning apparatus or living organisms, hence Physiological aspect of colour deals with the human sensory apparatus and how it is affected and interprets colour. |
| PSYCHOLOGICAL | Science of nature, functions and phenomena of the human mind. Psychological aspect of colour deals with human interpretive and associative responses. |
| PHYSICAL | Of matter; material properties or qualities of elements constituting matter. Physical properties of colour/pigment involve recognition of e.g. Transparency, translucency, opacity etc., etc., which may amplify or detract from the required sensation. |

..........

COLOUR DYNAMICS. LIGHT/COLOUR/MOVEMENT/MECHANICS/PERCEPTION.

Colour dynamics indicates an area of interaction between theory, perception, structure and mechanics which may be seen in apparently simple physical operations such as blinking and extending to more complex patterns. Our demonstrations are a small part of a vast world of colour/light which expands, encompassing myriads of directions from the infinitely variable natural spectrum of atmospherics surrounding our planet to man made multi-media happenings upon its surface.

The physicist, physiologist, and psychologist have developed various experiments to test specific phenomena; we are making use of some of this research, (a bibliography giving source materials is appended) but it should be stressed that we are dealing with information at an experiential level through which more personal development may be possible.

C

All observations take place under a series of controls, many of which are very simple, yet radically affect the result.

(a) Electric Illumination provides a non-coherent light source, in the case of AC vibrating at 50 cycles per second, this will condition the appearance of revolving stimuli at certain frequencies.

(b) Position, distance, altitude of individual from stimuli.
(c) Eye and/or head movement.
(d) Control of eyelid blink rate.
(e) Exposure of retina to stimulus will produce afterimages.
(f) Rubbing of the eyes will produce phosphenes.
(g) Persistence of vision; the eye seeing a series of seperate images in rapid succession will see a continuous sequence.

It is important that each student makes careful analyses of stimuli and reaction to them. Some experiments can produce unpleasant reactions.

VARIOUS EXPERIMENTS

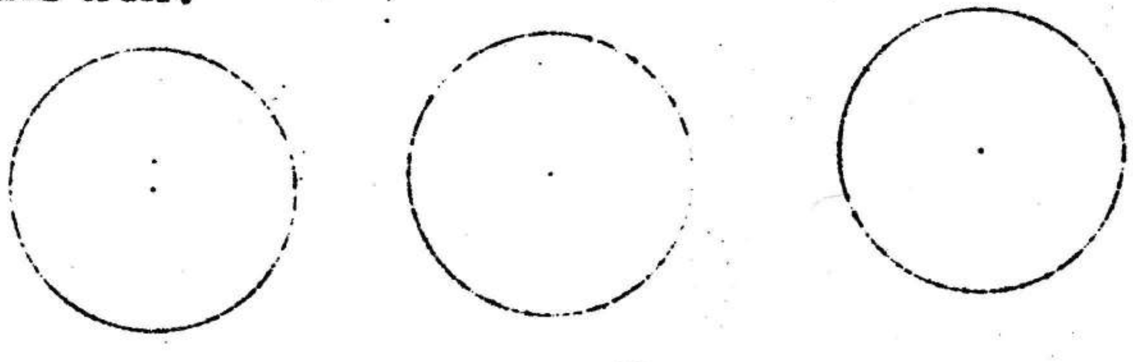
Spinning Tops clearly demonstrate the fusion of distinct images into a cohesive whole through persistence of vision; this is perhaps the earliest invention in the colour dynamics field. Many toys based on optical principles were developed throughout the last 1,000 years, the 19th century saw a mass of these brief details of which are given in appendix 1.

(1:0) MAXWELLS DISCS

James Clerk Maxwell, British Physicist, founder of the electro-magnetic theory carried out a series of experiments c. 1855/61 with sector discs of subtractive colour on a high speed motor board.

The discs each have a radial slot allowing one to be passed behind the other enabling varying proportionate areas of colour to be seen in relationship. This proportion can be measured by a radial percentage discs mounted behind both.

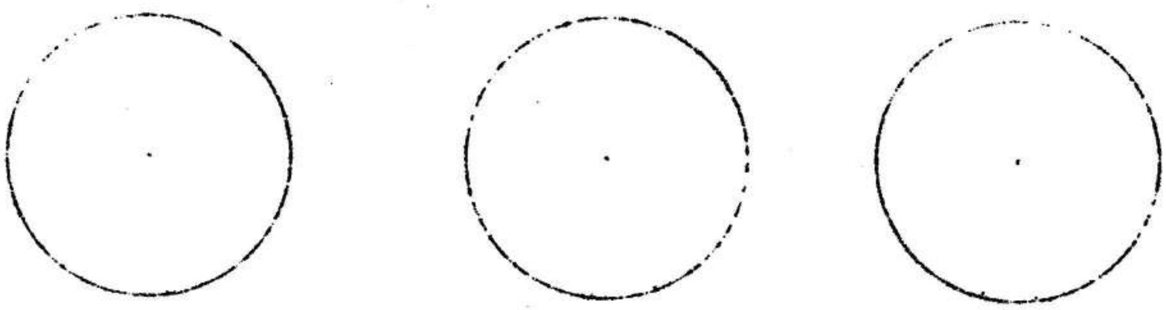
All colours are saturated, pure, and stand to each other in the natural order.



When spun at high speed the eye receives an overall impression of the 2 colour areas superimposed, this superimposition is obviously not completely subtractive as the pigments are not physically mixed; neither is it completely additive as the stimuli are not lights.

(1:1) SUBTRACTIVE PRIMARIES AND SECONDARIES

Pairs of Primary: - red - yellow - blue
Pairs of Secondary: - green - orange - violet
Discs are spun at various speeds, if pigments were physically mixed a muddy brown would result, with optical mixing a range of grey-white-tints is obtained according to pairs used and proportions present.

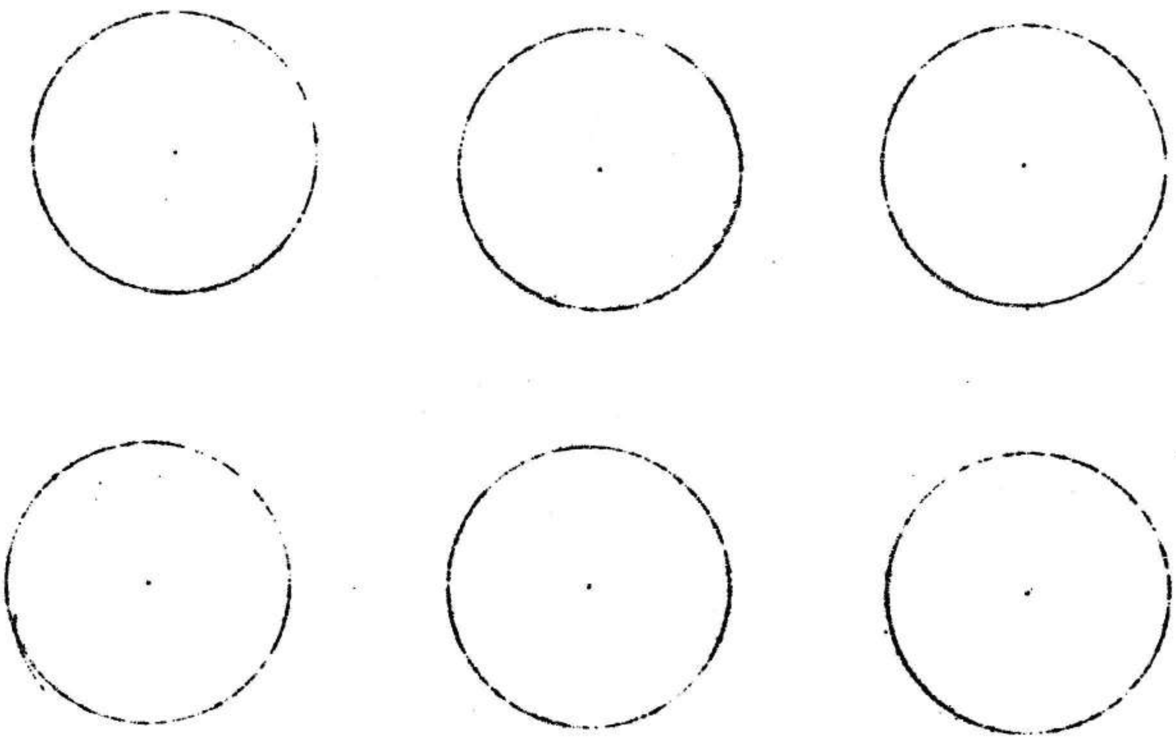


(1:2) COMPLEMENTARY DISCS

When a pair of complementaries is spun the total resultant appearance is dependant on the relative percentage of each colour pres nt: this is due to the inherent light/dark nature of saturdated colours as they appear in the natural order. Theoretically when a complementary pair is spun a neutral grey will be produced. Depending on the pair chosen the relative proportion of each will vary, (this can be measured on a radial percentage disc mounted behind both discs).

Red-Green which are tonally close in the natural order will require similar %.

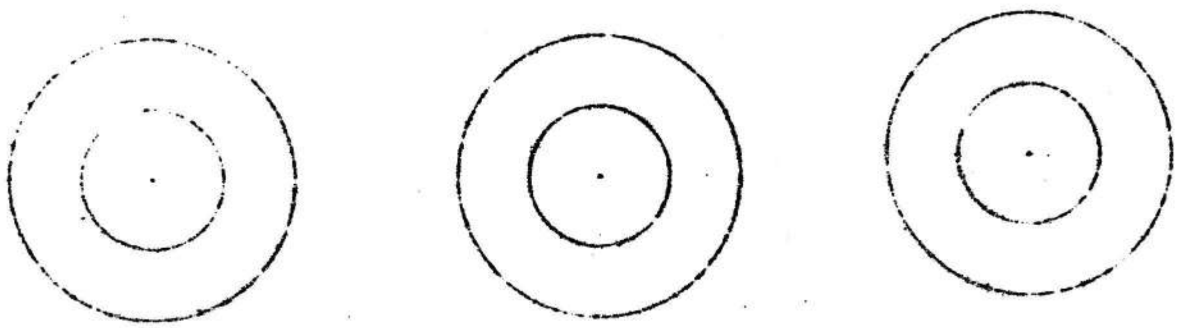
Yellow-Violet which are the tonally furthest apart will require different %.



## (1:3) COMPLEMENTARY DISCS PLUS SMALL CENTRE CONTROLS

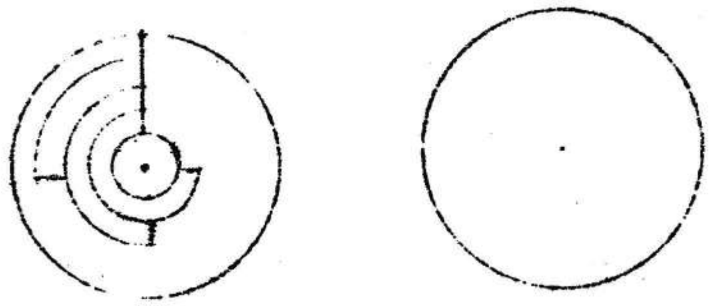
Pairs of complementaries spun with smaller centre discs of same pair but in differing proportions, to show differences in greys obtained.

As above but with small discs from another complementary pair to show the difference between pairs.



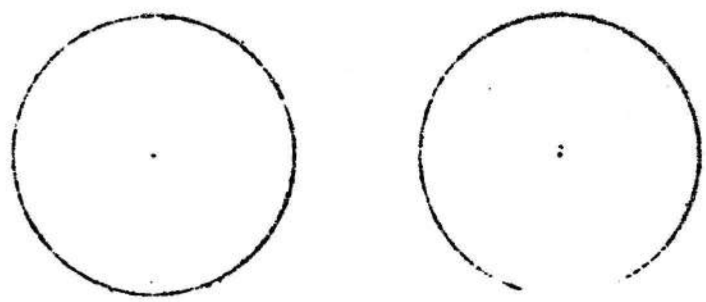
## (1:4) GREY CENTRE CONTROL

A graduated percentage disc of grey when placed on a primary or secondary and spun will show the changes in saturation of the hue. MINIMUM grey present result MAXIMUM SATURATION



## BLACK CENTRE CONTROL

A graduated percentage disc of black placed on primary or secondary and spun, will show progressive changes in the LIGHT/DARK or DEGREDATION of the hue.

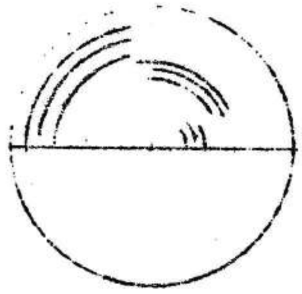


## (2:1) BENHAMS DISC

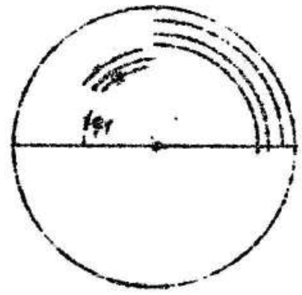
Black and white disc which when spun subjectively induces colour response according to frequency of figuration and the direction and speed of rotation due to the superimposition in the eye of the black arcs on the black half of disc.

Half completely black, half white which is divided into four sectors each containing three arcs in black, each bank of arcs stands on progressively increasing radii from the centre of disc. ratio 1:1 = approx ⅛" on 12" disc.

(a) Clockwise figuration.



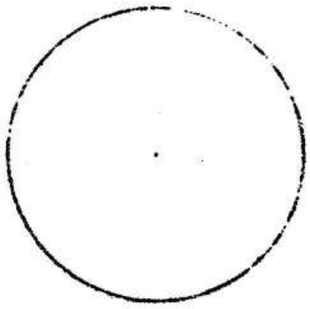
(b) Anti-Clockwise figuration.

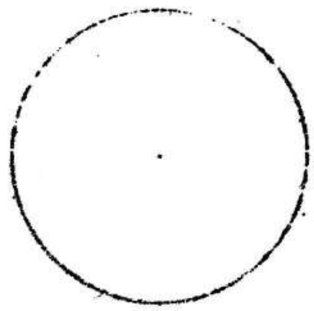


(Reference:- 'BBC 1's Colour Trick', transmitted in May 1969 on Tomorrow's World Review in Guardian, May 1969).

## (3:0) RADIAL DIVISION DISCS

Radial figurations in black and white also induce colour sensation according to speed and lighting. With 50 c.p.s. illumination there will be a point at which the speed and light cycle cross causing the direction of movement to remain stationary and then reverse. This phenomena will be discussed in full in Stroboscope experiments.





SPACE FOR DIAGRAMS

## (4:0) DUCHAMP'S ROTOR-RELIEFS

Marcel Duchamp 1887 - French: original member of Dada group.

The Rotor-Reliefs were produced in 1935 with colour figuration on both sides the original size was 7⅞" diameter and they were designed to be spun at 33 r.p.m. on standard gramaphone turntables. The original set comprised 6 discs and came with the instructions: "these discs turning at an approximate speed of 33 rpm will give an impression of depth and the optical illusion will be more intense when viewed with one eye than with two". This presents an original experiment in perception and the illusion of the third dimension due to a psychological transformation of the impressions of relative speed into those of distance.

The prints which we are using are 12" black and white so some of the original quality is lost.

(see Appendix 2 for further details)

## (5:0) AFTERIMAGES

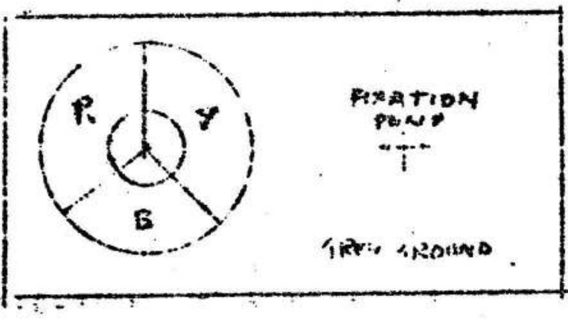
### (5:1) LIGHT/DARK

When the eye observes a sudden flash of light, a dark area of the same shape will be seen hovering in space, this is a NEGATIVE after-image, due to bleaching. For the first few seconds after stimulation a light area will be seen when viewed in darkness this is a POSITIVE afterimage and results from the optic nerve and retina continuing to fire after exposure.

### (5:2) COLOUR

When the eye observes a coloured area of specific hue for a period of time the sensation gradually alters owing to the fatigue of colour receptors on the retinal surface of the eye. If, after fixating an area of red for a time with one eye, a sheet of white paper is inter-posed the eye will 'see' a ghost afterimage of green-blue, it is proposed that this phenomena shows the eye to have three colour receptors sensitive to red, green and blue or violet. When fatigued by fixating the red area the red receptors become bleached in their photo-pigment and these receptors still working are seen to be more active. whatever colour area is presented the resultant afterimage will always be its complimentary, invoking the law of simultaneous contrast, of colour.

The colour transparency is fixated with one eye for 30 sec approx, and the eye moved to locate the afterimage obtained on the cross on other side of circle. The use of grey ground enhances the production of afterimage colour as the grey produced a state of equilibrium by producing a grey afterimage.




(5:3) CINE FILM AFTERIMAGES

Afterimages induced rapidly by the remote control of stop frame techniques will produce a clear demonstration of induced response.

(5:4) AFTERIMAGE DIRECTION/FIGURATION

When the eye fixates figurations in the above mentioned manner fatigue of receptors will produce afterimages which are complimentary in structure, indicating that the retina is sensitive to a theoretical grouping of quadrants of energy, vertical and horizontal. When focussing on certain frequencies the retinal mosaic can be observed distorting image signals which lie across the pattern of cells and the observed lines appear to break up in consequence.

(5:5) AFTERIMAGE: MOVEMENT

When we observe a revolving figuration disc and it stops we tend to see the disc moving in the reverse direction, however, if this direction is thought about it can be made to reverse again and vice versa.

(5:6) VISUAL NOISE AND RANDOM FIELD CONTROL

We have seen that complementary afterimages can be induced by focussing on a plain surface, if instead of this a random field control, or textured disc is substituted for the projection area, and the eye now fixates a figuration disc as before and projects the afterimage onto the textured ground the result is very different. The ground is inert and non directional, but it appears to be affected by the afterimage of the geometric stimulus and revolves and swirls in the reverse direction of the afterimage, again the direction can be altered by conscious thought.

(5:7) PHOSPHENES

When pressures are exerted on the eyeball and the eyelid remains closed we often 'see' luminous shapes, figurations, speckles etc., projected onto the closed lid. These are termed Phosphenes, and investigation of the phenomenon is comparatively recent; it is thought that phosphenes have been subconsciously observed by man for thousands of years and have become translated into various formal devices in the art of different cultures. These happenings in the eye could be termed 'afterimages of muscles control and metabolism'.

(6:0) STROBOSCOPE

A stroboscope is a mechanism which effects the intermittent interuption of a beam of light by means of a shutter (or electro-gaseous discharg) causing the light to pulse at a given frequency which can be increased or decreased.

In simple terms rapid blinking of the eye whilst observing a moving stimulus will produce stroboscopic effect: as will the movement of the hands with fingers outstretched across the field of vision.

According to the frequency at which the strobe is pulsing the moving stimulus will appear to be rotating in different ways, e.g. wagon wheels seen on films, where the frame speed and projector shutter speed cross over in terms of sequence of stages in the revolution of wheel.

Object movement is constant.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Stobe | pulse | slower than | object | movement: | result | is | movement in same direction. |
| " | " | same as | " | " | " | " | object appears stationary. |
| " | " | faster than | " | " | " | " | movement in reverse direct. |

The stroboscopic principle can be used to arrest the movement of any objects which have periodic motion so that this can be measured and photographed.

In our experiments we are using a range of mechanical and electronic pulses with a wide variety of colour discs having different organisations this free for all envelopes the sensibility with an amazing performance of mutations of unexpected compexity throughout the speed range.

Coupling of electronic strobes to lighting in turn coupled to sound equipment can be a positive relationship of audio-visual phenomenae, where pitch, rhythm, and level of sound can find equivalent translation in the world of colour light.

(7:0) MOIRE

(7:1) STRUCTURE

When two or more periody structures are overlayed interference will occur between the opposing axes of the periodic components. In simple terms if we look at two pieces of net material, two fences etc., behind each other at different angles the eye will see a third system produced where the strandsor posts cross, if movement is introduced a flicker or pulse will be set up as the elements pass behind each other. According to the distance between the observer and the two systems under observation, the frequency and degree of waves can be accelerated or decelerated.. Any periody structure will serve to generate moire patterns, geometric or free, providing one is aware of a massing of elements. The first instance of moire pattern in man-made objects is from a variety of watered silk which produces wave motions through close warp and weft overlay from which the phenomenon obtains its name.

In industry moires or interference fringes are used as an accurate form of measurement of physical objects and paths of motion flow patterns etc.

(7:2) COLOUR

If two periodic structures of different colour are superimposed the resultant moire will take from both and optically mix them, thus blue and yellow will make us 'see' green, but a differing green depending on the priority of overlay etc., We are familiar with optical mixing of colour in 4 colour photo printing where dots of separate colour induce the eye to see the full spectrum ranges, but here the angle of overlap of the dot screens is rigorously set to avoid presence of moire patterns which might detract from the recognition of the pictorial content.

LASER

Laser light differs from ordinary light in that it is much more intense, directional, monochromatic and coherent. The light emitted by an ordinary source such as a candle or an incandescent lamp consists of unco-ordinated waves of many different length, that is, it is incoherent and more or less white. The waves of laser light are co-ordinated in space and time and have nearly the same length. (This coherence and chromatic purity, and also the intensity of laser light, results from the fact that in a laser, excited atoms are stimulated to radiate light co-operatively before they have had time to do so spontaneously and independently.

The laser puts out scarcely more total visible light than a flashlight, but all its output is in light with one narrowly defined wavelength. A laser beam directed at the moon would have spread to only a matter of yards in nearly ¼ million miles.

An important application is in communications, which it promises to revolutionise; in photography (3D photographs) and as a "knife" in industry or surgery.

FIBRE OPTICS

The basis of fibre optics is the transmission of light or images along flexible glass or plastic fibres (each finer than a human hair), and clad in a material with a lower refractive index - by a process known as internal reflection. Thousands of fibres are arranged in bundles, which can be non-coherent for light transmission and coherent for image transmission.

Applications are in display panels, instrumentation, punch tape readers, matrix/line converters, image invertors, microdot projectors, Fibroscopes (remote viewing devices for inspecting inaccessible points) and of course in art.

## COLOUR TERMINOLOGY AND DEFINITIONS.

| | |
|---|---|
| LIGHT | Visible light comprises wavelengths of radiation within the electro-magnetic spectrum. The visual colour spectrum seen when 'white' light is split by a prism shows it is composed of wavelengths from RED/ORANGE/YELLOW/GREEN/BLUE/VIOLET. |
| ADDITIVE | Proceeding by addition: of LIGHT, the process by which colour lights combine to produce white light due to absorbtion of 2/3rds of the visible spectrum. |
| ADDITIVE PRIMARIES | Of light: RED LIGHT/BLUE LIGHT/GREEN LIGHT when combined equal white. |
| ADDITIVE SECONDARIES | Of light: RED + GREEN = YELLOW<br>GREEN + BLUE = CYAN<br>RED + BLUE = MAGENTA |
| SUBTRACTIVE | Process of taking away: of PIGMENT COLOUR: where combination of colour produces black by absorbtion of ⅓ of visible spectrum. |
| SUBTRACTIVE PRIMARIES | Of pigments: RED/YELLOW/BLUE |
| SUBTRACTIVE SECONDARIES | Of pigment: ORANGE/GREEN/VIOLET/theoretically produced from above. |
| SUBTRACTIVE TERTIARIES | Of pigment: RED ORANGE/YELLOW ORANGE etc., located between primaries and secondaries. |
| TRI-CROMATIC PRIMARIES | Of pigment dyes: YELLOW/MAGENTA/CYAN employed as transparent inks in printing when combined with the addition of BLACK produce appearance of full colour range. |
| PIGMENT (GENERAL) | Material organic or inorganic present in all objects, according to composition it will absorb or reflect various parts of light spectrum causing the eye to see it as a colour. |
| PIGMENT (PAINT) | Selected materials which when ground and mixed with a MEDIUM such as oil/gum etc., can be used as paint. Each pigment is known as a specific name which stands within each colour family or Hue. |
| HUE | Distinction between families of colour in pure state: e.g. HUE of RED; HUE of YELLOW; HUE of BLUE. Each hue includes all types of its colour family whether WARM or COOL applies also to secondary/tertiar hence CONTRAST OF HUE; examples from opposing hues placed together. |
| WARM | Discriminative interpretation of colour stimuli: in general terms RED/ORANGE/YELLOW are associative of WARM<br>BLUE/GREEN/VIOLET " " " COOL |

**OOL** — In particular terms as <u>all</u> hues comprise differing degrees of colour it follows that e.g. Reds may be Warm and Cool i.e. a WARM RED will tend towards ORANGE whilst a COOL RED will tend towards VIOLET etc., hence, Contrast of W/C: within one hue or between hues.

**ATURATION** — Degree of purity of given colour. Maximum Saturation means colour is in its purest, most intense form, undiluted by any other colour. Hence CONTRAST OF SATURATION: between hues in this state.

**ESATURATION** — Colour in an impure state, by the addition of other colours. Degrees of desaturation can be established within one hue.

**IGHT DARK (a)** — (i) Characteristic of hues of colour when compared in their most saturated form: Yellow is inherently LIGHT, Violet is inherently DARK.

(ii) Characteristic of PIGMENT sources: in natural state certain pigments appear DARK and their colour characteristics are hidden Light Dark contrast can be a confusing element in establishing the other contrasts mentioned.

**ONE/TONAL** — (i) Description of <u>degrees</u> of Light/Dark tendency of colour.

(ii) Description of degree of mono-characteristic range esp: black/white grey:

**INT** — Addition of white to a colour.

**HADE** — addition of black to a colour.

**OMPLEMENTARY** — Relationship between pairs of colours which are totally opposite in terms of hue and degree of warm and cool, so that they mutually enhance each other. Found diametrically opposite on COLOUR CIRCLE.

A complementary pair when mixed tends towards a neutral grey.

**ARMONIC** — Range of intermediate values produced when any two colours are progressively mixed with each other e.g. Red plus 1 part green/2 parts/etc. until equal quantities are mixed, then returning to Green. Sometime referred to as BROKEN colour.

**ISCORD** — Relationship between pairs of colours, where the NATURAL ORDER has been slightly inverted, e.g. Yellow which is naturally light paired with Blue which is naturally darker would discord if they are adjusted so that the blue becomes fractionally lighter and the yellow fractionally darker.

**DJACENT ISCORD** — Above relationship established between Adjacent colours i.e. Green-Blue etc., Also referred to as CLASSICAL DISCORD.