

*120 Years
of Consulting
Engineering*



**HOARE, LEA
& PARTNERS**
CONSULTING ENGINEERS

120 Years
of Consulting
Engineering
1862-1939

In November 1862, Henry Lea, acting on 'the advice of many gentlemen well acquainted with his qualifications and experience', set up in practice as a Consulting Mechanical Engineer. Quite apart from founding the present practice of Hoare, Lea & Partners, his initiative had a wider historical significance

Offices, 33, Waterloo Street,
Birmingham.

Henry Lea begs leave, respectfully, to announce that, by the advice of many Gentlemen well acquainted with his qualifications and experience, he has commenced practice as Consulting Mechanical Engineer.

He takes this opportunity to inform his friends and others requiring the services of one of his profession, that he is prepared to undertake to make Drawings and Specifications for Steam Engines, Millwork, general Machinery, Roofing, Bridges, Girders, and Iron Constructions of all descriptions; also the practical Inspection of Contract work, the Valuation of Machinery, and the preparation of Bills of Quantities and of Estimates for Iron work.

H. L. knowing from experience that very many Steam Engines in Birmingham and the neighbourhood are consuming excessive quantities of Coal, is ready to undertake the examination of Engines by means of the "Indicator," to superintend alterations and repairs, and to furnish designs for Boilers and Boiler settings with a view to ensure the prevention of smoke, and a greater economy in the expenditure of fuel.

References - Mess^{rs} Walter May & Co., Engineers Birmingham, and Westminster, Walter Williams Jun^r, Esq^r, Tipton; William Dredge, Esq^r, C. E. Bridge St., Westminster; and Nathaniel Lea, Esq^r, Bennetts Hill, Birmingham.

November 1862.

To the Chairman of the Board of Management
General Hospital,
Birmingham.

6th April 1899.

Dear Sir,

I learn from my friend Mr J.B. Clarke that my appointment as "Honorary Engineer" was made by the Governors of the Hospital at an annual meeting and that the designation cannot be changed until their next meeting.

I particularly wish that it should be altered, 1. because the designation "Honorary Consulting Engineer" far more correctly designates my position, and 2. that whatever meaning may attach in other professional branches to the words "Honorary Consulting" I am and have been since the year 1862 a Consulting Engineer and nothing else, and that designation has appeared on my door plate and letter paper during that period. Adding the word Honorary to indicate that the General Hospital Authorities can consult me without charge, there results the designation "Honorary Consulting Engineer" suggested by me when I first expressed my consent to act in that capacity.

I do not wish any difference of opinion as to my designation to interfere with my possible usefulness to the Hospital, and I therefore write this letter to say that during the current year and upon the assumption that my designation will be rectified at the next annual Meeting, I will hold myself at the service of the Hospital Authorities to advise them upon any Engineering points as to which they may wish to consult me, as for instance the bore hole and pumps which I already have in hand, and any other matters that may turn up.

It was never my intention to undertake responsibility for or a constant supervision of all the mechanical appliances, or the management of the Mechanical Staff, nor would it be reasonable I think to expect such constant responsibility and services from any professional engineer acting in an honorary capacity, and yet I think they are involved in the designation given me. What I intended to give, and am prepared to give, is gratuitous engineering advice whenever asked for.

Yours faithfully,

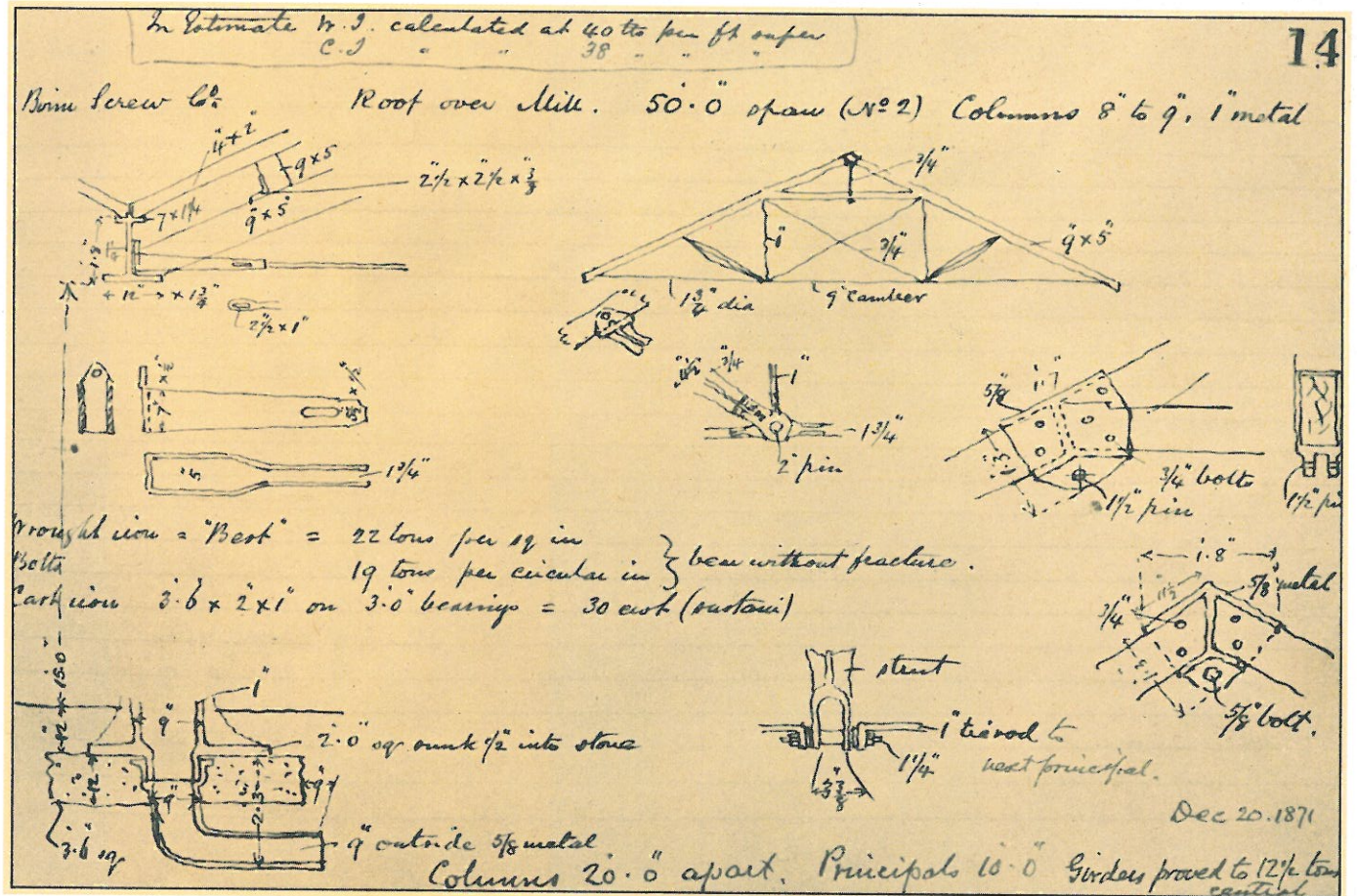
Henry Lea

in that there is no record of any engineer having previously called himself a Consulting Engineer especially related to the mechanical and electrical aspects of buildings.

Founding a new profession, however, was not without its attendant difficulties. His surviving letters show that for forty years or more he was plagued by two interlocking problems. Firstly, many of his clients did not understand what a consulting engineer was, nor did they recognise that, like an architect, a doctor or a lawyer, he was a professional man. As a direct consequence, he had considerable trouble in finding ways of charging for his services that were acceptable – understandable even – to his clients, and reasonably rewarding to the practice. Over

the years, he had to try a variety of methods. In passing, the fact that the misunderstandings lasted for so long would seem to indicate that his example was not very speedily followed by other engineers. That would not have bothered Henry Lea. By nature and through sheer ability, he was always a front-runner.

Born in 1839, details of his early life and education – as indeed of the qualifications and experience mentioned above – are unfortunately lacking. Nevertheless, although his notebooks reveal a restless perpetually enquiring mind, indicative of a largely self-developing talent, he evidently received a very thorough grounding in the basics of engineering. How else could he have tackled mechanical, civil, structural, marine, chemical, and electrical



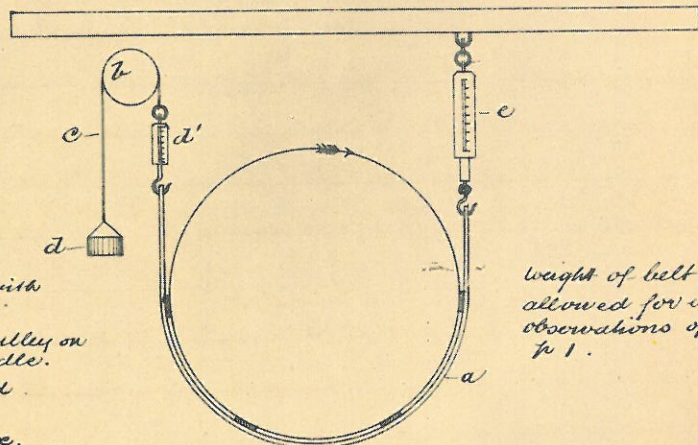
Left. By 1899, Henry Lea had been in business as a consulting engineer for almost 40 years. Yet, he was still having trouble in making people understand the nature of his profession and practice.

Above. Design of roof trusses for the mill of The Birmingham Screw Company.

engineering projects with the abundant confidence, efficiency and assurance that the record shows he did?

Dating from the early 1870s, his surviving letters, notebooks and memoranda reveal a remarkable man, and provide a unique insight into the engineering theories, ideas and opinions of the late 19th century. He was a most punctilious correspondent – incoming letters were

Strong shelf over fly wheel



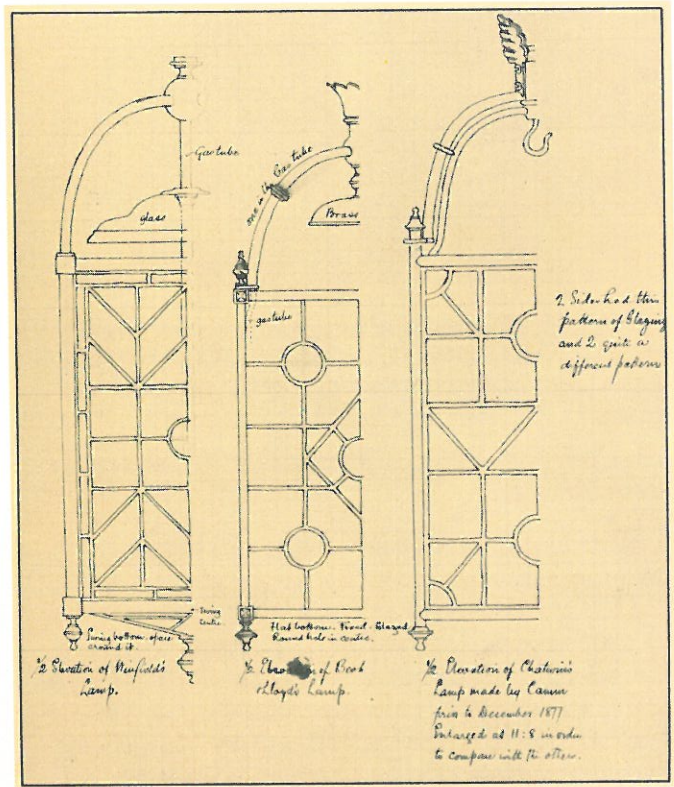
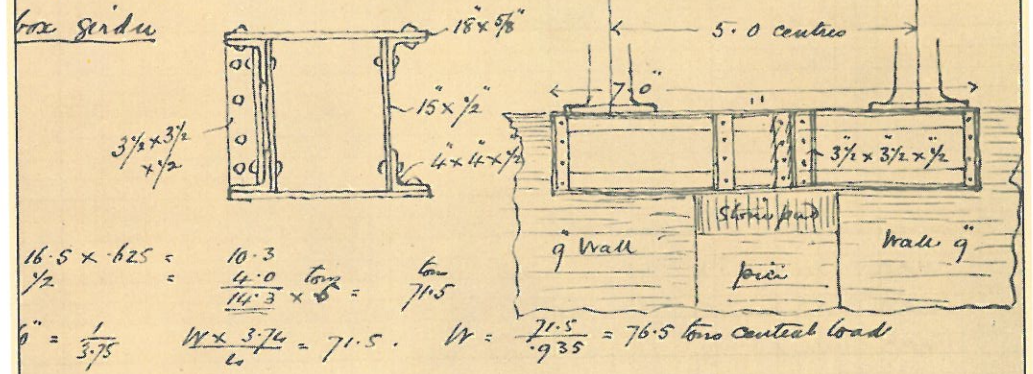
- a. Leather belt with wood facing.
- b. Very light pulley on small spindle.
- c. Light cord.
- d. weight box.
- d'. Light spring balance.
- e. Heavy spring balance.

Sketch of Brake arrangement.

Robtson's premises Continued

76 tons $\frac{76 \times 57}{4 \times 1} = 108$ tons strain $\div 1\frac{1}{2} = 72$ oz in $= 18 \times 4$!

$\frac{72 \times 2}{3} = \frac{144}{3} = 46 = 18 \times 2\frac{1}{2}$



SPRINGS for "Sugma" pump when 1076 R = comp on ext in inches of one coil mean dia of coil in inches w = wt applied in the D = dia on side of sq steel in c = constant 22 for round 30 for sq steel x, no of effective coils for total comp or a number of effective coils 2 less than actual R = $\frac{22 \times w}{D \times c}$ for round D = $\frac{w \times c}{R}$ for square steel

SWAN LAMPS. NO IN SERIES AND PARTICULARS	BURGIN MACHINE B-PATTERN 29 OHMS RESISTANCE E.M.F. AT 1550 REVS. 12 AMPERES CURRENT														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. CURRENT LAMP R	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180
TOTAL R	44.0	20.0	13.3	10.0	8.0	6.66	5.70	5.0	4.44	4.0	3.63	3.33	3.08	2.86	2.66
E.M.F.	58	58	62	67	72	77	82	86	91	96	101	106	111	116	120
SPEED H.P.	410	450	480	520	560	600	635	667	705	745	785	820	860	890	930
LAMPS PER H.P.	11.75	10.7	10.0	9.9	9.6	9.05	7.85	7.2	6.8	6.25	6.15	5.95	5.6	5.35	5.16
2. CURRENT LAMP R	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180
TOTAL R	63.0	44.0	30.6	23.0	18.0	15.0	13.4	12.0	10.9	10.0	9.25	8.66	8.15	7.70	7.32
E.M.F.	81	102	116	135	150	165	180	195	210	225	240	255	270	285	300
SPEED H.P.	785	825	865	905	950	990	1035	1075	1120	1165	1210	1255	1305	1350	1400
LAMPS PER H.P.	12.25	11.7	11.3	10.8	10.35	9.9	9.58	9.19	8.96	8.62	8.35	8.1	7.89	7.68	7.4
3. CURRENT LAMP R	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180
TOTAL R	23.0	20.0	16.6	14.0	12.0	10.5	9.4	8.5	7.8	7.2	6.66	6.15	5.70	5.32	5.0
E.M.F.	149	152	153	153	153	153	153	153	153	153	153	153	153	153	153
SPEED H.P.	1160	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800	1850
LAMPS PER H.P.	12.50	12.1	11.7	11.4	11.1	10.75	10.5	10.25	9.98	9.7	9.42	9.25	9.05	8.85	8.65
4. CURRENT LAMP R	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180
TOTAL R	103.0	80.0	60.0	48.0	38.0	30.0	24.0	19.0	15.0	12.0	10.0	8.5	7.5	6.8	6.2
E.M.F.	197	202	206	210	215	220	225	230	235	240	245	250	255	260	265
SPEED H.P.	398	405	412	420	428	435	442	450	458	465	472	480	488	495	502
LAMPS PER H.P.	12.55	12.36	12.15	11.95	11.75	11.55	11.35	11.15	10.95	10.75	10.55	10.35	10.15	9.95	9.75

Top left. Braking system devised for a gas engine providing electric lighting in Birmingham. A good example of our founder's immaculate draughtsmanship.

Far left. Comparative drawings of light fittings in a case where Henry Lea was consulted with regard to an alleged infringement of a registered design. In the archives, these drawings are followed by an exhaustive analysis of every component in the three designs.

Left. Detail of a page from Henry Lea's 'Technical Notes & Memoranda'. Although one or two items were clipped from published material, he generally set himself the task of copying information by hand - immaculately.

Above. Structural calculations for premises in Birmingham.

invariably answered on the day they were received. Never the man to waste, let alone mince, words, his answers to questions posed by clients or others are models of clarity, in which his considered opinion was always prefaced by a lucid outline of the options available. On occasion, he was capable of displaying a decidedly caustic wit - not least in his letters to suppliers and contractors who had fallen short of his own exacting standards.

Like other mortals, he must have had his good days and bad days, inspired spells and periods of routine achievement. But nothing, absolutely nothing, allowed the

standard of his wide-ranging output to drop below the level of absolute competence. Henry Lea was a professional to his fingertips.

Of all the carefully preserved and invaluable archive material that he left behind, his notebooks and memoranda provide the most compelling portrait of the fine engineer that he was. In his extensive technical memoranda, he continually monitored the 'state of the art' in every field of engineering. Though well ahead of his time in some disciplines, particularly electric lighting, he carefully recorded and examined new developments in others. Whilst his 'Electrical Notebooks' demonstrate his considerable contribution to the developing technology of electric lighting, his 'Calculations for Existing Equipment' are, perhaps, even more impressive. In these, he can be found subjecting new ideas, equipment and installations to

rigorous examination. Few things, if any, were accepted on trust or at their face value. Henry Lea made his own calculations, and not infrequently found the subject matter wanting.

Two points are abundantly clear in his letters and notebooks:

1. To Henry Lea, there was no such thing as a standard solution to a given problem. Every job required, and was accorded, its own specific solution, and was carefully analysed in terms of initial cost, functional efficiency,

Below left. Notes on chilled castings, copied by Henry Lea from 'The Engineer' 24th December 1880. Who, nowadays, would publish on Christmas Eve?

Below. Estimate for an electrical lighting plant in Russia. Surviving letters and notes show that Henry Lea was travelling abroad and establishing an overseas reputation very early in his career.

running costs, operational and maintenance requirements.

2. Though a brilliant and innovative theorist himself, he never lost sight of the practical implications. Time and again, his notebooks show him demolishing a new idea on the grounds that, however original and intellectually satisfying it might seem, it would quite simply not be practical in application.

Although never averse to looking for commissions on the rare occasions when they were in short supply, for most of his working life there seems to have been no shortage of clients beating a path to his door in Birmingham. By the seventies and eighties of the last century, he had already established a growing reputation overseas. When he died in 1912, he left control of a successful and well-respected practice to his son Fred M. Lea who had worked as his principal assistant for many years.

Enter tangentially so as to cause rotation of the metal.
not too rapid or it will remove the wash of fine blacklead and pure clay from the chill. Heat to 160° to 200° before pouring.

For Corn Mill Rollers abt 3'-0" long x 12" dia
Chilled abt 1" deep

	parts	percent
Nematite N° 5	10	= 35.1
Lillehall C.B.	8	= 28.1
Chester white	4	= 14.0
Brymbo	2 1/2	= 8.8
Pontypool white	4	= 14.0
		<u>100.0</u>

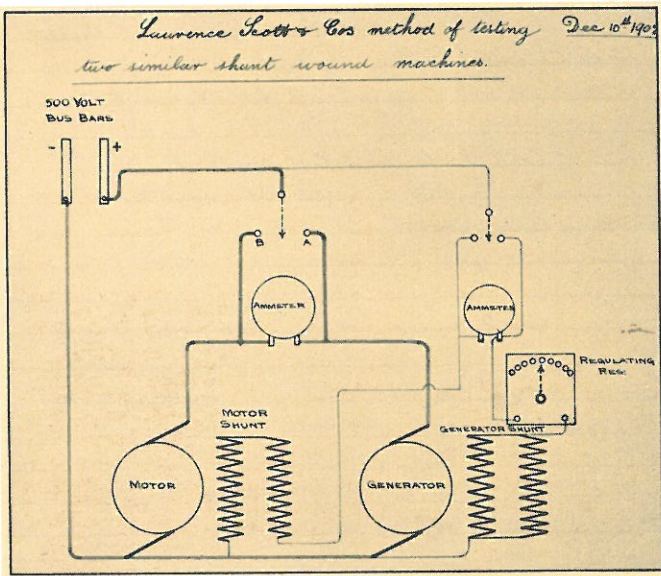
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The Thornton Woollen Mill Co
St Petersburg

1893

Compound Vertical Steam Engine 11 1/2" x 17 1/2" x 10" by G. E. Belliss Co 90 BHP at 240 revs per min. with boiler pressure 100 lbs. Mounted on heavy C.I. bedplate to carry dynamo	410	0	0
Similar Engine but 45 BHP (two supplied) each condensing engine to deal with steam from 3 engines each developing 90 BHP	320	0	0
	333	0	0
Dynamo, shunt wound. Output 70 kilowatts, 102 volts, 240 revs; by Havor & Boulson.	660	0	0
Do. do 35 kw at 260 revs	408	0	0
Switchboard (concentric system)	134	0	0

The above prices do not include packing & delivery.

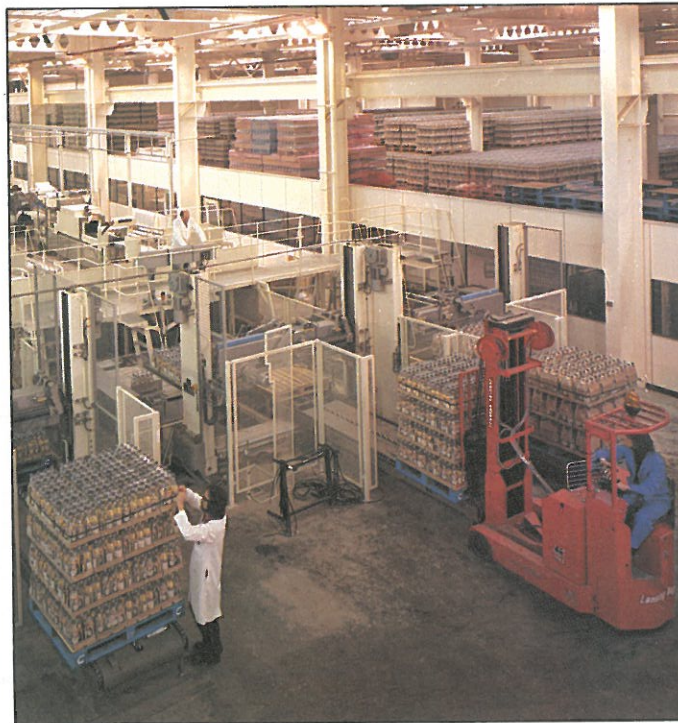


Above. Detail from Henry Lea's 'Electrical Notebook'. This part of the archives is mostly concerned with his own designs, ideas and theories. Nevertheless, as here, interesting developments by others were carefully recorded.

Perhaps because of the steadily increasing advance in engineering technology, it was becoming more difficult for an all-rounder to be ahead of the field, Fred seems to have been less of an innovator than his father. Nevertheless, the records show that he was a well-trained, extremely able and highly respected engineer, and was instrumental in attracting major clients to the practice. In one important respect, he faced a far more difficult task than Henry Lea, in that the recession of the inter-war years created severe problems in industry and commerce. It is a tribute to his sound management of the firm's affairs that it remained in good shape throughout this period.

Although there was a small increase in the staff in the mid-thirties, Fred Lea seems to have been content to keep the size of the practice more or less the same as in his father's day. This may have been – very likely was – due to the economic uncertainties of the depression. On the other hand, there could have been a contributory reason. But that belongs to the second half of the story.

In 1938, Fred Lea took his son, Donald, into partnership. Fred Lea died in the following year.



120 Years of Consulting Engineering 1939-1982

At this point, Edwin S. Hoare enters the story. After working as an engineer for a firm of laundry equipment manufacturers, he started up as a laundry consultant in 1932. The laundry work rapidly developed to encompass steam-raising plant for heating, and later to hospital work.

Three years prior to 1939, Edwin Hoare approached Fred Lea with a view to amalgamating their respective practices. Fred, failing to see the logic of the move, declined. It is tempting to speculate, however, that there was more to his refusal than his inability to see business and operational advantages. Such a move would surely have been completely contrary to his understanding of the practice founded by his father. Henry Lea's practice structure may have been essentially Victorian in conception, but it was entirely in line with his individuality and creativity. There was one professional engineer, surrounded by as many assistants as he needed, and working under his direction. It must also be remembered that, by 1936, the practice had been a family business for 74 years – Fred succeeded Henry, and Donald was the successor to them both.

When Edwin Hoare made a similar proposal in 1939, Donald Lea took a different view from his father, and Hoare, Lea & Partners came into being. Historically a momentous year, 1939 was to provide the launch pad for the rapid expansion of the partnership and, eventually, dramatic changes in its structure.

Left. British Aerospace, Taper Etch Facility, Bristol. This is the first aerofoil etch forming process in the world. Hoare, Lea & Partners designed all engineering aspects.

Far left, top. Beau Sejour Leisure Centre, Guernsey.

Far left, below. Cinzano (UK) Bottling Plant, Telford. The partnership were responsible for design and project management.



Edwin Hoare. 1887-1957

War broke out in September, and several of the existing staff left to join the armed forces. The partnership very quickly became involved in a considerable amount of 'essential works', especially in Birmingham, including the conversion of manufacturing plant to munition factories and the design of airfields. After the bombing of Liverpool, the firm was employed to provide emergency housing for homeless people in Huyton and, during this period, the partnership widened its scope to become an integrated practice employing architects as well as structural, civil, mechanical and electrical engineers. By the end of the war, a London office had been opened, and this was followed by new offices in Plymouth, Manchester and Burtonwood, and the staffing level increased accordingly.

The immediate post-war years saw a rapid increase in overseas work, an early appointment being to design a rayon production facility at Travencore in India. During this period, in particular, Edwin Hoare was travelling extensively abroad and widening the scope of the practice.

After nearly twenty years of devoted and energetic service to the partnership, Edwin Hoare died in 1957. During his life, he was instrumental in bringing about significant changes in the structure, scope and direction of the firm.

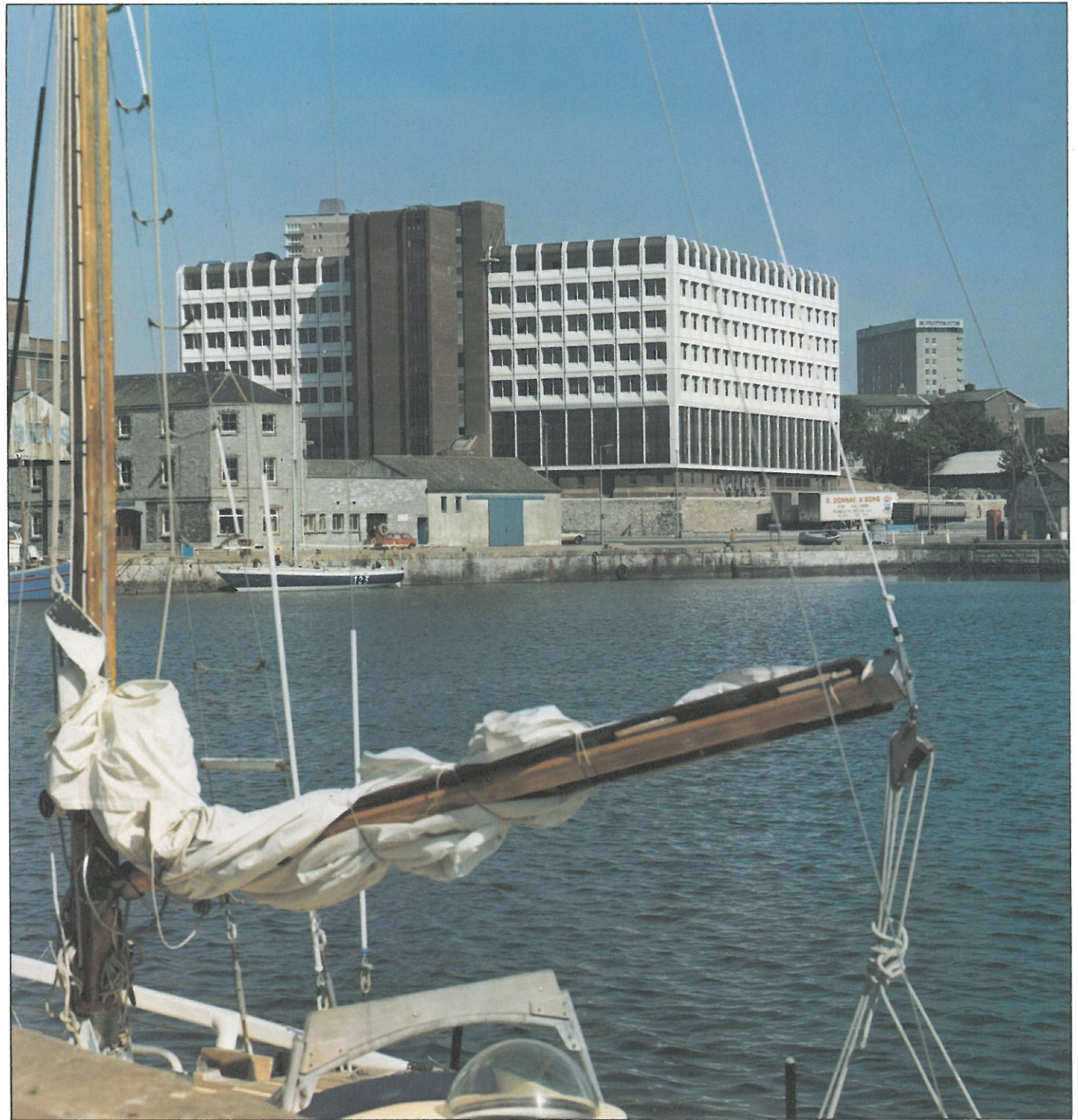
But, major changes were still in store. In the 19th century, it was possible for Henry Lea to apply his expertise to civil, structural, mechanical, marine, chemical and electrical engineering projects and, to a gradually diminishing extent, it was still possible for Fred Lea in the early decades of the 20th century. However, by the 1950s it was no longer possible. Such was the acceleration in the complexity of building and environmental technology that an increasingly high degree of specialisation was called for. There can be little doubt that both Donald Lea and Edwin Hoare foresaw the trend in 1939.

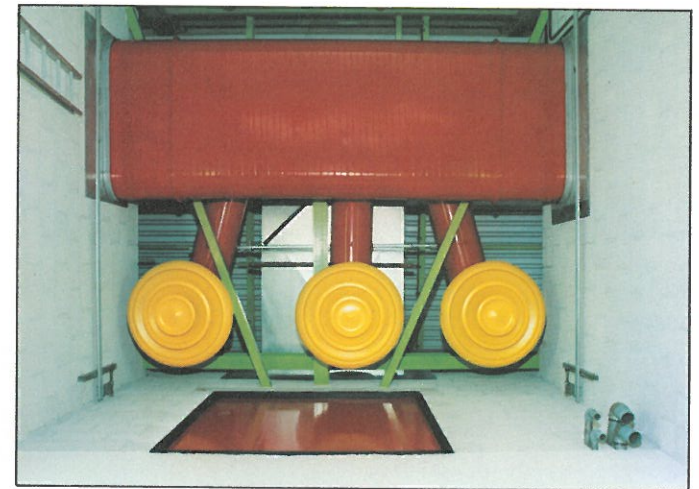
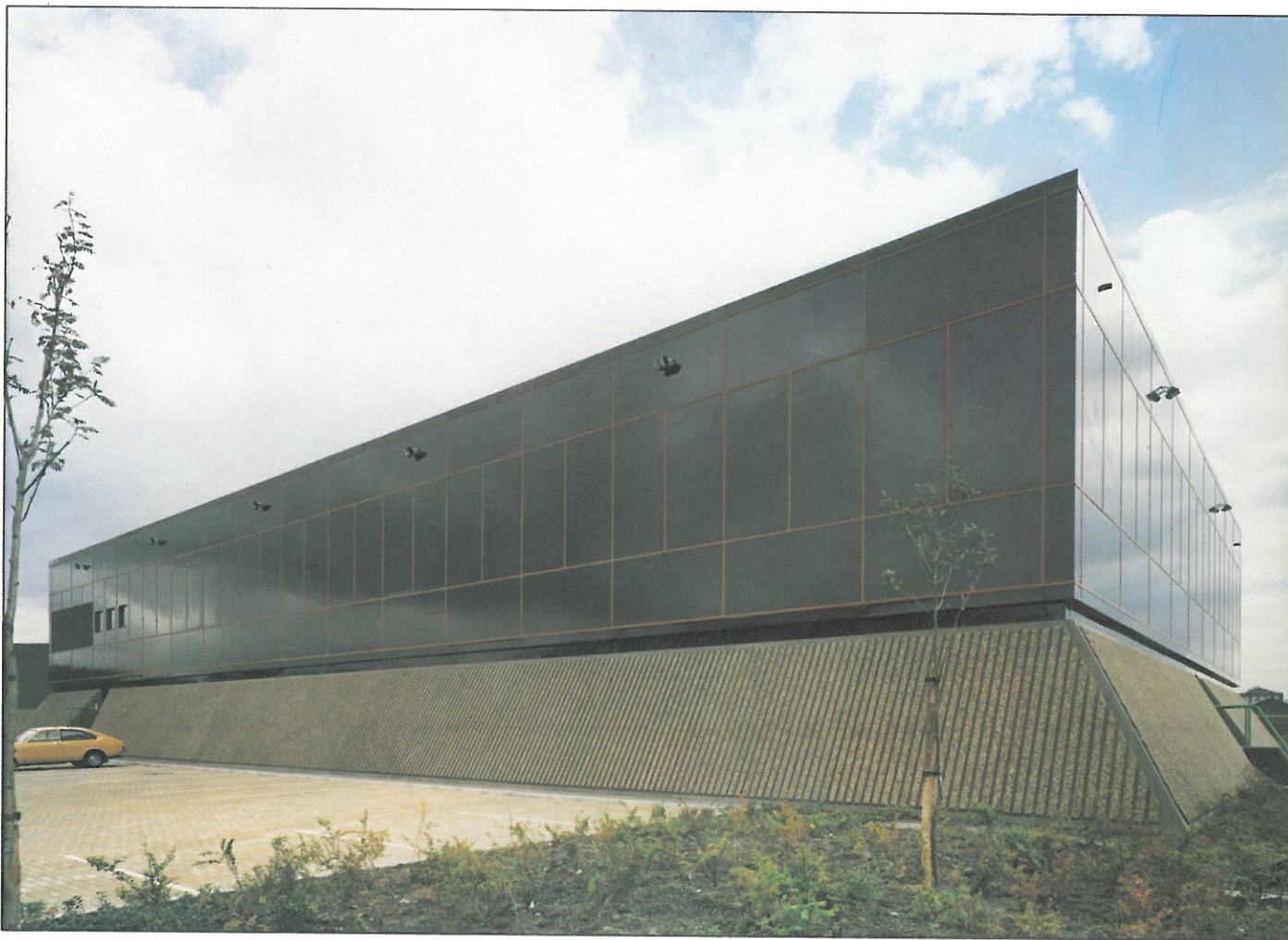
The changing situation brought challenges and opportunities to which the partnership responded. By the early sixties, the Hoare, Lea partnership was applying the diverse skills of multi-disciplinary teams to the planning, design and construction of universities, large schools, hospitals, defence works, and a wide range of commercial and industrial projects. By the end of the decade, the partnership's specialist skills included air-conditioning, heating, lighting, ventilation, electrical, civil, structural, public health, materials handling, vibration, acoustics – to mention only a few.

Since then, the list has grown even longer, and the partnership currently employs approximately 250 people in seven UK offices (Birmingham, Bristol, High Wycombe, London, Manchester, Plymouth & Poole). The partnership is also involved in Europe, the Middle and Far East, Africa and South America, thus making it one of the larger firms of international consulting engineers.

A record of the vast range of projects and scientifically advanced research and development commissions with which the partnership is currently involved is outside the

Right. Telecom House, Plymouth.





scope of this narrative. One area of activity, however, must be mentioned. Energy conservation is of great concern to the partnership, and its expertise in this field is now very substantial. Large scale projects involving low energy use systems, such as heat recovery and district heating, have been completed throughout the world. Special skill and experience have been gained in the use of alternative energy systems, and schemes using solar energy, heat pumps and geothermal equipment have been completed, and others are in course of construction. In 1980, the partnership was appointed 'Lead Consultant' to the Department of Energy for the UK Geothermal Energy Utilisation Research & Development Programme. In connection with this programme, Hoare, Lea & Partners

Above & above right. Midland Bank Facility, Manchester, with hi-tec exposed services.

Below right. Service centre, Dudley District General Hospital, providing energy for a 1200 bed 'harness system' hospital.

are working closely with the government financed Energy Technology Support Unit, based at Harwell, and have a major responsibility for developing, both technically and commercially, the use of this most important form of energy, as well as co-ordinating the technical effort of other engineers and scientists working in the field.

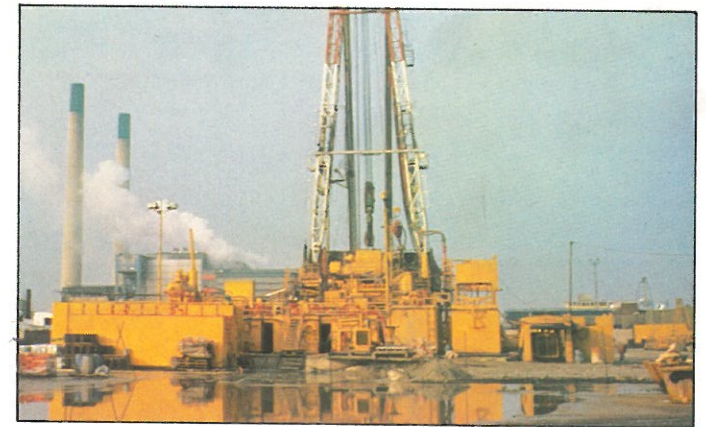
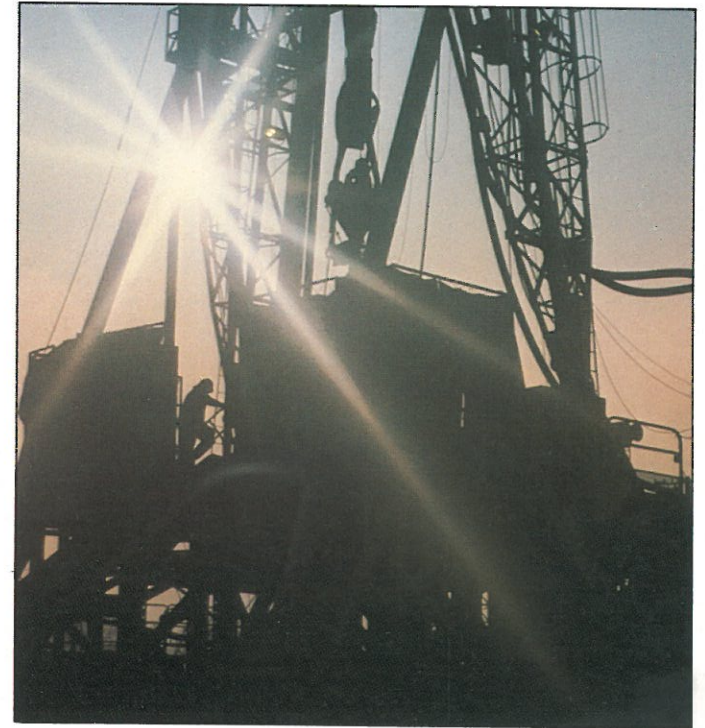
Finally, we return to our roots. In 1862, Henry Lea

founded a new profession and a successful practice. He also established a great tradition which the present members of the partnership are heirs to. His legacy includes: responsible professionalism; wide-ranging capability; continuing innovation and creativity; acute awareness of the 'state of the art' in every relevant field of activity; creation of the optimum precisely-fashioned solution for each individual job; avoidance of unnecessary and expensive sophistication; careful evaluation of the practical implications; cost refinement and control; exacting standards of site supervision and commissioning.

As the partners lead the firm into the 21st century, this tradition will be maintained.



Birmingham Repertory Theatre



*Opposite page.
Birmingham Repertory Theatre.*

*Above left & below left. District heating for a 1000 homes
community at Duffryn.*

*Above right. Experimental geothermal 'hot rocks' project,
Camborne.*

*Below right. Operational geothermal scheme, Marchwood,
Southampton.*