Reviews

A History of Hot Air and Caloric Engines

Robert Sier
Argus Books 1987 Price £8.95 paperback

In many places where technology is imparted to young persons, there is often to be found in a teacher's store-room or cupboard a small 'hot-air engine'. It may be a bought model or it may have been made by some skilled teacher.

For many of us who have seen a hot-air engine spinning merrily on a lab-bench it is all too easy to see it as just a 'philosophical toy'. Interesting, yes, but in the eyes of many it has nothing to do with the realities of life. Yet in the 19th century air engines chugged for years in Scottish farms, pumping water or powering machinery. More than a century ago they were used to drive foghorns or generators for lighthouses. They were also effective in workshops and for running refrigerators. In 1853 John Ericsson ran a 'caloric-engine' ship 260 feet long using fuel in a most economical manner. Why hasn't the hot-air engine caught on, then? Is it something like the airship? It works but it is not always as practical as heavier-than-air machines. There are few ideas simpler than heating air in chamber so that it drives a displacer piston which is then made to operate on a power piston — and variations of this arrangement. But corrosion, leaks, lubrication problems and other snags have not made progress easy. To be powerful, a hot-air engine would need large pistons. One cannot imagine a V-8 hot-air engine withut giggling.

Interest in the use of hot-air engines in education appears to have peaked just over a decade ago. Graham Walker's article in the *Scientific American* (229 (2) of Aug. 1973) set the ball rolling but in the U.K. teachers would have been more aware of T.E. Haynes' *Hot-Air Engines* (1977), which was Book 2 of John Murray's 'Model Engineering for Schools' series. This described in a most practical way how an engine could be made from brass and steel in a school workshop. Actually one could suggest that 'every schoolboy' of a practical nature knew something about air engines. This was because they often featured in youngsters' annuals. Archibald Williams' *Things to Make,* widely available in 1939 and later, had plans for a model with the displacing piston ingeniously made of wood with an asbestos shield.

Mr Siers' work is a welcome addition. Before its appearance one would have had to chase scattered references and patents. Those who wished to improve their understanding of hot-air engines would have had to fall back on Ivo Kolin's remarkable 2-volume *Thermodynamic Atlas* (1966, 1972). Its volume II, which covers the development of heat engines, has extremely clear and attractive diagrams. Mr Siers has not aimed his own book at the educational market but, rather, at the industrial archaeologist or the historian of technology or the model-maker. He illustrates with photographs engines that have actually existend and prevents us from basing our understanding of them on hopeful patent drawings. But it would be difficult to create school projects from his book. One wishes that books like the old *Project Technology Handbooks* were available on heat engines.

Now that we possess Mr Siers' comprehensive little book with its valuable classification system, we might be lulled into thinking that he has enviably covered everything. But there were many effective types (Woodbury's, Stillman's, Baldwin's) which the author does not mention. Yet his diagram of the Roper engine is much easier to understand than in earlier treatises. The subject is dauntingly vast but its two-fold importance is still valid. First, it is educationally stimulating in helping people acquire a thorough grasp of the theory of heat engines as well as expanding that highly lateral bump in the brain that excels in devising technical solutions. Second, the air engine has a potential in intermediate technology as well as in such advanced establishments as Harwell and Philip's where models were developed. In the U.S. a nuclear powered air engine was developed to operate an artificial heart! Clearly the idea cannot be killed off. Only time will tell whether Mr Siers' book resurrects or embalms the idea.

Francis Celoria

Machines in Motion

Leonard Maunder
Cambridge University Press £12.95

This hard back book is based around Leonard Maunder's 1983 Royal Institution Christmas Lectures and seeks to convey the author's enthusiasm, knowledge and commitment to the exciting world of engineering technology.

It uses machines and motion as the focus when linking established mechanical practice to great discoveries and supports the investigative and inventive spirit of designers who continue to move theory and practice into new ground.

The book is, however, much more than a collection of practice and discoveries. It tries to pull together the underlying principles which govern the technology and attempts to do this in a disarming way — springing complex theory onto historical narrative — using a plausible progression that readers might happily ascribe to. In this way his opening chapter on the 'driving forces' moves from the late Paleolithic Age to Greek civilisation to the Renaissance and onward to the Industrial revolution linking Hero, Leonardo, Newton, and the likes of Watt, Stephenson and Newcomen. It leads unfailingly into vectors, forces, electrons, and kinematics with practice, principle and calculation in abundance.

Other chapters, carefully chosen to include the topics of momentum, vibration, control, fluids and flight, and living machines, continue the diet with the addition of descriptions, photographs and diagrams of experiments from his 1983 lectures. It is the experiments — exciting in practice — which lose the most in this presentation with descriptions which are at times hard work and very tedious.

Presentation is an important aspect if pupils and students are to pick this book up and read it with interest, and this is clearly its weakest area. Although it could quite usefully be 'dipped into' by students when the need arises, the text is on the whole daunting and the black and white photographs and diagrams do very little to encourage reading for interest. It may be significant that one

photograph in the 'Under Control' chapter is printed upside down!*

The range of content covered is excellent and I personally found parts of the book absorbing. Clearly in its own way this book makes an interesting addition to the literature available to teachers and students. However, teachers beware, the level of mathematics and physics which the book presupposes of the reader will usefully limit it to the most able and aspiring young technologists and engineering designers.

Jim Patterson

* Page 108, Figure 4.1 iv (b) — A Modern Milling Machine.

Lettering & Typography

Tony Potter
Usborne £5.50

This book does nothing for me aesthetically and seems to be a mixture of somewhat uncoordinated colours and juxtaposed areas of type and illustrative material. However, I assume it is aimed mainly at the teenage market and can therefore see it appealing to young, potential artists and designers studying in schools and further education colleges.

The author has packed quite a lot of information into the pages of the book and when it is examined carefully it is obvious that it could be a very useful reference, particularly with respect to the formation of letters. However, I do wonder how much the author knows about this subject for he appears to have employed source material from a wide spectrum without giving the usual acknowledgements, a factor that I am prepared to forgive in view of the fact that he has offered a rich feast for the benefit of his readership.

The contents are fairly comprehensive, and embrace — in picture form with a minimum of text (which in my opinion is one of the book's assets) — tips about the construction of letters; historical derivations, the pragmatics of layout and spacing, etc., through to designing and typographical layout. Graphic designers make use of various methods, and some of these are explored well, including paste-up and copying techniques. A very helpful page of equipment and materials supports the text, while a useful glossary of terms is included.

John Lancaster

Technical Draughstmanship

Eanna O'Brien
Gill & MacMillan £7.95

This book covers a wide range of technical drawing techniques and syllabus work. The material also covers the technical graphics options of engineering and building applications. As a complete course of study this book forms a good and sound introduction for any potential 'draughtsperson'.

Two colours have been used throughout to help in the explanation of drawing procedures. Red lines will correspond to construction lines. However I would have liked to have seen a section which dealt with the very important colour application techniques, which is becoming increasingly required by most English examination boards at both GCSE and 'A' level GCE Graphic Communication syllabus's.

Each chapter has a concluding set of exercises to reinforce the work of the section. I found these useful and a helpful way of making sure that the chapter's content is well understood. However because Eanna O'Brien has tried to cover such a wide range of topics I felt that certain 'A' level GCE topics were lacking in depth e.g. the structures section is somewhat lacking in complex examples.

In short, I feel that this book is likely to become a useful 'one off' in the reference section of CDT library resource areas, and not likely to be purchased as a course work book for each student. Its main strengths are in supporting the engineering option for CDT Design and Communication and for general 'A' level Technical Graphics reference use.

Martin Patterson

The Story of Perspex

Alex Harness
Plastics Processing Industry Training Board (free)

Just as 'Hoover' is the generally accepted terminology for vacuum cleaning, so 'Perspex' has become extensively used to cover the field of plastic blocks and acrylic sheets.

My first experience of 'Perspex' was as a student of Building in the early post war years. The encounter was not of a highly technical nature, as one might imagine it to be, but rather less earth shattering, in the form of a cigarette lighter made from the magic material.

I well remember the thrill of actually being able to watch the drill cut its way into the body of the material and see the depth to which you were penetrating with the taps in making screw threads. But oh! the frustration of not having the correct adhesive with which to fuse two pieces together. If only this seventeen page booklet had been available then.

The story of 'Perspex' begins at a time prior to the 'christening' when Imperial Chemical Industries were experimenting with tough hard polymers that would not turn yellow in sunlight. It brings us up to date by dispersing silica and pigments into the basic chemicals used in the manufacture of 'Perspex' to produce a hard, heat resistant, non-porous material which can be poured into moulds and cured. Although this product is basically 'Perspex', it bears the trade name of 'Asterite' and is an ideal casting material for sinks, baths etc.

The main body of the book deals with the technical development of what is now known as the Stevenston Process which came about as the result of two separate lines of research in two different parts of I.C.I. Rowland Hill studying artificial resins and polymers at what is now Organics Division at Blackley in Manchester and John Crawford working at the laboratories of the Nobel Division at Stevenston in Scotland investigating various interlayers for safety glass, culminated in a patent being applied for in 1931 in the name of 'Perspex'.

The booklet is a comprehensive documentation of the development of 'Perspex' as a commercial product from

plane canopies during the war years to present day hospital incubators, shop signs, baths and sinks. It deals with the problems of interlaying to produce safety glass and bubbles induced through incorrect temperature, sales statistics and chemical compositions and it concludes with four pages on the properties of 'Perspex', safety and fabrication techniques. It is well presented with monochrome photographs and clear line drawings. It also features work done in schools and colleges in colours.

The publication is free of charge, in single copies or class sets available on written application to the Education Service of the Plastics Industry at the University of Technology, Loughborough. The author states that the booklet is intended for student readers and with that in mind has chosen to use systematic chemical nomenclature, now commonly used in schools and colleges, and recommended by the Association for Science Education.

Althouth primarily designed for student readers I can't help thinking that teachers and lecturers will be retaining one copy from the class set for their own personal file.

J.W. Thompson

Hot Air Balloons — Pupil Workcards and Teachers' Guide

E.J. Arnold £8.95

This is a teaching pack consisting of 24 A4 workcards produced quite attractively in restricted colour with simple, mainly 2D illustrations, some of which are in cartoon form. Also included is a Teachers Guide in A6 double page format which contains a detailed list of materials from polythene and cartridge paper to brass eyelets, tinsnips, gloves, fire blanket and extinguisher etc. There is an introduction to the set of workcards with notes.

The introduction informs that pupils' are to be involved in simple processes of theoretical and practical research and goes on to say that the design brief asks them to 'investigate the history of balloon flight and its application to the design of hot-air balloons which they will construct'. I found by reference to the work-cards that this was not, strictly speaking, so; the Design Brief on card 1-2 states: 'Design a Hot-Air Balloon which is both stable and flies for as long as possible. Consider the appearance of the finished product. Investigate the many possible shapes for a Hot-Air Balloon and collect your information by making diagrams, prototypes and careful testing of your ideas'. Immediately prior to this on the same card it is suggested however, that pupils 'Look at the illustration of the barrage balloon, the weather balloon and the airship which appear on the previous page. Find out about their construction and uses, both past and present. This may help you with ideas in the design process'.

The introduction further indicates that additional information will be collected through prototype construction and a rigorous testing procedure, this then leading to the construction of a larger scale model of the most successful prototype. Teachers are asked to evaluate carefully the quality of ideas, the development of prototypes and final models together with the quality of graphic work, recording of findings etc and last but not least, the way in which the children organise themselves.

Following the introduction, the guide comments on each card sub-set in turn.

I would like to have seen some further identification of important factors concerning flight, like: weight/related to form/related to volume occupied — strength related lightness of construction — centres of gravity etc. Kite design and technology might be valuable in considering stability and any additional aspects of prolonged flight or assisted lift (or would this be cheating) — Insulation in respect of maintaining initially injected air temperature — the possibility of maintaining the expanded form after air has cooled. Rather, major stress is placed on possible shapes and outlines to be investigated, and here, some constructive comment would have been useful, in respect of, say, enclosed volume to weight ratio, this further related to stability potential, so that both teachers and pupils alike, would think along more precise and mathematically determined lines, where there would be greater chance of a successful outcome. While exploration of possibilities is an important aspect of education in the design process, it is equally important to consider existing knowledge, in respect of any design exercise. I feel that some 'control' should be exercised rather than that 'exploration' be completely random with distinct possibility of failure related to, principally, an aesthetic appreciation of shape, form and symbolism. It is important in this section that pupils understand, that forms chosen should have certain characteristics in respect of satisfying the volume/weight/ stability factors so that model designs would be based on previously identified characteristics — it is equally important at this stage to identify through discussion, and, possibly, demonstration, shape and form characteristics which would adversely affect, both, stability, and length of flight.

I am a little concerned that, in cards 1-3, and 1-4, pupils are presented with a range of 15 shapes from which they are to choose four of their 'favourite' designs — I will concede however, that, at least, pupils and teachers are informed at the beginning of this section that 'not all these shapes will be successful'.

However, this information is not substantiated with any reasoning for or against any of the two-dimensionally illustrated forms, in respect of their satisfying or not, any requirements for successful flight, or otherwise.

Prior to the 'flight testing' section, potential heat sources are identified, these being: an electric fan heater on maximum heat-setting, a hair dryer, again on maximum, or, if these are insufficiently powerful, a propane gas burner.

Despite the constant references to safety on the cards, I find this aspect of the project topic rather worrying, particularly the usage of a propane gas burner. The cards do stress however that if a gas burner is used, it must be handled and operated by the teacher and that safety instructions should be read. A warning is also given of fire risk in respect of all heat sources.

Completed balloons are considered aesthetically, and tested and compared for performance in respect of flight

duration, hover time, stability, and height achieved with, also, the rate of ascent.

Additionally, the question of whether or not, individual balloons would lift with increased weight is considered, together with any other comparative aspects which could be thought of by pupils/teachers.

Overall I find this series to be 'procedural' rather than exciting in design terms, and not particularly helpful in respect of investigational possibilities and guidance for busy teachers.

Mal Evans

Teaching Materials available from Industry and Commerce

Understanding British Industry £1*

This is the sixth edition of a project which was created in April 1979 to list the proliferation of companies and commercial organisations providing educational materials for use by teachers. In the intervening eight years the education/industry 'movement' has developed apace in terms not only of the sophistication of material being offered to schools but also in the rationale that has been developed on both sides for closer liaison and mutual understanding.

So, for the first time, we find reference to companies producing GCSE study material. The two forward-looking organisations concerned are The Conservation Trust and Lever Brothers Ltd and they take their place among over 170 agencies, companies, employers' organisations and QUANGOs offering materials on everything from an 'Egg teaching pack' (British Egg Information Service) to information from a body that surely deserves to be more widely known, the Inland Revenue Education Service.

Around 10% of the entries will be of direct interest to CDT teachers but it is not difficult to imagine the scope of material proving attractive to those who have additional responsibilities for cross-curricula studies which take the industrial or economic foundations of society as their starting point. The booklet is comprehensively cross-referenced by subject and by organisation and the inclusion of phone numbers is welcome.

Perhaps the most compelling justification for the continued appearance of the booklet is that it takes teachers back to primary material. Indeed, it could be said to have come into its own with the arrival of source-based GCSE work. There is, however, a sense in which the format of the publication could be modified to reflect changing requirements. An expanded introduction would be useful, providing the teacher with a guide to the computerised data-bases of resources and of electronic mail which are emerging. It could also summarise the work of a number of national centres and projects which are heavily involved in education/industry work and which are often a mine of case material and general advice. In this context it might be helpful to remove entries for bodies such as the Central Statistical Office and the Support for Innovation Scheme to the Introduction.

UBI is to be thanked for having brought together a wide range of disparate and sometimes obscure providers of teaching materials. For those who work closely with UBI, however, there is still a sense of lost opportunity that the organisation does relatively little to publicise itself and its innovative work in the education and industry sphere. If there is room for an entry on the Council for British Archaeology in a digest of resource material on industry and commerce then surely there is room for an entry on UBI's own publications?

William Richardson

* (Available from UBI, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QE. Cheque with order payable to CBI Education Foundation)

Starting Technology — The Simple Approach

Paul Shallcross
E.J. Arnold £6.75

This book is intended for use by non-specialist Primary teachers, and consists of Pressure-Fax Duplicating Masters, with instructions on the various ways in which the ink can be pressed out of the master on to a copy paper. This process enables the teacher to issue to the children a worksheet containing the technique to be taught, possible applications, some basic constructions, questions and an area in which to write or draw. Inevitably, the hands become inked through handling the book.

The content is divided into three parts: an introduction to tools, materials and safety; the making, testing and development of 'a simple rolling chassis' using elastic band construction and readily available materials; and problem-solving involving a different type of movement and machine. Finally, there is a most useful list of materials and tools required to carry out the various activities.

The section on the saw in 'Using Tools' could present problems for the non-specialist. The sawing activity is counterproductive in that it could be a hazardous and even dangerous experience: it does not provide the necessary information and will therefore not give the success which leads to the building of confidence.

In general, the format is useful and the book contains many sound ideas; but the content tends to be very prescriptive, posing questions of a restrictive and closed nature, making only limited intellectual demands, and yet assuming a high level of manipulative skill. One cannot help but compare the method of construction of a chassis as shown in the book with that in which cardboard triangles are used with prepared square-sectioned wood.

It is suggested that teachers should experiment for themselves with the materials and tools suggested as a prelude to embarking on them with the children. Any teacher proposing to use the book would require in addition appropriate in-service training before attempting such experimentation.

Stan Shaw