such as pollen analysis, linking this with the nature of the constituents of the tailings at the sample locations. Also, an investigation of the present remaining structures and what lies below them.

As to the report on my C14 sample, the figures are: Har-9131 charcoal DC13 (o/oo -29.4 AGE BP (YRS) 1310 ± 80 Cal RANGES (IML program, data of Stuiver & Reimer, 1986): 68% AD 640 to AD 800 and 95% AD 570 to AD 890.

The report, dated 12/4/89 was by R L Otlet. Jill Walker gave greatly appreciated help in organising the analysis.

Perhaps it is worth remarking that the charcoal sample submitted was of seven individual fragments separated from the charcoal rich lens in the lower section of the tailings. Other charcoal rich lenses and layers are available for sampling. The reasonably close possible date spread of my sample does not suggest the material had suffered much disturbance. The Harwell report indicates the charcoals' most likely age as actually late 7th century.

Any help to stimulate more detailed and 'academically respectable' research into Week Ford is beneficial. The possibilities offered by well stratified tailings holding such useful material as charcoal and probably pollen, seem to me to be worth a thorough investigation, particularly if undertaken in conjuinction with similar work at other suitable West of England blowing house sites, several of which are available for study. A potential cornucopia of information on the developments in metallurgy and related economic history awaits release.

I submit there is evidence of smelting at Week Ford even as early as the 7th century.

Bryan Earl,

Book reviews

Jean-Yves Andrieux, **Forges et Hauts Fourneaux en Bretagne du XVII au XIX Siècles. Côtes-du-Nord.** *Editions CID, Nates - 1987 - 324 pages - 46 illustrations - Fr. 170.*

In his book, J-Y Andrieux, lecturer at Rennes University, does not so much endeavour to give an exhaustive description of the steel mills located in the département des Côtes-du-Nord (Brittany) than to describe the methods he used to study a few sites combining archaeological field studies, toponomy, and study of archives. Making full use of several disciplines, he concentrates on the technical aspects of the sites rather than their history or economy (although in the annexes very interesting cost data are given).

The book is presented as the results of the author's researches about which he writes: "La recherche s'attache autant in fine aux méthodes de l'archéologie industrielle qu'à l'exploration complète d'un territoire géographique donné." Y-V Andrieux includes in the production aspects the sources of raw materials (lime, iron ore, charcoal, water) as well as housing facilities (Maître de forge, clerical staff and workers) and the social activities needed by those isolated communities (stores, cantines, churches).

In the preface, Denis Woronoff writes "voici un livre probe, convaicant parce qu'il est rigoureux" . . . "C'est le récit, sans complaisance, d'une aventure qui a la Bretagne pour cadre; c'est l'essai d'une méthode qui appelle des prolongements régionaux."

Until the 18th century the iron production in Brittany was still a cottage industry. During the first half of the 17th century, however, the nobility began to establish iron-works to increase the return of their forest and take advantage of fairly good iron ore deposits. These mills have, however, always suffered from seasonal lack of water. During the second half of the 18th century difficulties arose because of deforestation and the increased distances at which ore had to be collected. But later the introduction of coke was considered as a threat to the forest exploitation and many steel mills were then converted into other industries.

Amongst the six main mills of the Côtes-du-Nord, Y-Y Andrieux chose three plants whose study requires different approaches.

1. Forges de Poulancre:
This mill was started in 1641 and production has been discontinued in 1750. Archives are very poor. The site is dilapated with the exception of the mansion of the Maître de Forge. J-Y Andrieux made an extensive survey of what is left)illustrated by a topographic layout). This is a remarkable example of what can be concluded from a comprehensive archaeological survey of a site.
2. Forges de Vaublanc:
In 1671 and old paper mill was converted into a steel plant. Plenty of archives are available. It is therefore possible to follow the whole history of the mill until its end after 1871. Good example of the numerous legal cases raised by the opposition of industrial spirit and feudal laws and mentality. Description and layout of the plant from the early 18th century. Interesting data on how it passed through the Revolution. Description of the plant when it was sold in 1808. Layout of 1829. In 1847 puddling was introduced and the slitting mill replaced by a rolling mill. Charcoal was still used in the blast furnaces. But wood becoming scarce and local mines being exhausted it was converted in 1871 into a china clay washing plant.

3. Forges et Fonderies du Pas:
Installed only in 1828 to manufacture kitchenwares and water distribution items, the blast furnaces were operated until 1880 (production of iron in 1870: 3 000 T.) when the plant was converted into a cupula based iron foundry. Du Pas foundry was closed in 1978. Unfortunately the industrial installations have been totally destroyed. Nevertheless a comprehensive study of the site and its history is possible thanks to very good archives and a thorough photographic recording made by the Inventaire Général des Monuments et Richesses artistiques de la France.

Forges in their natural environment:

Sources of lime:
Very few limestone deposits. The main source was oyster shells brought back from Saint-Brieux were the final products were carried.

Iron Ore:
Good description of the small family mines extracting only 30 to 60 Tpy. Links with the plant owner who was providing transport and foods and very often was acting as a banker by paying advances . . . which were binding the miner and his family. "Les réseaux d'approvisionnement des forges en minerais constituaint un véritable travail de fourmis, beaucoup plus comparable à un grapillage élémentaire . . . qu'à une propection planifiée . .".

Charcoal:
There were no large forests in North Brittany. At the end of the 19th century the forests in Brittany were covering only 5.5% of the province against 16.5% for the whole of France. Although the steel industry was started to increase the returns of the forests, already by mid 18th century the production had to be reduced because of lack of wood. But when coke was introduced, the forest owners were disturbed and envisaged to reconvert their steel mills into other industries (china clay, tannin).

Water:
In Britanny seasonal lack of water has always been a major problem for the steel mills. The author gives very comprehensive descriptions of a few water systems based on large reservoirs.

Production Spaces:

Y-Y Andrieux describes the typical workshop arrangement of these charcoal based mills. "the workshops . . . are located along the water system when the store rooms and housings progressively climb on the hills surrounding the pounds and the canals".

He gives a very comprehensive description of the blast furnace of La Hardouinais as in 1817 based on archives and field work. He gives also valuable information on furnace operation and slag analysis.

The Bretons had privileged relations with Liège. Hence the use of the wallon process in most of their fineries. A slitting mill was introduced at Forges aux Salles already in 1623 by Geoffrey de Finement, a Maître de Forge from Liège.

Social Spaces:

The author distinguishes four types of accommodation:
1: The house of the Maître de Forge, small in the early stage but slowly reaching the size of a large mansion with stables and big garden.
2: The large houses of the accountant and foreman (contremaître).
3: The worker small dwellings reserved to the few "intern" workers. Description of worker houses from mid 18th-end 18th-early 19th-and early 20th century.

In the annexes are reproduced eleven well chosen legal documents, inventories, accounts and payrolls taken in archives dated between 1623 and 1862. There is also a comprehensive bibliography with 429 French and English references.

J P Schotsmans.

Kathleen Burk: The First Privatisation: The Politicians, The City and the Denationalisation of Steel. ***The Historians' Press, 1988, pp ix plus 156.***

This is not the usual type of subject matter for consideration by HMS members. The author, Lecturer in History and Politics at Imperial College, provides a study of the nationalisation of the steel industry by the Labour Government in 1948 and its subsequent denationalisation by the Conservative Government in 1953. This makes most interesting — though, perhaps, in some places, due to the plethora of detail, verging on the tedious — reading. It is, moreover, very well written and has a wealth of references as footnotes on virtually every page.

The initial impression obtained from this story of the first foray into "privatisation" is that many of the techniques used by the Politicians and the City in the much more familiar pattern in recent years were forged and refined — metallurgical terms surely are appropriate in this context — during the period 1951-53. It also brings home to those who were closely affected by these happenings how little the man-in-the-street knew in those days; a comparison with the publicity given to the privatisation in 1988 only serves to underline the enormous growth of "media presentation" during the thirty-five year interval. It is noteworthy that, in 1953, in the case of the United Steel Companies — the first company to be denationalised — the issue was oversubscribed three times; the steel company shares were, as a result, far more widely distributed among the general public than those of other companies. Within six months, however, it was abundantly clear that many subscribers had merely come in for a quick profit; the quoted price of the shares had accordingly fallen — a not unfamiliar pattern in more recent times !

The record of the interplay between the Politicians and the City, with seemingly only occasional sallies from the Industry and the Unions, is the main meat of the discussion, elaborately drawn from both official and private papers. It is surprising how many times opinions were radically changed, due to conflicting

arguments, on both sides of the political spectrum. Indeed, as stated in the Preface, the steel industry was nationalised in 1949 by a government which did not wholly believe in its nationalisation; it was then denationalised in 1953 by a government which did not wholly believe in its denationalisation; it was then renationalised in 1967 by a government which did not wholly believe in its renationalisation. There is, indeed, much support for those who consider the well-being of the steel industry to have been jeopardised by political dogma in these pages. Subsequent to 1948, political uncertainties and small majorities in the House effectively precluded the institution of the major rationalisation and recapitalisation so clearly required to set up a viable and competitive industry. As a result, it was relatively easy to sell back the individual companies piecemeal in 1953; even so it took all of seven years. It was different after 1968. The subsequent regionalisation and rationalisation of the industry effectively destroyed the old company identities for ever. The success of these changes together with the subsequent re-denationalisation still remains to be seen.

A small point of criticism: while the denationalisation of the giants such as United Steel Companies, Lancashire Steel, Stewarts and Lloyds, John Summers, Dorman, Long and Company and the like are well documented, to those, such as your reviewer, who were caught up in the results of the first nationalisation and the subsequent denationalisation, perhaps a little further detail would be welcome as to the eventual outcome for the smaller firms involved.

K C Barraclough.

Sir Henry Bessemer: An Autobiography. Published 1905 Facsimile Reprint, *Institute of Metals, Book No 451, 1989. 380pp, 210 x 146 mm., £16.95, US $33.90.*

Henry Bessemer was born at Charlton in Hertfordshire on 13th January 1813. His father was no mean engineer; he had been involved in land drainage in Holland and in engraving at the Paris Mint before the French Revolution drove him back to his native land, where he produced fine ornamental gold work and eventually established a type foundry. Henry's early acquaintance with such operations fitted him well for what was to be a career as a professional inventor, for this, truly, is what he became — he relates how, going to London at the age of 19, he knew full well that he laboured under the disadvantage of having no trade or profession. "On the other hand, I felt a consciousness that Nature had endowed me with an inventive turn of mind and perhaps more than the usual amount of persistant perseverance, which I thought I might be able to use to advantage". In his earlier years, he mistrusted the patent system, relying on secrecy as his protection; from 1838 to 1883, however, he took out no fewer than 117 patents. The width of his interests is clearly demonstrated by this massive list: 6 refer to glass, 13 to sugar, 12 to ordnance, 10 to ships, 10 to railways and over 40 to iron and steel production.

As a pastime, Bessemer painstakingly developed a method of making intricate lost wax castings of natural objects in white metal — three prawns lying on a vine leaf, a moss rose bud with leaves, a beautiful piece of Scotch kale — which he subsequently covered in a thin film of copper. His first essay at capitalising on an invention came with his production of an intricately embossed deed stamp as an integral part of the appropriate document. This was to preclude the common practice of removing old stamps from out-of-date deeds and affixing them to new ones — a loss to the Government of up to £100,000 per annum. The President of the Stamp Office was duly impressed; in order to institute the change, with its complicated machinery, Bessemer was offered a post as Superintendent of Stamps at £600 per annum. He ruefully relates that, on informing his fiancee of his good fortune, she casually remarked that the same end could have been achieved simply by embossing the date on the existing stamp to preclude its re-use ! He felt he should offer this suggestion, which was accepted with pleasure by the Stamp Office; the old system with its dies and presses was retained and there was no further mention of the post of Superintendent. This obviously continued to rankle; over forty years later, Bessemer thought fit to bring the story to the notice of the then Prime Minister, Lord Beaconsfield. The seeming result was Bessemer's knighthood in 1879 !

His first commercial success was in the production of embossed Utrecht velvet. This he carried out by rolling the fabric between heated patterned rollers; the secret was to adjust the temperature so that the fabric in contact with the patterned part of the rolls was partially fused and thus stayed deformed when the pressure was removed but was not destroyed by the heat. The hollow rolls were internally gas-heated; the temperature was controlled by reference to the behaviour of rods of controlled composition lead-tin-bismuth alloys when pressed on to the rolls; he had three alloys, one melting at the right temperature for the operation, one melting 10° lower and one melting 10° higher. Originally he received 6s. per yard for embossing; when the price came down to 1s. per yard, he sold his machinery to a weaver in Banbury.

Bessemer's next essay was to provide him with the capital for much of his later work. Purchasing some "gold" powder for his sister's artistic work, he realised that here was brass selling at £6 per ounce whereas the solid metal cost 6d. per ounce. The story of his development work, culminating in the designing of the machinery to do the job and, eventually, the setting up of a large shop to provide the powder commercially makes most intriguing reading. He was an excellent draughtsman; he made detailed drawings of the different types of machines he needed, split them up into their various parts, sending these randomly to firms in Manchester, Glasgow, Liverpool and London and eventually erecting them in separate rooms in a building with only one single external opening, other than the closely guarded door — a hole through the wall where the power from an externally-housed steam engine was fed in to drive shafting and gearing. To

complete the security, his wife's three young brothers were engaged at high salaries to run the whole unit, which remained inviolable for over forty years !

The production of presses for the extraction of sugar from cane, for which Bessemer received a Gold Medal from the hands of the Prince Consort, and the design of a furnace and rolling process for the continuous production of sheet glass, which he sold to Chance Brothers for £6,000, were followed by gunnery experiments which, themselves, proved to be the prelude to the invention for which he is best known — "The Bessemer Process". The story of the British Association meeting in Cheltenham in 1856, the rush to take out licences for the new procedure, the subsequent problems, which "came on me suddenly, like a bolt from the blue [and] well nigh paralysed all my energies", and how Bessemer overcame them, eventually earning the reputation, with justification, as the founder of bulk steel manufacture is too well known to require elaboration. The "Autobiography" provides, in great detail, the inventor's recollections, some forty years later, of these momentous happenings.

The last of Bessemer's own writing covers the efforts he made to provide a ship which would have a saloon so stabilised as to counteract rolling when at sea — Bessemer was an acute sufferer from sea-sickness and a crossing of the channel would make him ill for days. His story of the experimental work he did on land and eventually the design and construction of a full size sea going vessel has to be read to be believed.

Bessemer died in 1898, at the age of eighty five, leaving his Autobiography unfinished. The final postscript is by his eldest son and deals with a number of unrelated points, including the production of mirrors and lenses which Bessemer undertook during his retirement to provide himself with a telescope — which was never finished — and a "solar furnace", whereby metal could be melted by concentrating the power of the sun's rays — a monstrous burning-glass in effect, with which he actually melted small bars of steel. He also perfected a diamond polishing machine.

Bessemer wrote in an individual style. It is that of a man convinced, and rightly so, of his own importance and, understandably, not devoid of a certain pomposity. He was, after all, the man who introduced bulk steelmaking to a world which was increasingly in need of materials to further the phenomenal growth of engineering activity during the second half of the nineteenth century and without a steelmaking revolution would have stagnated. By 1892 Bessemer could claim that the world output of steel made by his process had exceeded 10 million tons per annum. The Autobiography is, accordingly, a historical document and it is accompanied by a wealth of illustrations. Those showing the development of the Bessemer converter are particularly valuable but many others are equally fascinating.

The work, however, is an autobiography and, as such, only gives the author's account of those controversial matters with which the history of the Bessemer process for steelmaking was burdened. The reader will, accordingly, find nothing of the pioneering work done in Sweden by Goransson, who succeeded in making the process work, and informed Bessemer of his procedure, at a date when the best Bessemer could do was to granulate his liquid metal and remelt it in crucibles; it is significant that Bessemer's partner noted in his diary, some eleven months later "First made steel direct". Whereas there is much space devoted to the "Manganese Question", which is, in essence, a rebuttal of the claims of Mushet, it is significant that, in his paper to the Civil Engineers in 1859, Bessemer gave no mention of any ladle addition and that, in his 1861 paper to the Mechanical Engineers he clearly specifies the addition of a small measured quantity of charcoal pig iron containing a known amount of carbon with no mention of manganese. Only in 1862 does a French visitor comment on the addition of 5-8% spiegeleisen in Bessemer's Sheffield Works. All this is clearly at variance with Bessemer's writing thirty five years later. Nor, surprisingly enough, is there any mention of the Kelley controversy in America. It is undeniable that he did not give due acknowledgment to the external assistance he received. As early as 1863 Percy complained that the manner in which he referred to the chemical part of the investigation which eventually led to the successful operation of the Bessemer process "might lead to the inference that this had been exclusively conducted by himself or his partner" and that "it would have been more generous on his part to acknowledge the valuable aid he had received from more than one expert analyst." This was echoed by Robert W Hunt, who had pioneered the Bessemer operations in America, commenting on the paper Bessemer provided for the 1896 meeting of the American Society of Mechanical Engineers; he stated that, whilst he had the greatest respect for Bessemer and did not wish "to say anything which would take away an atom from his honor and glory", he wished that "he were a little more generous and a little more just". This, it has to be admitted, is an impression which is left with the reader of the Autobiography.

On the other hand, one cannot but sympathise with Bessemer in respect of his treatment at the hands of the War Office and the Admiralty. It is clear that, whatever the shortcomings of the early Bessemer steel may have been, it was obviously superior to wrought iron for ordnance and the protection of vested interests Bessemer imputed to Sir William Armstrong seems to have operated mightily against the production of Bessemer steel guns. The prejudice shown by Sir Nathanial Barnaby at the Admiralty, which puts back the introduction of steel ships for two decades, was also patently unjustified when the success of the Bessemer plant of the London and North Western Railway at Crewe is set alongside.

This reissue of Bessemer's Autobigraphy makes it available to a much larger readership than those few who have previously taken the trouble to search it out and study it in Universities and Libraries. It is excellently produced and the numerous photogravure plates have lost but little in their reproduction. The

Institute of Metals has performed a great service to the growing number of students of the history of technology in making available this valuable document at a very reasonable price. Despite any reservations, it tells the evolving story of the activities of one of the towering figures of Victorian times — one of the most important of "that line of tinkerers that had made the Industrial Revolution", as one eminent writer put it in recent years.

K C Barraclough,

Obituary

Professor David Gordon Tucker died at his home at Barnt Green, near Birmingham, on March 8th 1990 aged 75. Dogged by ill health for several years Gordon Tucker had not been seen at HMS meetings for some time but nevertheless had continued to write and publish on industrial history particularly on the subject of water-powered engineering. His studies on the derivation and manufacture of millstones will remain standard references for many years to come.

'It is our purpose here to examine this evidence and by relating it to known developments in technology elsewhere, to speculate on what processes were used . . .' These words, written in a JHMS article in 1976 sum up his approach to the history of technology and it was this systematic manner which made his writings so much appreciated in publications ranging from Bulletins of local industrial archaeological societies to the *Encyclopedia Britannica.*

Gordon Tucker was a very eminent electrical and communications engineer. Indeed he was *Professor and Head of the Department of Electrical Engineering* at the *University of Birmingham* from 1955 until he retired in 1973. But he was also a very inquisitive man. Once his interest had been aroused, in almost any subject, a finely honed investigative mechanism slipped into action resulting in extensive examination of the physical remains (assisted by gum-boots and a billhook wielded in a very determined manner) followed by meticulous assessment of all the documentary evidence. This would be followed as a matter of course by an extremely scholarly 'learned paper' the publication of which would without exception, add to the accumulated store of knowledge.

We first met Gordon and Mary at a Newcomen Society Summer Meeting in Glasgow in 1969. We were already members of the Historical Metallurgy Group (as it then was) and the Tuckers quickly shared our enthusiasm. Afterwards we met regularly at Aberystwyth Summer Schools, in mid-Wales and in the Forest of Dean where we scrambled amongst the ruins of lead mines and iron smelting sites. Gordon and Mary had a cottage in the Wye Valley and glorious days in the summer sunshine led to extensive joint examinations of the metallurgical remains of the area around Tintern and Monmouth.

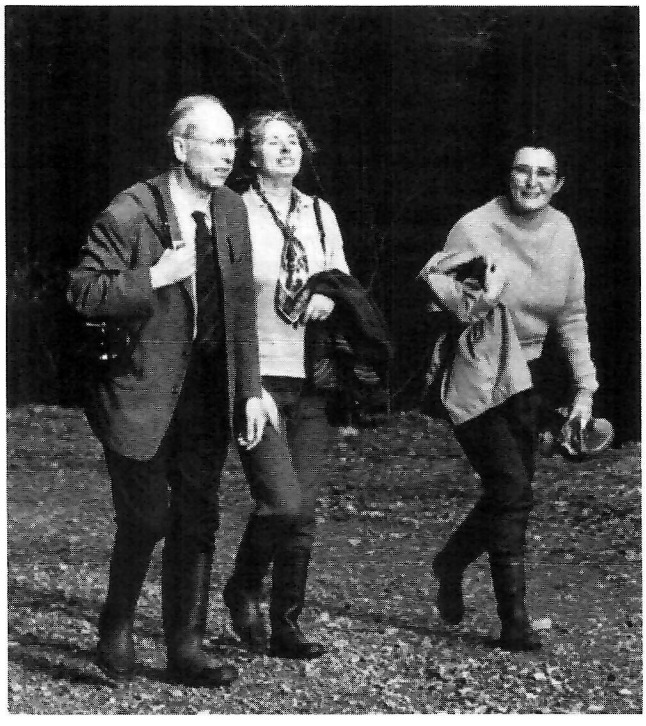
Papers appearing in Historical Metallurgy between 1975 and 1981 testify to Gordon's devotion to copper smelting, brass-making and wire-drawing activities in the district.

Apart from his specialist interests Gordon Tucker was always prepared to take an active part in the administration of organisations involved. He served as a Council Member of HMS and was a Council Member and Vice-President of Newcomen until 1984. From 1979 until 1984 he was a Commissioner with the Royal Commission for Ancient and Historic Buildings in Wales and from its inception until his death was a prime mover in the work of the Midland Wind and Water Mills Group.

Born in Walthamstow he graduated at the University of London (BSc 1936, PhD 1943 and DSc 1948) and joined the GPO at Dollis Hill Research Station in 1934 moving to the Royal Navy Scientific Service in 1950 and to Birmingham in 1955. He was elected a Fellow of the Society of Antiquaries of London in 1984.

These then are a very few milestones in a long and distinguished academic career. But to those fortunate enough to form lasting friendships there are countless happy memories. Measuring an extremely involved water mill at Longtown on the River Monnow, scrambling along a nettle infested leat above Penalt in the Wye Valley and for relaxation? taking part in a gradually accelerating game of Monopoly in a cosy cottage parlour. This was Gordon Tucker the family man, the fellow enthusiast for so many things which we hold precious and who will be sadly missed.

Joan and Roy Day



Professor Gordon Tucker, Mary Tucker and Joan Day. Wye Valley c1970.