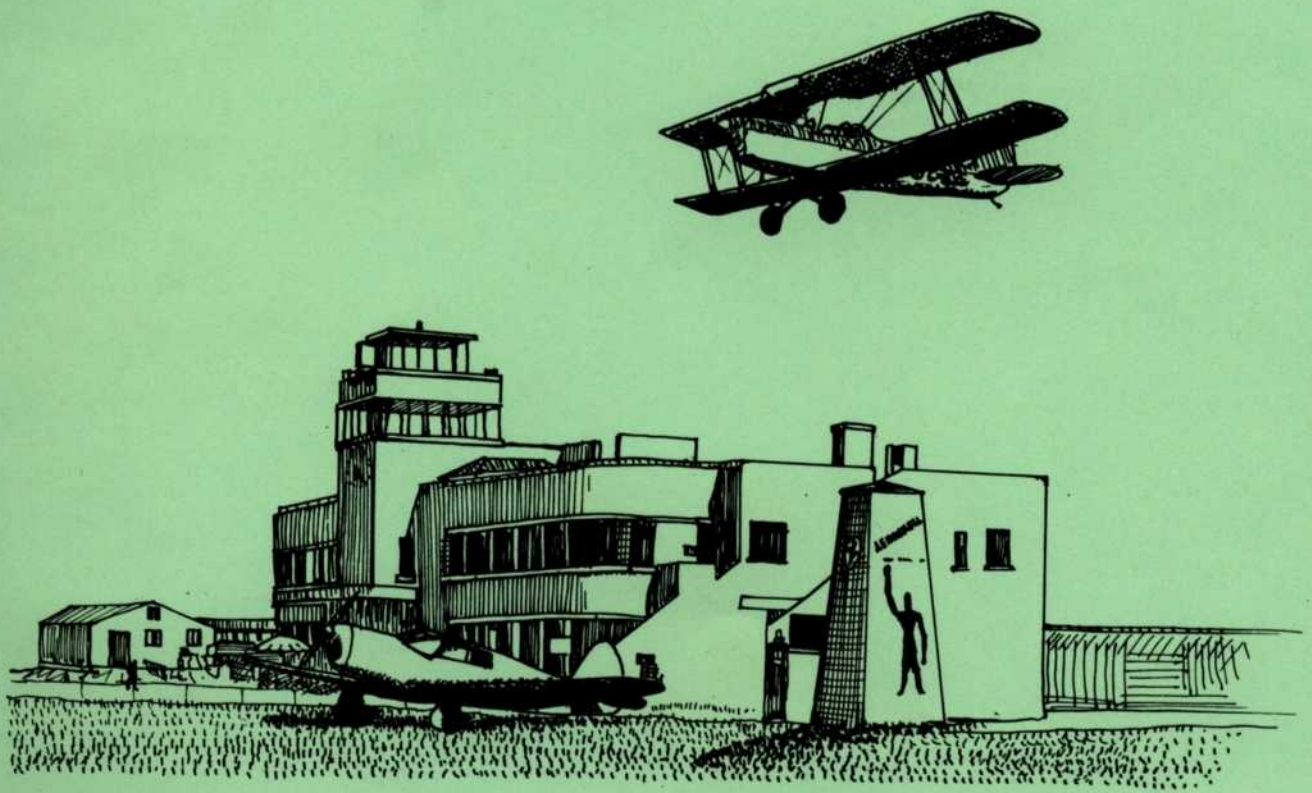
SUSSEX INDUSTRIAL HISTORY



SHOREHAM AIRPORT TERMINAL BUILDING C. 1936 R.G. Martin 1985

Palace Pier, Brighton * White and Thomson Limited * Shoreham Airport
A Charcoal Burners Hut * Ice Houses in Brighton * Mining in Sussex

ISSUE No 14 **PRICE £1.50**

SUSSEX INDUSTRIAL ARCHAEOLOGY SOCIETY

OFFICERS 1983-4

CHAIRMAN	Air Marshall Sir F.B. Sowrey	Home Farm, Herons Ghyll, Uckfield.
VICE-CHAIRMAN	J.S.F. Blackwell	21 Hythe Road, Brighton.
HON. GENERAL SECRETARY	R.G. Martin	42 Falmer Avenue, Saltdean, Brighton.
HON. TREASURER and MEMBERSHIP SECRETARY	J.M.H. Bevan	12 Charmandean Road, Worthing.
HON. EDITOR	E.J. Upton, B.A.	Rowan Cottage, North Trade Road, Battle.
HON. PROGRAMME SECRETARY	D.H. Cox	3 Middle Road, Partridge Green, Horsham.
HON. ARCHIVIST (DOCUMENTS)	P.J. Holtham	11 Lark Hill, Hove.
HON. ARCHIVIST (PHOTOGRAPHS)	E.J. Upton, B.A.	as above
HON. SECRETARY WEST SUSSEX AREA	R.M.Palmer	11 Arlington Close, Goring-by-Sea.
HON. SECRETARY CENTRAL SUSSEX AREA	J.F.S. Blackwell	as above
HON. SECRETARY NORTH SUSSEX AREA	E.W. Henbery	10 Mole Close, Langley Green, Crawley.
HON SECRETARY EAST SUSSEX AREA	A.J. Haselfoot	Albion House, Cobourg Place, Hastings.

COMMITTEE

A.G. Allnutt	E.W. O'Shea
Dr. B.A. Austen	G.C. Thomerson
F.W. Gregory	M.F. Tighe

COVER PICTURE

Shoreham Airport Terminal Building c 1936.

The Annual Subscription to the Society is £5.00, Payable on 1st April. Life Menbership is available for a single payment of 15 times the current annual subscription. Annual and life Membership includes the annual issue of 'Sussex Industrial History' and the quarterly 'Newsletter'.

The Society is registered as a Charity, registration No. 267159.

ISSN 0263-5151

SUSSEX INDUSTRIAL HISTORY

Journal of the Sussex Industrial Archaeology Society

No. 14

1984/85

CONTENTS

Published by the Sussex Industrial Archaeology Society

THE PALACE PIER, BRIGHTON

William D. Everett

Amusement Piers are a traditional part of the British seaside and Brighton has featured in their history from the beginning.

Until the early part of the nineteenth century, Brighton was an important seaport for the growing traffic of passengers and goods between England and France. For many years, passengers had been ferried to and from packet boats and other vessels by means of local rowing boats called 'punts'. These boats were also used to pull the rafts on which luggage, horses and carriages were loaded. Even then, the passengers often had to be carried on the backs of fishermen the last few feet to the beach. In the days before the railways most of the heavy goods, like coal, were brought by sea and unloaded onto the beach.

A company was formed called the Brightelmstone Suspension Pier Company and Captain Samuel Brown, a specialist in naval architecture and marine engineering, was appointed the engineer to build a suspension pier. Land was purchased under the East cliff, suspension chains were anchored 54 feet into the cliff below New Steine and the other end into the sea bed under the landing stage. Four cast iron towers build on clumps of wooden piles driven into the sea bed held the chains, from which the deck was suspended. A T-shaped platform, 80 feet wide on its own wooden piles, was the landing stage for the boats.

Built in less than twelve months, the Brighton Suspension Chain Pier was an advanced engineering achievement for its day. The official opening was on the 25th November 1823 and in 1825 the first steam vessels began to operate at Brighton. Like many good ideas, another and more popular use was found for the new pier by accident. It was used by the residents and visitors as a way of affording out-of-door recreation for what may be termed select Society. The toll fee of 2d tended to keep it more or less exclusive as a fashionable promenade. The towers were hollow and contained small shops or stalls and at the head of the Pier was a camera obscura. There was also a floating-bath attached to the north-east end of the pier-head for the convenience of bathers and a band played once a week in the season.

The first Palace Pier Company was formed in 1886 and the Brighton Marine Palace and Pier Act, 1888 was 'An Act to incorporate and to confer powers upon the Brighton Marine Palace and Pier Company and for other purposes'. The Act allowed for a Pier 666 yards long, Capital of the company £150 000, in 15 000 shares of £10 each. The Pier to be completed within five years of the passing of the Act. The Pier Company to remove the Chain Pier at its own expense and to display a light at the outer extremity of the pier, such lights as the Corporation of Trinity House shall from time to time direct, and each night in which they so fail, be liable to a penalty not exceeding £20. The toll to be 3d.

The Palace Pier was started in November 1891, the designer being Mr. R. St. George Moors: the contract was placed with the Mayoh Bros. of Manchester. In October 1892 the Contractor ceased work and the Pier Company entered into possession and proceeded with construction. (In the same year the Chain Pier was purchased for £15 000). Another Act of Parliament in 1893 allowed an extra three years for completion, with a penalty of £500 to be paid by way of liquidated damages and it stipulated removal of the whole of the Chain Pier by 7th August, 1896. In March 1895 the Limited Company, who had been constructing the Pier since October 1892, ceased work, their funds being exhausted. When the stoppage took place about 1060 feet in length of the pier had been completed and about £43 000 had been spent including the purchase of the old Chain Pier and property connected with it.

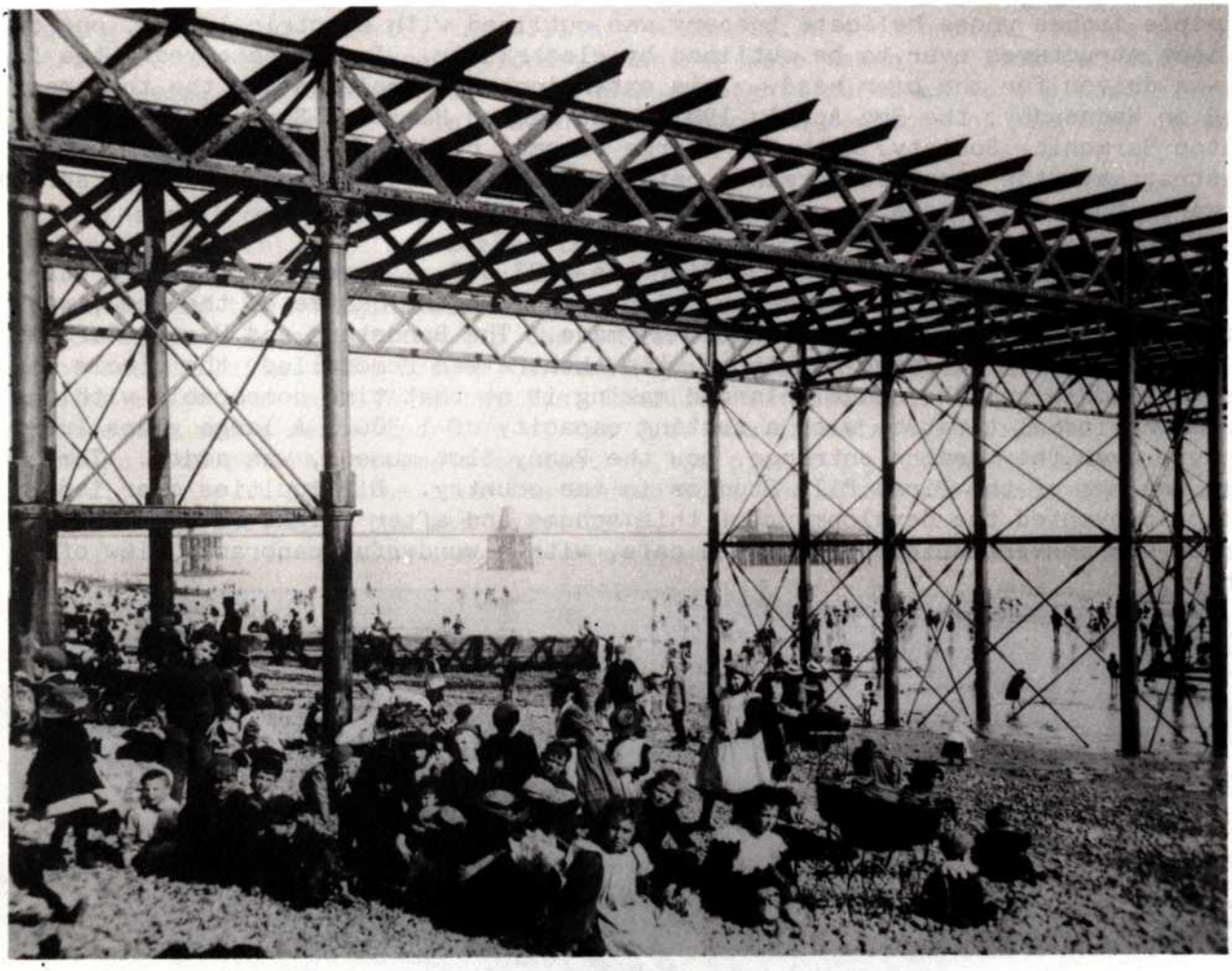


Figure 1. Construction of Palace Pier with Chain Pier in background. c1895-6

A third Brighton Marine Palace and Pier Act dated 7th August, 1896 allowed time for completion of pier and works to be extended yet another three years and for the Pavilion at the pier head to be completed by 7th January, 1900. The act also allowed the completed length to be opened and tolls collected as soon as it had been passed by the Borough Engineer. If the Pavilion was not completed by 7th January, 1900 the portion if opened in the meantime, to be closed. The Act also stated "that the Company shall be responsible for all damage which may be in any way occasioned in consequence of the Chain Pier being allowed to remain standing whether arising from the want of proper repair thereof".

On Sunday 9th October, 1896, the Borough Engineer of Brighton ordered the Chain Pier to be closed, after examining the structure and finding the pier head 6'9" out of the perpendicular, a storm having damaged it and also the Company's works. On the night of the 4th December, 1896, a violent storm washed away the Old Chain Pier, did considerable damage to the new pier, and debris from the Chain Pier was washed along the beach severing part of the West Pier from the shore. In January, 1897, a winding-up order in the High Court was obtained for the liquidation of the Company, but proceedings were stayed by an order dated 2nd February, 1898, on condition that the debts and claims against the Company were discharged, which condition was complied with and the construction of the works continued. This was due to intervention by Sir John Howard, the benefactor of a Convalescent Home at Kemptown and a wing of the Royal Sussex County Hospital. On Saturday, the 20th May, 1899 the pier was opened to the public, its deck was clear from side to side except for

the triple arches whose delicate tracery was outlined with electric lights, one of the first structures ever to be outlined by electricity. In the same year, the first pile was driven for the pier head. This extension was completed and the theatre opened on Wednesday, the 3rd April, 1901. The Sacred Harmonic Society (now the Brighton Harmonic Society) with Mr. George Foreman conducting the Pavilion Orchestra, gave the first performance before an invited audience and tea was served afterwards to 1 500 guests.

Up to that time the cost of the Pier was £137 000, and very little more was done until 1906, when the windscreen, which runs down the centre of the deck, was erected. In 1911 several improvements were made. The Bandstand and Winter Garden (now the Palace of Fun) were completed, the theatre was remodelled, the circle and boxes were added and the stage enlarged making it at that time comparable with the average provincial theatre, with a seating capacity of 1 300. A large glass fronted structure over the theatre entrance, now the Penny Slot museum, was added. The latter was one of the first Film Studios in the country. Difficulties over its position prevented the development of this scheme and after slight alterations, the room was converted into a licenced cafe, with a wonderful panoramic view of Brighton.

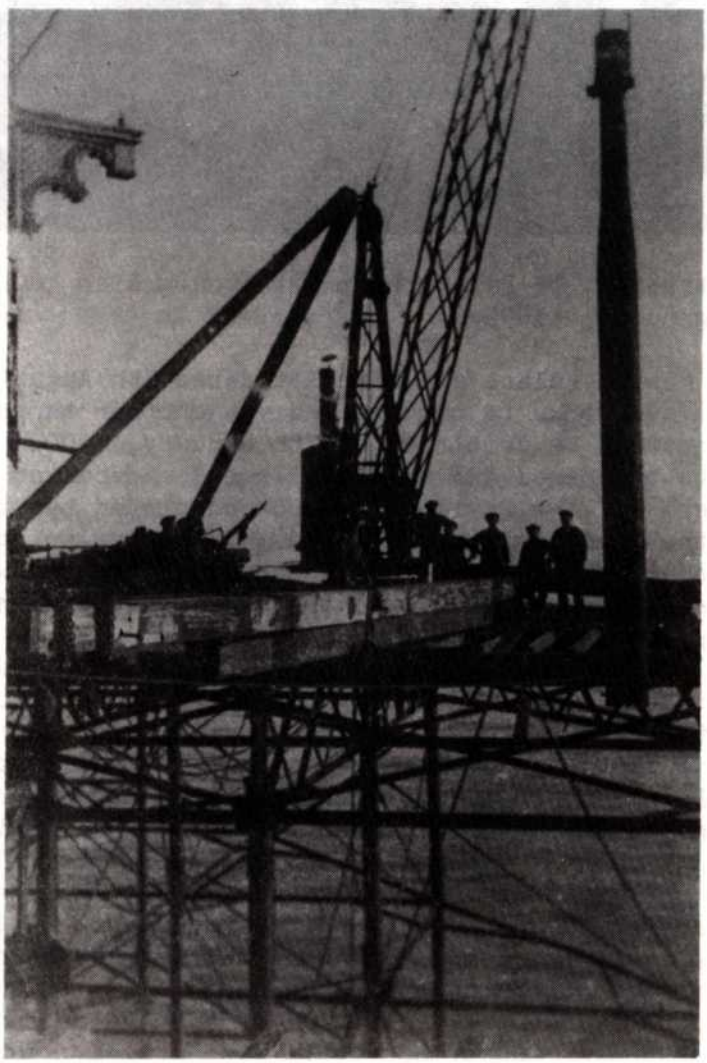


Figure 2. Construction of Pier Head. c1900.

During the period 1914-18, the military authorities took nominal charge of the Pier Structure and numerous precautionary measures were taken. A look-out was posted at the Pier Head, sentries patrolled the deck at night, sandbags were placed along the rails and mines were wired in readiness to demolish sections of the Pier in the event of invasion.

When the seafront promenade was widened in 1930, the Pier entrance had to be set back about 40 feet and it was then that the present canopy and clock tower were erected. The original Toll Houses were preserved for sentimental reasons. In 1934, Mr. Oliver Dalton the Managing Director of the Pier arranged for the original "fish-scale" roofed Toll Houses of the Old Chain Pier to be placed at the north end of the Palace of Fun Building. The Dodgem Car track was build in 1935 as an extension over the landing stage and in 1937-38 the East Pavilion was erected. In May 1940 the Army took possession and a centre portion of the Pier was immediately blown up. German dive bombers made several attempts to destroy the pier but only near misses were registered. Early in 1946 the pier was handed back and after strenuous work it was re-opened to the public on the 6th June, 1946.

Figure 3. Shortening of Palace Pier approach due to road widening. c1934.

The Palace Pier, which is a third of a mile in length, is supported on 368 Cast Iron Screwpiles, with lattice girders, each 50 feet and 10 feet alternately and running longitudinally, in three rows, 18 feet apart. Fixed to the top of the lattice girders, are 8" x 4" rolled steel joists, each 45 feet long and spaced at

5 feet intervals. On the R.S.Js are laid 3" x 6" wooden joists, at 2 foot intervals, overlaid by 2" x 5" wooden deck with $\frac{1}{2}$" gaps. Keruing is the timber most commonly used these days, but Kapur is better if available. A promenade of 22 feet is maintained for the whole length of the pier on both sides, the deck being widened when passing buildings. About 100 yards from the entrance is the Palace of Fun, a building 220 feet long and 45 feet wide, with a dome in the centre, 65 feet in diameter and 35 feet high. The next building, now used as a cafeteria, was originally the bandstand and the original supports of the bandstand that stood on the deck are still to be seen in the centre of the building. At the pier head is

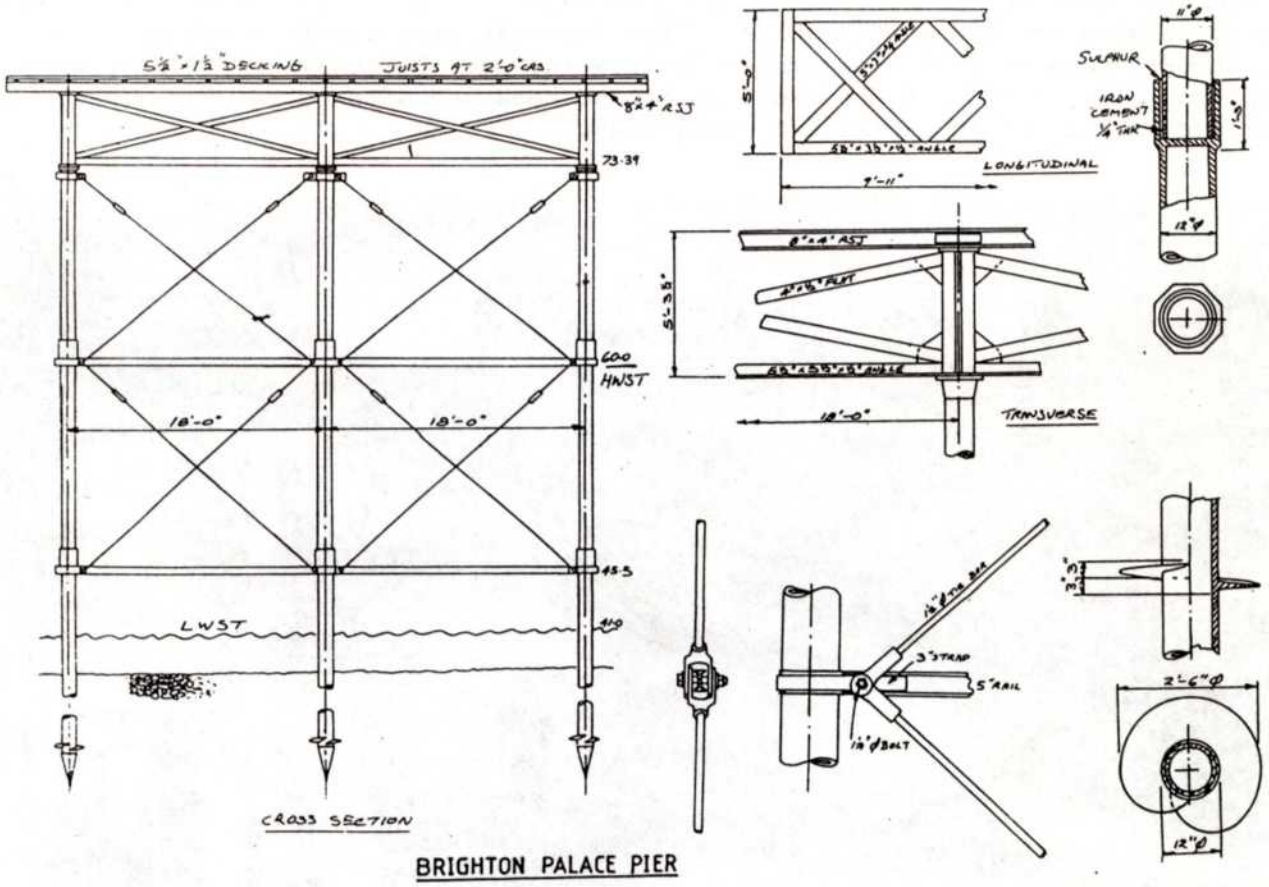


Figure 4. Brighton Palace Pier construction details.

the imposing theatre building, with shops each side at deck level and bars at the northern corners. The piles under the pier head are at 20 foot centres, with 20 foot long lattice girders above. The landing stage had 246 12" x 6" R.S.Js, driven into the sea bed, with concrete sleeves to protect them from the action of the tides carrying stones, etc. prematurely wearing the flanges. After the war, it was found that the majority of these were undermined to a depth of 2 feet, with the cylinders decayed and broken. During 1949 these concrete cylinders were renewed. Pneumatic chisels were used to cut back the old concrete and new concrete bases were formed, 4 feet in diameter and 4 feet high in shuttering of 18 swg. galvanized corrugated sheet, mounted in two halves, on an angle iron frame and bolted round the pile.

By 1970, it was obvious that these troubles were recurring, the 1949 concrete bases were now undermined and the R.S.Js were thin or in some cases non-existent at sea bed level, leaving a large amount of concrete hanging from the end of the R.S.J. pile, with eventually the action of the sea giving them a pendulum effect until they started to break off, one by one. It was decided that as the landing stage was only used by anglers - it had been many years since a boat had been alongside - it should be demolished, as it would have meant rebuilding rather than repairing. It was during the removal of the landing stage, on Friday, 19th October, 1973, during a sudden storm, that a Thames lighter of 50 tons, 80 feet long , that was moored to the landing stage, loading the scrap iron, broke free from its mooring ropes and smashed 27 piles, causing the collapse of the ironwork, decking and buildings above before clearing the pier, turning over and sinking 50 yards away, where it still rests. The repairs were funded completely by the Pier Company as this risk was uninsured. The Local Authority contributed £1 000 when the work was completed. After clearing the steel and other debris from the pile bases, 8" x 8" square steel box sections were clamped to the stumps of the cast iron piles and filled with concrete, the lattice girders being placed on the new piles. The north west corner of the theatre block had sagged some 2 feet, due to the missing piles below. Eight jacks were used, some capable of lifting 25 tons, to jack the building back into place. It was a tricky engineering feat and the amazing thing was that the building went back as well as it did.

Storms (without the help of a 50 ton barge,) show up a pier's weak points, tie rods and pile clips are particularly obvious when they are coming to the end of their life and, of course, the salt spray adds to the corrosion of the steelwork. An important job each autumn, is to clear the pile drain hole of the mussels and other encrustations to empty the rain water out, otherwise in a severe winter the water freezes and is liable to crack the pile, as some of our sleeving testifies.

The most important part of maintenance is to find the money to pay for it. Maintaining a pier is expensive, and never ending. The Palace Pier has averaged about £130 000 in maintenance for the past few years and in 1983, with the decision to replace a larger amount of decking than usual, the figure reached £200 000, and this is mainly on the substructure. There is still much to do on the buildings, but I believe that the most important thing for a pier is to survive the winter storms and so to operate in the coming season.

It is essential that our piers survive, they are an important part of our heritage and we must protect them for future generations. Foreign visitors are fascinated by them, seaside towns would not be the same without a pier; and for people such as myself, after 36 years working on one, it is a way of life.

WHITE AND THOMPSON LIMITED
NORMAN THOMPSON FLIGHT COMPANY LIMITED

John D. Land

At the end of the first decade of the 20th Century electrical engineer Norman A. Thompson, in financial partnership with wealthy Douglas White and aeronautical engineer F.W. Lancaster as designer, founded White and Thompson Limited at Middleton-on-Sea, Sussex.

The Company started by constructing the White and Thompson No. 1, a biplane in 1911. The aircraft had a four castoring wheeled pneumatic tyred under-carriage. The fuselage, of ash framing, was clad with light sheet steel (this was built by the Daimler Car Company, Coventry). A biplane tailplane with elevators was fitted to the rear of the fuselage, a sail type rudder plus elevators were mounted on the nose. The wings were clad in 23 swg aluminium. The two rotary Gnome Rhone engines were mounted side by side, cross belted in case of single engine failure, driving paddle

bladed pusher propellors. Mr. Lancaster's design was for a fast aircraft with high power but due to the excessive weight the machine made only one brief hop when the under-carriage collapsed and the machine turned over. The project was then abandoned.

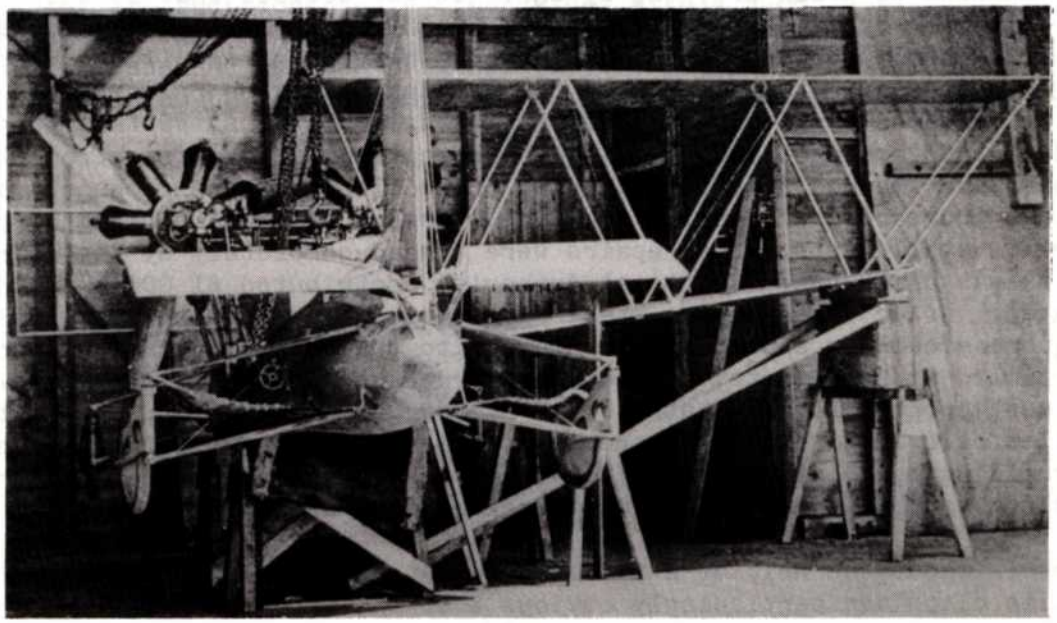


Figure 1. White and Thompson Biplane (1910) No. 1.

During 1913 the W. & T. No. 2 was built, a side by side two seater pusher biplane, with an A.B.C. engine driving a three-bladed propellor through an extension shaft along the fuselage and normal wood and fabric wings and tail-plane. The aircraft was successfully flown by Norman Thompson and several Naval Officers including Lt. J.C. Porte, R.N. who unfortunately turned the machine over on the ground. This project was abandoned due to the growing interest in flying boats.

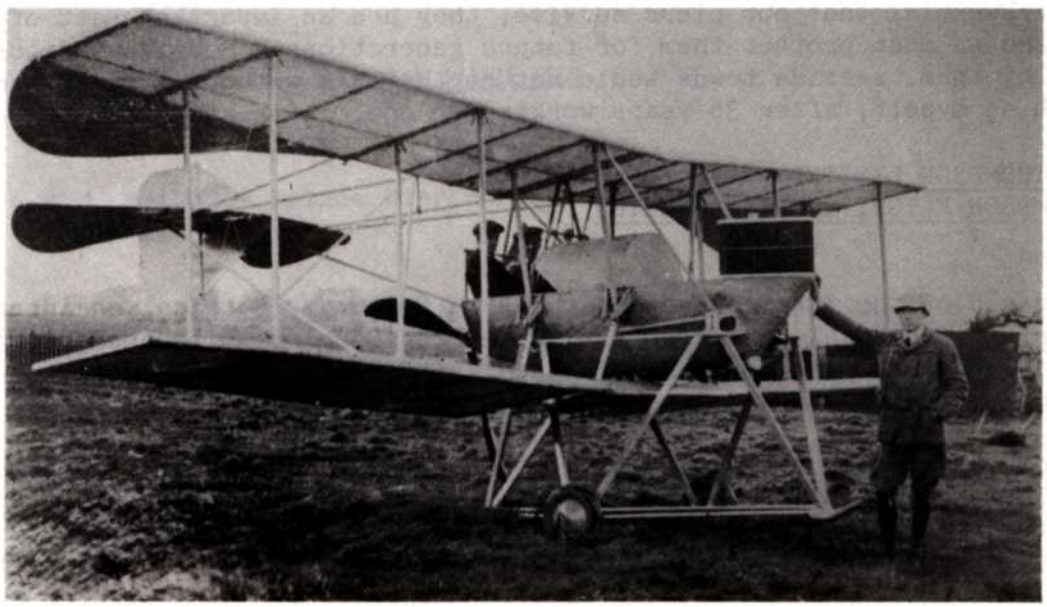


Figure 2. Norman Thompson Biplane (1913) No. 2.

Captain E.C. Bass had obtained the manufacturing rights for the American Curtiss flying boats in Great Britain. White and Thompson were to enter two machines in the Circuit of Great Britain contest of 1914. So from a design similar to the Curtiss evolved the Seaplane No. 1 which was powered by two Curtiss OX vee eight engines driving three-bladed variable pitch propellors. The wooden hull was made at the works of Williams and Company at Littlehampton. The aircraft only flew once and again, another project ceased, this time due to the coming War.

Seaplane No. 2 was to be flown in the Circuit Race by Captain Bass but the Race was cancelled. The seaplane's hull was made by Saunders on the Isle of Wight. This was of CONSUTA construction, an ash and spruce frame with mahogany plywood skin sewn together with copper wire with conventional biplane wings with single fin and rudder tail plane attached to the hull. The single 120 HP Beardmore built Austo-Daimler engine drove a four-bladed wooden propellor. The machine first flew on the 9th August 1914 and was a success, having good flying qualities. The Admiralty purchased the prototype, modifications were made and the type W. & T. No. 3 came into being. Lt. Porte was so impressed and saw a great future in the development of the flying boat that he resigned and went to Curtiss in America. Once the war had started he returned to the Royal Navy and helped to set up the important Flying Boat Station at Felixstowe.

During 1914, Mr. F.P.H. Beadle became the chief designer, his first aircraft being the "Bognor Bloater", a normal single-engined biplane. The fuselage was of CONSUTA construction, two seats in tandem with a Renault 70 HP engine driving a four-bladed propellor. The aircraft was test flown by Eric Gordon England in March 1915. The Admiralty ordered twelve, with two as spares. They were based along the East Coast.

The W. & T. No. 3 flying boats were the next aircraft to be ordered and go into production. With a single Beardmore or Hispano-Suiza motor, at least eight were built, two with dual controls. The prototype was flown by Gordon England and delivered by him with Douglas White to Dover. The aircraft was armed with a single Lewis machine gun.

On October 4th, 1915 the Company changed its name to Norman Thompson Flight Company Limited. Their first project under the new name was the N.T. No. 4 sometimes called the Small America. This was a four-bay biplane with two Hispano-Suiza engines driving pusher propellors. It had an elegantly shaped hull with an enclosed cabin, which was unusual for those days. At an early stage a Davis two-pounder gun was fitted, but never used, the standard armament being a single Lewis gun and bomb racks. Some fifty N.T. No. 4s were built and production was continued until the summer of 1918. They were based from Calshot eastwards up the East Coast to Scapa Flow. It was a good sea boat and liked by the pilots.

During the First World War the Company was contracted to build various other firms' aircraft. Twenty four Short Bros. S38 single-engined biplane float planes were built, also twenty Franco British Aviation single-engine flying boats, the hulls being manufactured in France. These were used as training aircraft. The Company now took up the idea of building a trainer based on the W. & T. No. 3 flying boat. The N.T.2.b., as it was to be numbered, had an enclosed cockpit with dual controls and it handled well both in the air and on the water. The aircraft was powered at various times by many different types of engine, including the Sunbeam Arab driving a four-bladed wooden propellor (one of which can be seen at the Tangmere Battle of Britain Museum). A number of the N.T.2.bs were built by Saunders on the Isle of Wight and Supermarines at Southampton. Some 150 machines were built and at the end of the war some 80 were still on Admiralty charge being based mainly at Calshot, Lee-on-Solent and Felixstowe., When Handley Page absorbed the Norman Thompson Company in 1919 two N.T.2.bs were sold to Peru.

In early 1917 a tandem two-seater biplane flying boat with a single Hispano-Suiza engine was built as a fighter. This was sent to the Isle of Grain Service Test Centre but owing to its poor performance the aircraft was withdrawn.

A devlopment of the N.T.4.a. in 1918 was the N.2.C. which comprised the hull of an F.2.A, one of Lt. Porte's Curtiss design modifications, with the wings and tail unit of an N.T.4.A. Only two were assembled as the end of the war stopped any further aircraft work.

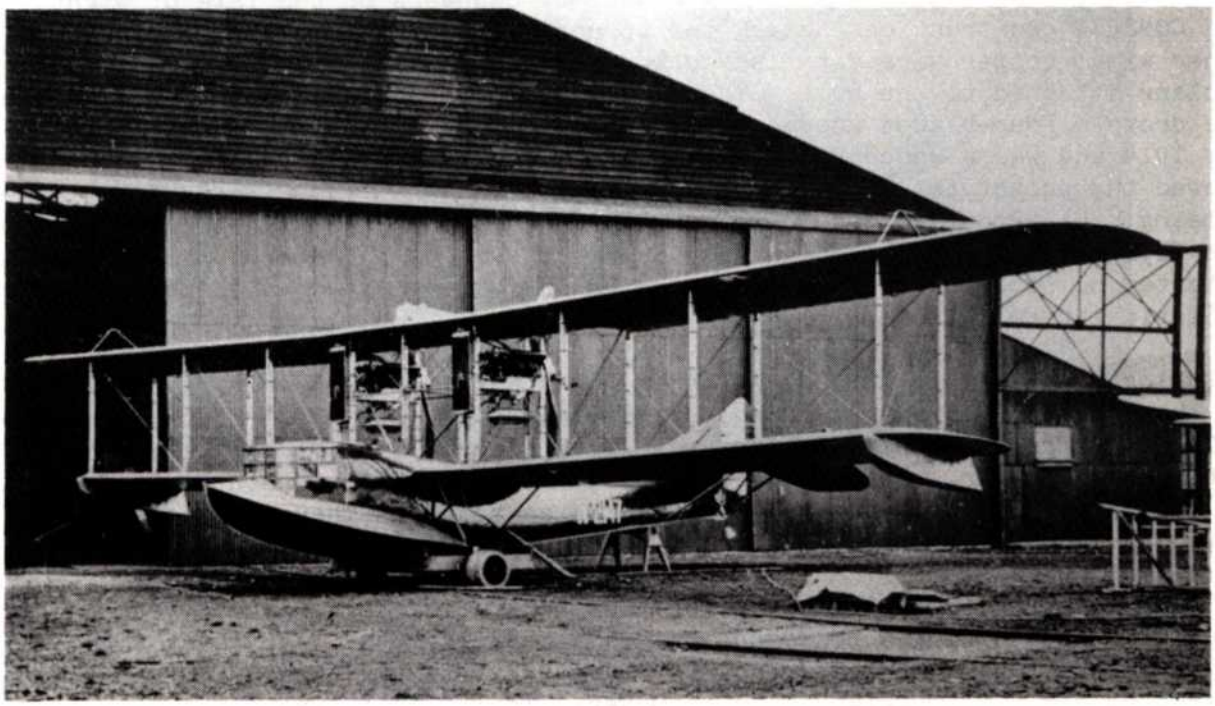


Figure 3. Norman Thompson N.T.4.A. 2 x 200 h.p. Hispano-Suiza engines.

Norman Thompson Flight Company Limited then went into liquidation, the Royal Navy having been their only customer throughout the war. The works were closed in 1919, the assets sold off to Handley Page and the site sold in 1920. The hangers still remain as part of a holiday camp.

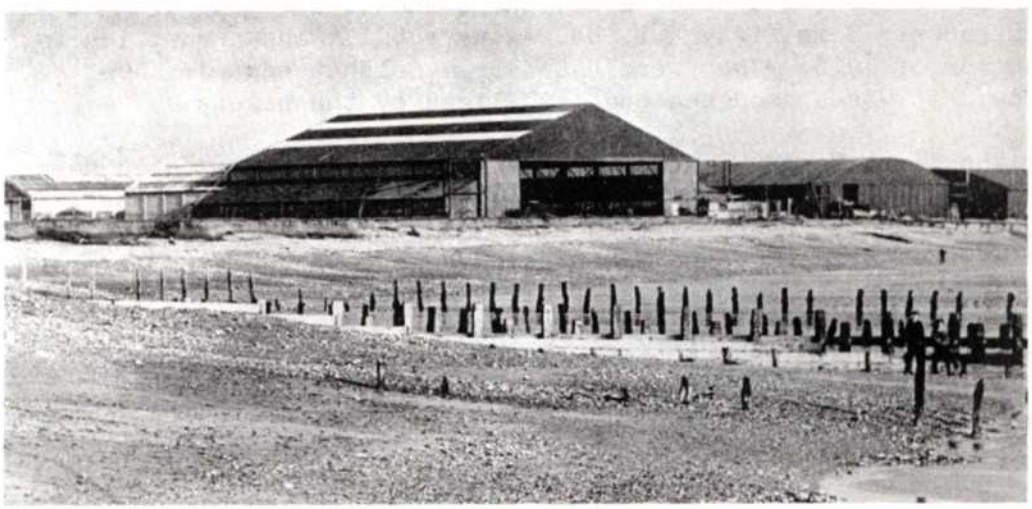


Figure 4. White and Thompson Limited, Middleteon-on-Sea.

Sources

A Study of White and Thompson.	David Ames of Felpham.
British Aviation.	H. Penrose. Cassells. 1967.
British Aircraft, 1809-1919.	P. Lewis. Pitmans. 1962.
Seawings.	E. Jablonski. R. Hale. 1972.
British Military Aircraft Serials, 1911-1979.	B. Robertson. P. Stevens. 1979.
Flying Boats and Seaplanes since 1910.	K. Munson. Blandford. 1971.
British Aeroplanes, 1914-1918.	J.M. Bruce. Putnam. 1957.
British Naval Aircraft since 1912.	O. Thetford. Putnam. 1958.
Photographs.	J. Thompson of Littlehampton. Author's Collection.

A BRIEF HISTORY OF SHOREHAM AIRPORT

Richard Almond

Britain's Oldest Public Licensed Airport.

The history of Shoreham Airport goes back to the very beginning of English flying; it was one of the first half dozen flying fields in the country. Only three of the original still remain, and Shoreham is the only one still operating as a public licensed airport. In May 1910, artist and past pupil of Lancing College, Mr. Harold Piffard, began testing a 40 hp pusher biplane that he had designed and built at his studio in London. Remembering a suitably flat area in the brooks south of the College he hired a small field and hoisted a red flag to

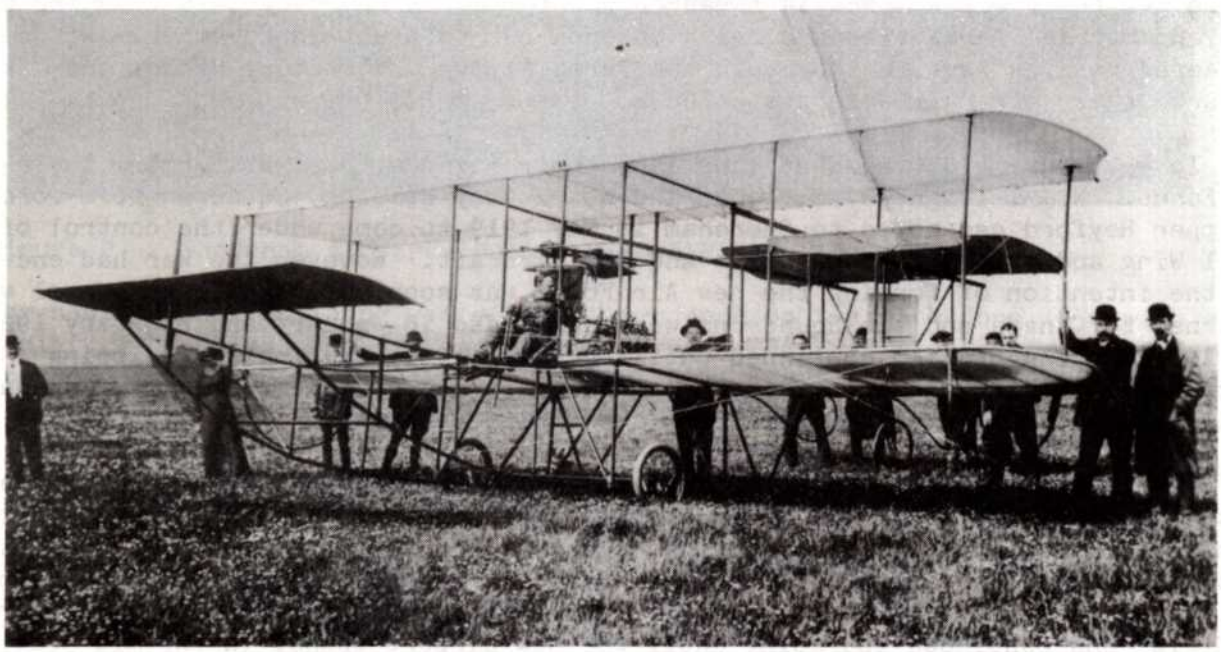


Figure 1. Mr. Harold Piffard on his single seat 40 hp pusher biplane.

warn the local residents whenever tests were to be carried out. The landlord of the nearby 'Sussex Pad' seeing the goings on bet a crate of champagne that the machine would not fly the length of the field, but after delays waiting for suitable weather 'Piff' was successful on the 10th July, so winning the wager and becoming the first to fly a powered aircraft over Sussex.

By early 1911 a recognised aerodrome existed, and a race from Brooklands to Shoreham on the 6th May was won by Gustav Hamel in a Blériot monoplane. In June ten wooden hangars and a grandstand were built for the 'Circuit of Europe' and 'Round Britain' air races, the first truly international events to be held. Shoreham was a refuelling and timed staging post and the field was extended to 500 yards square. A official opening ceremony for the new Brighton (Shoreham) Aerodrome, as it was then known, was held on the 20th June attended by the Mayors of Brighton, Hove and Worthing.

First Cargo Flight

The world's first recorded cargo flight was from Shoreham on the 4th July 1911 when G.E.C. hired Horatio Barber to fly a box of 'Osram' lamps, in his Valkyrie machine, all the way to Hove. At about this time brothers Cecil and Eric Pashley started a flying club; the Brighton (Shoreham) Flying Club became the Sussex Aero Club in 1913, later the Southern Aero Club, the oldest in Britain. Cecil was Manager and Chief Flying Instructor and during a very distinguished career instructing continuously for 55 years he logged 20 000 hours flying and taught more people to fly than any other person.

In October 1912 the Avro Company moved to Shoreham, followed by the Farman Flying School. Other companies soon occupied the row of hangers alongside the railway line and a period of development of often secret revolutionary designs, including floatplanes off the River Adur, continued until the outbreak of War.

The First World War

With the onset of hostilities the aerodrome was requisitioned by the War Office for the Royal Flying Corps and No. 3 Training Squadron was soon busy teaching young men to get their wings. No. 14 Squadron was formed in February 1915 training with Be2c and Maurice Farmans before being shipped out to Egypt in November. After this the aerodrome was home to the South East Area Flying Instructors School and captured enemy aircraft were evaluated.

In November 1918, the Canadians made their first attempt at forming their own Air Force. No. 1 (Fighter) Squadron and No. 2 (Day Bombing) Squadron were formed at Upper Heyford and moved to Shoreham in May 1919 to come under the control of No. 1 Wing and to accept their SE5a and DH9 aircraft. However the War had ended and the intention of forming the new Air Force was soon muted. All personnel were returned to Canada and the Squadrons were disbanded in January and February 1920. A C.A.F. Packing Section continued until December 1921, crating and shipping aircraft, including many captured German aircraft and equipment, back to Canada - a multi-million pound sterling gift from the U.K. Government.

For a while the aerodrome reverted to cattle grazing, but aviation came back to the area in 1925 when F.G. Miles started the Gnat Aero Co. and began operating from a field south of the railway line. In 1926 the company moved to a new site north of the railway and west of the New Salts Farm Road becoming Southern Aircraft Ltd., producing the Southern Martlet 1929-31. The field was known as 'Lees Barn Airfield' and continued operating until the new airport opened in the mid 30s.

The 1930s Expansion

In 1930 the municipal authorities of Brighton, Hove and Worthing formed a joint committee to establish a municipal airport for the three towns, Sir Alan Cobham was engaged to survey possible sites and he chose the original field that had been used until 1921. The site was purchased for £10 000 and a further £31 000 sanctioned for the construction of a new terminal building and hangar. Work commenced November 1934 and was completed late 1935. The Croydon based company, Olley Air Services Ltd., was appointed to manage the airport and a service Croydon-Shoreham-Deauville was started on the 13th July. On the 1st July Southern Railway re-opened 'Bungalow Town Halt' (originally opened in 1910, it had been closed in January 1933 when the line was electrified). The wooden platforms were just to the east of the road tunnel; renamed 'Shoreham Airport' it remained open until 15th July 1940.

Figure 2. Shoreham Airport 'Bungalow Town Halt'.

The new terminal building was officially opened on the 13th June 1936 with an air display. Companies such as Channel Air Ferries, Railway Air Services and Jersey Airways soon started using the airport and in 1937, 1 429 regular service flights and 6 308 passengers were recorded. Destinations served were Bournemouth, Bristol, Cardiff, Liverpool, Manchester, Portsmouth, Ryde, Croydon, Jersey, Le Touquet and Deauville. In December 1938 Channel Air Ferries and Railway Air Services merged to form Great Western and Southern Airlines Ltd.

The expansion of the RAFVR in 1938 saw the formation of No. 16 Elementary and Reserve Flying Training School, together with the Martin School of Air Navigation. Hawker Hart, Hind, Fairey Battle and Avro Anson, together with De Havilland Tiger Moth and Rapide/Dominie graced the Shoreham circuit.

War Again

In September 1939 the airport was again requisitioned, this time by the Air Ministry for the Royal Air Force. Shoreham became the terminal for flights to Britain from France and by the neutral countries of Belgium, Denmark and Holland, up until the invasion of these countries. Croydon, normally used by these airlines, was closed to them for security reasons. Several routes were in operation:- Sabena flew S37 and DC3 from Brussels direct whilst D.D.L. operated Copenhagen-Amsterdam-Shoreham overnight with Focke-Wulfe 200B airliners. K.L.M. flew the Malmo-Copenhagen-Amsterdam-Shoreham service with DC2 and 3s. All these aircraft were painted in neutral colours, orange overall with the registration and nationality in large letters. Because of this conspicuous colour, camouflage netting was placed over each aircraft immediately on arrival.

British Airways and Imperial Airways operated as National Air Communications from September 1939 to June 1940, with services to Jersey and Guernsey using Ensign, Dewoitine D338 and to Tunis and Alexandria with Albatross and Lockheed 14. N.A.C. liaised with Coastal Command reporting ship and submarine sightings. The twice daily flights to Jersey and Guernsey were transferred to Exeter on 18th June 1940 for the evacuation of the Channel Islands. A Fighter Interception Unit that had been formed at Tangmere in April moved to Shoreham on the 18th August to test new night fighter equipment and techniques. From October 422 Flight with Hurricanes were based here before moving on to Cranage in December to become 96 Squadron.

Shoreham's main role throughout the War was Air Sea Rescue. A detachment of 277 Squadron was kept extremely busy over a period of about four years rescuing ditched aircrew out of the English Channel. Initially Lysander and Defiants were used to find the 'customers' then to protect the Walrus amphibian whilst it carried out the rescue. Later Spitfire ASR2 and 5 replaced the Defiant and the Sea Otter joined the Walrus. Their crews earned many DFC and DFMs and the Squadron's final tally was 598 allied and German aircrew rescued and a FW190 and 5 V1 flying bombs shot down.

The Airport, being so close to the coastline, suffered several strafeing and bombing attacks, and hangers were damaged. During 1942 the Canadian Army installed a complete airfield destruct system. 60 ft. and 120 ft. pipe mines were strategically placed on a grid system to be electrically detonated in the event of an invasion. Not all were removed after the War and it was not until the construction of a tarmac runway in 1981 that the remaining few were made safe by Army Bomb Disposal.

Many damaged allied aircraft force-landed, particularly during the USAAF daylight bombing raids in 1944. Perimeter gun emplacements still survive today and under the grass runways there are two 'handrolic' concrete pillboxes. The well known landmark, the silver dome on the north west side, was used internally to train gunners, (enemy aircraft being projected on to the ceiling with a centrally mounted gun automatically recording hits). Nos. 3 and 245 Squadrons equipped with Hurricanes were temporarily based during 'Operation Jubilee', the ill-fated raid on Dieppe in August 1942.

In the Spring of 1944 Shoreham became a satellite for Tangmere and Kenley fighter stations and No. 345 Free French Squadron with Spitfires were operational until D-Day when they moved to Deanland near Lewes to combat the V1s.

Peacetime Activities

After the War the airport was restored to civil use and operated by the Ministry of Civil Aviation from 12th March 1946 until 15th August 1951. Some passenger services were resumed but these generally did not last for long as the rapid growth in aircraft design during the War and the conversion of bombers into civil airliners, meant that most had outgrown the runway lengths available at Shoreham.

To enable the expenses of operating the airport to be offset from manufacturers' profits, it was let on short leases, firstly to F.G. Miles Ltd., from 1952 until 1960. Fred with his younger brother George, brought his highly successful business, that had designed and produced over 7 000 aircraft during the War, to Shoreham to start on new projects. Radar aerials were made and experiments in new plastic glider wings and two new small jet aircraft were carried out. First to fly was the Sparrowjet in 1953 and the M100 Student in 1957. An electronic division made the first aircraft simulators, the basis for the very successful complex machines that now leave the Link-Miles factory at Lancing.

The second tenant to lease the airport in its entirety was the Beagle Aircraft Company in 1960. Prefabricated drawing offices replaced wartime installations and a new hangar opened in 1968 to produce 177 Beagle Pup aircraft with exports worldwide. However the company ran into financial difficulties before production reached the breakeven point. Sadly, orders for the Beagle range of aircraft were quite healthy at the time. The Government, by then the owners of the company, deemed capital requirements too great to make it a commercial success and a receiver was appointed. Unable to find a buyer the company was finally liquidated in February 1970.

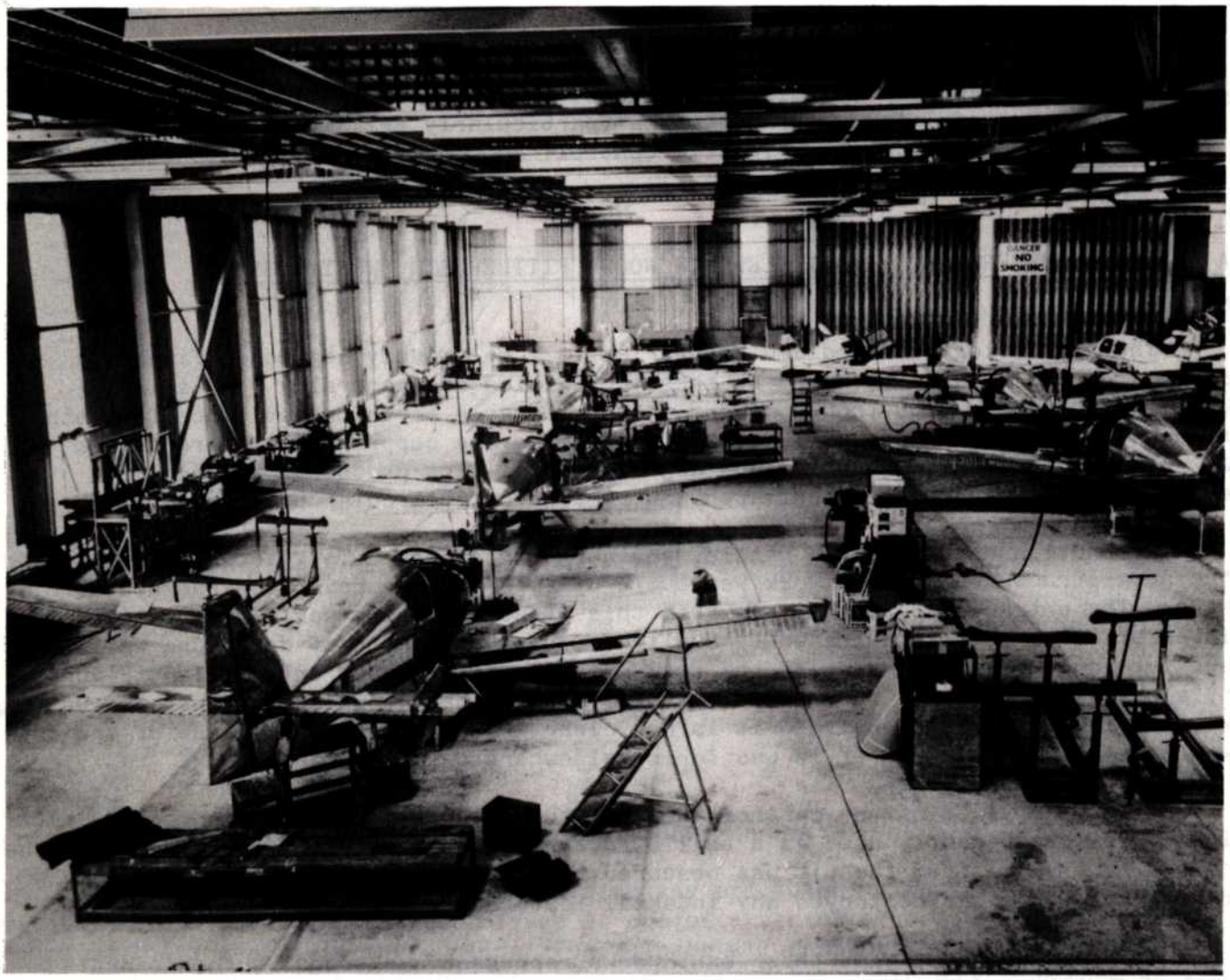


Figure 3. Beagle Pup production line. 1969.

Municipal Control

The tenancy was surrendered to the Joint Airport Committee and on 15th May 1971 Shoreham reverted to its pre-war status as a municipal airport. Since then much has been done to make the airport a popular busy General Aviation facility. After three public enquiries the tarmac runway was approved and built in 1981. This was the largest building project since the terminal building had been opened in 1936, thus guaranteeing all weather operations and ridding Shoreham's long standing reputation of being more like a marina than an airport in winter. Over 100 aircraft and helicopters are now based at the airport and scheduled flights have resumed to Jersey and Le Touquet.

With the end of the recession hopefully in sight, Shoreham is ideally situated, not only geographically, but with good facilities to serve future generations of airborne travellers. Many people are employed by the three flying schools, a College of Aeronautical Engineering and numerous other resident companies, so continuing Shoreham's long tradition first started by Piffard's pioneering achievements 74 years ago.

Note: Richard Almond is compiling a detailed history of the airport and would be most grateful for any photographs (particularly WW2) loaned or given. Please contact:- Air Traffic Control, Shoreham Airport, Telephone 2303.

A CHARCOAL BURNER'S HUT IN FITTLEWORTH WOOD, FITTLEWORTH, WEST SUSSEX

Mark Gardiner

The archaeology of woodland industries is a relatively neglected field of study, for the remains produced by these activities are generally very slight. Within Fittleworth Wood though, there is considerable earthwork evidence for both stone-quarrying and wood-using industries. Among the coppice stools are former saw-pits, some shallow quarries and adjacent spoil-tips produced by stone extraction; there is also the earthwork remains of a circular hut.

The hut is situated on a gentle, south facing slope.[1] To give a level base for the superstructure the earthwork was built up to a greater height on the southern side. The entrance to the hut was from this direction which would have allowed the interior to be best illuminated by sunlight. A short length of dry-stone walling survives on the eastern side of the entrance and is indicated on the plan (Figure 1) by a heavy broken line. A spread of stones around the hut indicates that the walling was originally more extensive. It is not clear if the whole of the base of the hut was made in this way, or if it was formed elsewhere by a low earth bank.

Little survives of the northern half of the hut. After abandonment the interior was apparently used as a shallow quarry with access being provided from the north. The spoil from the pit has obscured the earthworks on this side and the removal of stone has destroyed any internal features of the hut.

It seems probable that these earthworks represent a charcoal burner's hut with a diameter of 7 m and walls 0.8 m thick. This is somewhat larger than other similar huts which have been recorded,[2] nevertheless the hut can be compared with standing huts shown in contemporary photographs. These show a conical superstructure of turf supported by a framework of poles. In a few cases the hut is shown to have footings made of a low dry-stone wall.[3] These huts were built in woodland near to the site of charcoal-burning to provide temporary accommodation because it was necessary for the colliers to stay close to their kiln while it was burning.[4]

Figure 1. Plan of excavated Charcoal Burner's Hut.

It is not possible to date the hut with any precision. The shallow pit made within the hut after it went out of use is one of a series of scoop-like quarries found in the immediately surrounding area. These all respect the position of the coppice stools and young standard oaks now found in Fittleworth Wood and they were probably made earlier this century or in the late nineteenth century. Charcoal burning is recorded in The Mens, a woodland 3 km to the north, which was similarly used for small-scale woodland industries. There is a reference to charcoal burning

there in 1843 and this continued till late in the nineteenth century.[5] It is quite possible that the same colliers may have been working in The Mens and Fittleworth Wood and may have constructed the hut.

The relationships of surviving trees, the earthworks from quarrying and of the hut have been used to suggest a sequence of events and a possible date for the use of the hut. It is probably only through archaeology that evidence for the largely undocumented woodland industries may be gained.

Acknowledgements

I would like to thank the landowner, Sir B. Barttelot for permission to survey this earthwork.

References

1. At TQ 023005.

2. S.H. Warren (1910). Charcoal burners in Epping Forest; their primitive hut and the formation of hut-circles. Essex Naturalist 16, 65 - 73, esp. 69.

3. L. Armstrong (1978). Woodcolliers and charcoal burning. Horsham: Coach Publishing, plate 10.

4. Ibid., 38.

5. R.M. Tittensor (1978). A history of The Mens: a Sussex woodland common. Sussex Archaeological Collections 116, 364.

ICE HOUSES AND THE COMMERCIAL ICE TRADE IN BRIGHTON

R.G. Martin

In Britain the practice of storing ice in specially constructed chambers was started in the 17th century and continued up to the early 20th century. At first ice was collected exclusively from local ponds and lakes and was placed in the private Ice Houses of large estates where, if properly insulated, it would last the year through. These Ice Houses were usually built partly or wholly below ground, typically with a cylindrical pit of about 3 metres in diameter and 6 metres deep with a domed top. An entrance passage, horizontal or with steps leading down was often used for access and occasionally a loading shaft through the top. Materials used were usually brick but other local materials such as clunch, sandstone and flint rubble were also used. An Ice House of a much larger character at Petworth House was described in Sussex Industrial History No. 13, (1983), pp. 15 - 21 by the author. The expressions 'Ice Well' and 'Ice House' are synonymous.

Within the present Borough of Brighton there were several private Ice Houses that are known to date from the 18th or early 19th century, as follows :

Ice House in Chalk Pit at top of North Street (TQ 307044)

The chalk pit in which the Ice House ws situated was first shown on the map surveyed in 1779 by Yeakell and Gardner.[1] The land which had previously been owned by Nathaniel Kemp was bought by L. Weltje, the Prince of Wales's steward, who leased it to the Prince in 1788. The Ice House was presumably built at about this time as in 1789 it was referred to as "new erected building called an Ice House with Tea Room and Summer House over".[2] An extant plan which was prepared when the adjacent

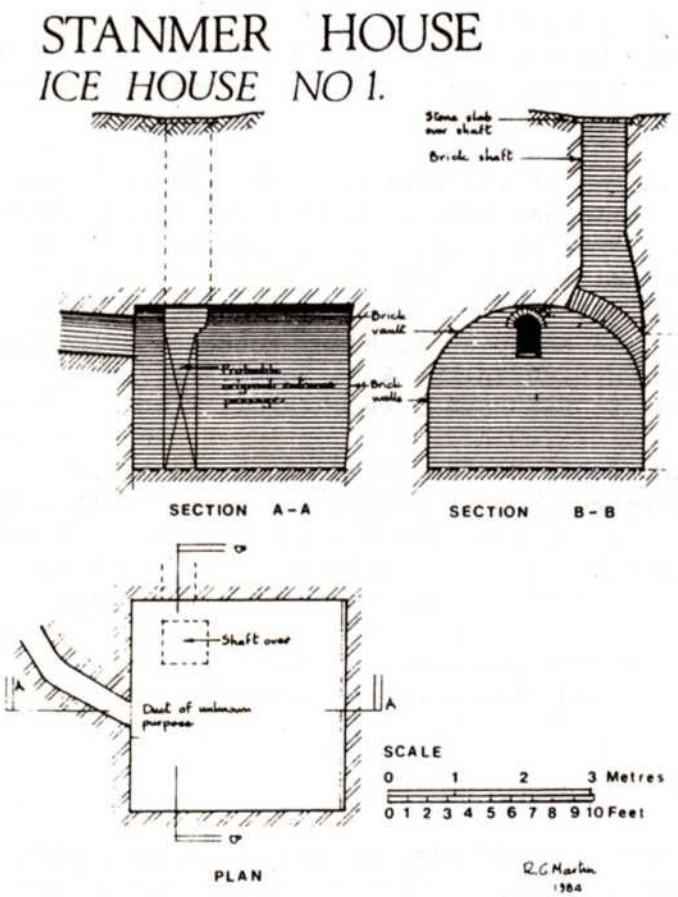


Figure 1. Stanmer House, Ice House No. 1.

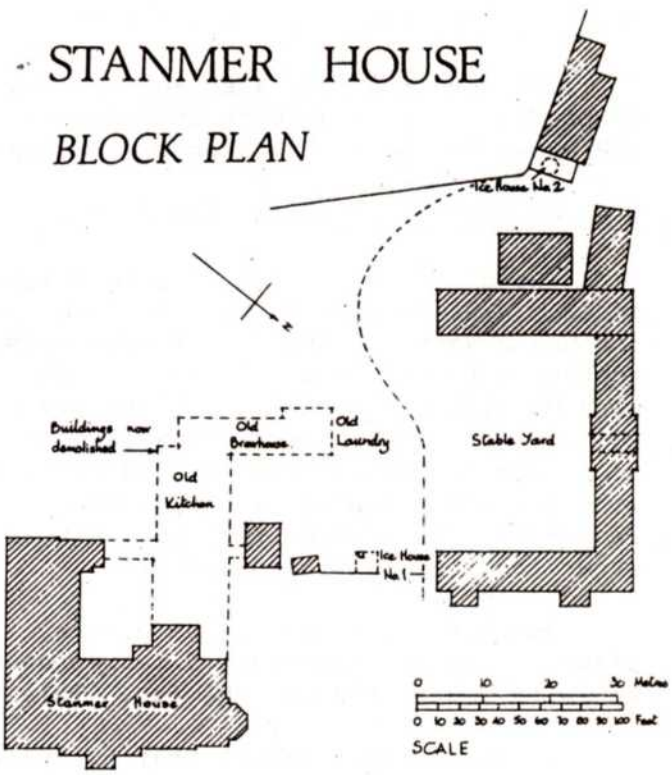


Figure 2. Stanmer House, Block Plan.

land was offered for sale in 1818 shows the precise location of the Ice House.[3] It is known that two Ice Wells were rebuilt by the Prince Regent in 1823 and it is presumed that these were the Ice House noted above and that at the Royal Pavilion described later.

Between 1830 and 1867 there was no access to the Ice House from North Street and the address given in the Directories is Regent Row, a small alley between North Street and Regent Hill. In 1869 and 1874, the site was called 'Pocock's Ice Store', in 1878 'Pocock and Steven's Royal Ice Store' and in 1879 'The Kent and Sussex Ice Store'.[4] In 1874 the Rate Books describe the site as "Ice Well and Stabling", stating the owner as Brighton Council and the occupier as Henry Pocock and in 1884 as James Horton Stephens. Although these entries in the Rate Books are for 96½ North Street they were doubtless referring to the same site.[5]

From 1879 to 1903 the site was known as 96a North Street and was located on the east side of Regent Row. The occupier throughout this period being the 'Kent and Susex Pure Ice Company'. It is probable that offices for the company were built on the North Street frontage in front of the Ice House, the access to the Ice House still being from Regent Row. The site is currently occupied by Messrs. Gamleys.

From 1879 onwards the 'Kent and Sussex Pure Ice Company' had a factory in Portland Road, Portslade,[6] and between 1887 and 1890 also had premises at No. 106[4] North Street.

Royal Pavilion Ice House (TQ 3114 0424)

An Ice House owned by the Prince Regent was situated at the south-west corner of the Royal Pavilion grounds. During excavations in 1956 it was uncovered, several feet below ground, and was described as having a domed brick roof.[7] Its location is shown on the plan of the Royal Pavilion estate by John Nash in 1822.[8] This part of the grounds, previously known as Furner's Gardens, was acquired by the Prince during 1804.[9] Presumably the Ice House was subsequently built by the Prince and that this was one of the two Ice Wells that were rebuilt in 1823.

Castle Tavern Ice House (TQ 312041)

The Prince Regent also acquired another Ice House when he bought a quarter part of the Castle Tavern which included an Ice House.[10] This was probably demolished in 1821 when the Royal Pavilion was reconstructed by John Nash.

Stanmer House Ice Houses (TQ 3349 0948 and TQ 3343 0946)

The only extant Ice House in Brighton is at Stanmer House, shown in Figures 1 and 2. It is a small square brick chamber with a brick barrel vault. Access is through a vertical brick shaft 2.7 metres deep although there are indications of another entrance, now bricked up. This could have led towards the, now demolished, service wing of the house. There are remains of a lead lining to the walls of the chamber also a high level duct leading southwards. It is probable that this Ice House was originally constructed for some other purpose, possibly in connection with the water supply system which was very extensive, otherwise there is no reasonable explanation for the depth of the structure below ground and of the other features mentioned above.

Another Ice House on the estate, is described as circular on plan, 2 metres in diameter and approximately 5 metres deep, with a domed brick roof rendered internally and with access through the top. This has now been back-filled and concreted over.[11]

Estate workers report that both Ice Houses were used until shortly before the First World War and that ice from the estate was used in the house and also carted into Brighton for sale.[11]

The Commercial Ice Trade up to 1854

During the first half of the 19th century the increase in numbers of middle and upper class residents and visitors to the town created a demand for ice and a commercial ice trade developed to cater for this. The sources of supply of this ice are uncertain but there might well have been active trading down the east coast of England from the Norfolk Broads. It is known that ice was being imported into London from Norway by the 1850s.[12] There are no obvious local sources to satisfy such a demand. Old Steine was reputedly marshy until drained in 1792, Queen's Park Lake was not created until the 1880s and apart from several small ponds at Falmer, Rottingdean and in Stanmer Park, the only other local stretches of open water were storage reservoirs. In 1962, when an electricity substation was being erected close to the Islingword Road Reservoir (at TQ 322050) a structure was discovered and from drawings prepared at that time, this appears to have been a large Ice House.[13] Its juxtaposition to the reservoir suggests that ice was taken therefrom, but as the level of the water would have been fluctuating daily, the formation of ice on the surface would have been inhibited.

There were Ice Houses in Brighton during the first half of the nineteenth century at the following locations[5]:

No. 14 Henry Street	(TQ 314043)	1834 - 1836
No. 4 Upper Church Street	(TQ 307045)	1839 - 1844
No. 36 Russell Street	(TQ 306041)	1839 - 1854
No. 42 New Dorset Street	(TQ 306046)	1839 - 1854
No. 12 St. James's Gardens	(TQ 314041)	1834 - 1844
No. 4 Centurion Place	(TQ 307045)	1840 - 1844
No. 3 Centurion Place	(TQ 307045)	1854
No. 11 Powis Grove	(TQ 305047)	1854
No. 16 William Street	(TQ 314043)	1854

The Commercial Ice Trade, 1854 - 1915

During the second half of the 19th century and more particularly after the 1870s, when ice was being imported, there was a proliferation of Ice Merchants in Brighton. It is significant that these were concentrated in the area around St. Nicholas's Church where the chalk substrate is near the surface, the closest point to the centre of the old town that this occurs. Ice merchants were often associated with Fishmongers who had other premises but it seems likely that their Ice Houses were located in this area. Their construction would probably have been cylindrical in shape and entirely underground, the sides of brick, or maybe unlined, with a domed brick top through which would have been the access trap. One was discovered while excavation work was being carried out in the playground of St. Paul's School and was probably the remains of one of those in Centurion Road.[14] It is probable that these town Ice Houses were used for temporary storage of ice pending daily distribution throughout the town.

There are records of Ice Merchants at the following locations:

No. 1 Centurion Road	(TQ 307045)	1865-1870	(Frederick Hayllar - Ice Merchant)
No. 14 Centurion Road	(TQ 307045)	1899	(Larkin & Co., Ice Merchants)
No. 15 Centurion Road	(TQ 307045)	1878,	(Ice Store - George Smithers)
		1887,1892, 1899	(Ice Store - Larkin & Co.)
		1885-1890	(Ice Store - J. Leleu)

No. 17 Centurion Road	(TQ 307045)	1904-1905	(Consumers' Pure Ice & Cold Storage Syndicate, Ltd. - also at Portland Road, Hove)
No. 19 Centurion Road	(TQ 307045)	1907	(Mowatts Ltd., Ice Merchants)
No. 21 Centurion Road	(TQ 307045)	1903 1905 1906	(Samuel Larkin) (The Kent & Sussex Pure Ice Co.) (Provincial Consumers' Ice Supply Ltd.)
No. 16 Henry Street	(TQ 314043)	1869-1892	(Wright's Ice Well)
Holland Road		1910 1915 1921	(United, Carlo, Stevenson & Slater) (Linde, British Refrigeration Co.Ltd.) (Lightfoot Refrigeration Co. Ltd. - Ice Works and Cold Store)
No. 39 Market Street	(TQ 311041)	1892 onwards	(Samuel Larkin - Fishmonger and Ice Merchants)
No. 70 Middle Street	(TQ 309042)	1907-1910	(Mowatts Ltd., Ice Merchants)
No. 42 New Dorset Street[4,5]	(TQ 306046)	1874-1875	(W.S. Mutton - Ice House)
No. 96a North Street	(TQ 307044)	1874/75 1884 1879-1903 1878	(Henry Pocock - Ice Well and Stabling) (James Horton Stephens - ") (The Kent & Sussex Pure Ice Co.) (Pocock & Stephens - The Royal Ice Stores)
No. 106 North Street	(TQ 307044)	1887-1890	(The Kent & Sussex Pure Ice Co.)
No. 10 Powis Grove[5]	(TQ 305046)	1874/75	(W.S. Mutton - Ice Well)
No. 72 Preston Road	(TQ 309056)	1895	(E. Ingarfield - Ice Merchant)
No. 1 Prince Albert Street	(TQ 310040)	1862-1875 1879-1885 1878 1885-1910	(Frederick Hayllar -(Fishmonger and (John Leleu - (Ice Merchant) (George Smithers - Ice Merchant) (Samuel Larkin & Co. - ")
Regent Row	(TQ 307044)	1869-1875 1879	(Pocock's Ice Stores) (The Kent & Sussex Pure Ice Co.)
No. 21a Ship Street	(TQ 309041)	1907-1909	(Christiania Lake Ice Store)
Nos. 12/13 Upper St. James's Street	(TQ 319039)	1887	(Thomas Crosskey - Ice Merchant)
No. 54 Western Road	(TQ 305043)	1862-1895	(Pocock & Stevens - Fishmonger and Ice Merchant)

Importation of Ice

As mentioned above, Ice had been imported from Norway into London from the 1850s. There are records of ice imports into Sussex, at Shoreham from 1873[15] to 1915 and at Newhaven from 1887.[16] It is not known whether either of these dates represents the start of the trade, but it is significant that the number of Ice Merchants in Brighton increases sharply from the 1870s. onward. The tonnages of ice imported into Shoreham are shown in figure 3. The trade effectively ceased during World War 1.[17]

Detailed records of shipments at Shoreham Harbour from January 1901,[18] show that over this period ice was carried in steamers of 250 to 350 tons mainly of Norwegian ownership from Drobak, Christiania (now Oslo), Porsgrund, Brevik and other ports in what is now Oslo Sound. The round trip normally took about

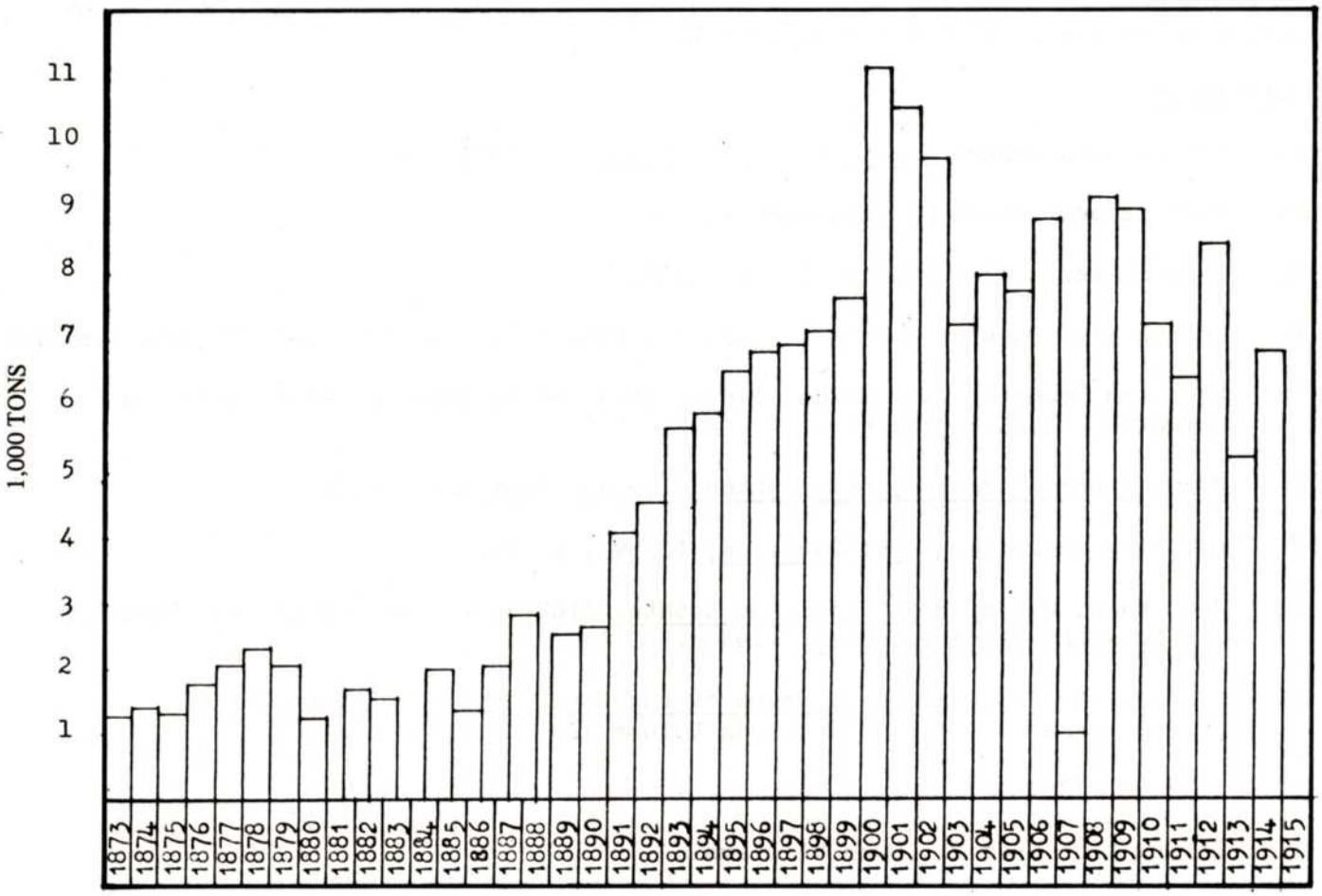


Figure 3. Annual Import of Ice to Shoreham.

2½ to 3 weeks with continuous shipments being made between about February and November. Sometimes return trips were made via north-east England where, presumably a cargo of coal was loaded. Ice was usualy unloaded at Baltic Wharf[19] where there were timber storage sheds, now replaced, and also brick built stores at the edge of Wellington Road which had arched basements under and which still exist. Samuel Larkin & Co. is listed in the directories as having premises at Baltic Wharf between 1889 and 1903 and Mowatt Ltd. in Wellington Road between 1908 and 1915. Both these firms had other premises in the centre of Brighton.[4]

At Newhaven ice was imported in sailing ships. It was stored in timber storage sheds in Meeching Chalk Quarry owned by Messrs. Colgate and Gray.[4,17] Access between the quay and the quarry was by use of the Duke of Sheffield's tramway using horse drawn tipper wagons which were also used for carting chalk for cargo or ballast from the quarry. These sheds were used for ice storage until World War 1, the blocks of ice being kept separated with wooden battens. Unloading from the store was from the upper level using horse and cart.[17]

From 1879 ice has been manufactured locally. The 'Kent and Sussex Pure Ice Company' had a plant along Portland Road, Portslade and advertised "Pure Ice Made from Celebrated Goldstone Water, Fresh every Day from the Factory - Private Families can be Supplied Daily".[6]

The quantity of ice used during this period was quite substantial. The total imported through Shoreham in the peak year of 1901 was 11 115 tons.[19] Allowing for ice being also imported through Newhaven, and for some being manufactured, this represents the contents of more than 400 Ice Houses of average size, although how many times each one would have been refilled during the season is purely speculation.

It would seem that, in the late 19th century many people in Brighton regarded the provision of ice as a normal requirement.

References

1. Yeakell and Gardner, Map of Brightelmstone, (1779)

2. East Sussex Record Office, SAS BRI 115.

3. East Sussex Record Office, SAS BRI 124.

4. Folthorp's, Page's, Pike's and Kelly's Directories of Brighton and Hove District.

5. Brighton Council, Rate Books, (1834, 1839, 1840, 1854, 1874/75, 1884) in Brighton Reference Library.

6. Page, Street Directory of Brighton Hove and District, (1879)

7. Clifford Musgrave, Royal Pavilion, (1959), p. 19.

8. John Nash, Map of Royal Pavilion Estate, (1822), reproduced in John Dinkel, The Royal Pavilion Brighton, (1983), p. 75.

9. S. Farrant, Physical Development of the Royal Pavilion Estate, (1982), Sussex Archaeological Collections Volume 120, pp. 177, 178.

10. Ibid, p. 180.

11. Information from Mr. Owen Williams.

12. Prof. Tore Ouren, The Norwegian Ice Trade, National Maritime Museum, Maritime Monographs and Reports No. 49 - 1981, p. 31.

13. The Waterwheel, house magazine of Brighton Waterworks Department (now Southern Water Authority), Dec. 1962, pp. 4 and 5 and Feb. 1963, p. 6 also drawing prepared by Engineering Department, in author's possession.

14. Information from Mr. Richard Braybon.

15. Public Records Office, PRO Class Customs 23, (1873 - 1885).

16. Newhaven Port, Trade Returns, documents no longer available, information from J.H. Farrant.

17. Information from Mr. Peter Bailey and Mr. Robert Holden at Newhaven Harbour Museum.

18. Shoreham Port Authority, Trade Returns made by Shoreham Harbour Trustees (1880 - 1914).

19. Shoreham Port Authority, Arrivals and Departures Ledger, (1901 - 1915).

MINING AND SUBTERRANEAN QUARRYING IN SUSSEX

Paul W. Sowan.

Sussex has some of the country's oldest underground mineral workings, for flint, as well as two of the south-eastern counties' remaining active mines - those for gypsum at Brightling and Mountfield. There have been others whose existence is witnessed by scattered mentions in the literature, and it seems more than likely there are others again, waiting to be found. In the last few years elsewhere in the south-eastern counties unrecorded mines (some worked as recently as earlier this century) have been discovered in Berkshire, Hertfordshire, Kent, Middlesex and Surrey.

The purpose of this article is to summarise what little is on record concerning subterranean mineral workings in Sussex, in the hope that this will encourage others to take up fieldwork and detailed research. A wide range of kinds of source material is cited here to illustrate some of the seams of information which may be worked. These seams are by no means all exhausted. Obscure, national, and specialised sources have been consulated, which local workers can supplement from better-known traditional local sources. Some guidance, and some interesting comparisons, may be derived from consideration of adjoining Kent and Surrey, too, as these counties' mines (in broadly comparable rocks) are better documented than those in Sussex. National grid references, where given, can usually give only a very approximate indication of location for as-yet unidentified sites.

Mines, Pits and Quarries

The traditional works for mineral workings, irrespective of their being openworks or underground, reflected the nature of their products. Pettus (1670)[1] explained it well:

> A mine is defined to be a certain Foramen, Hole, Hollow place, or Passage digged in the Earth, from whence Metals or Minerals are by labour raised: for if common Stones only are found (as Marble, Touchstone, Freestone, &c) we call them quarries, and not mines. And where Clays are digged ... we call them pits.

In short, a mine was a place, openwork or not, where metals or especially valuable minerals were found, pits yielded disaggregated low-value materials such as chalk, sand, or clay; and quarries were for squared stone for building. Usually, primary sources before about 1860 or even later fail to qualify any of these workings as open to the sky or subterranean. Only coal and ironstone mines were specifically registered, regulated, and subject to inspection under earlier nineteenth century legislation. All other subterranean workings (for whatever products, even chalk or clay) became, legally, 'metalliferous mines' under the Metalliferous Mines Regulation Act, 1872, and subject to registration and inspection. The older terminology was further blurred by the Quarries Act, 1894, which applied to all openworks (whatever the mineral raised) 20 feet or more deep.

Flint Mines

Although the Upper Chalk (the part of that formation containing most flint) outcrops in numerous counties in lowland England, it is remarkable that in only a few of them was flint mining important in Prehistoric times. Recent research[2] based on trace-element analysis suggests that:

> Most axes from East Anglia and Wessex, regions with plentiful local flint, had been imported from the mines of the South Downs in Sussex ... operating during the earlier part of the Neolithic, prior to 3000 BC in radiocarbon years.

And although adjoining counties have no shortage of Upper Chalk or of flints, in most cases they have no recognised flint mines approaching in importance those of Sussex. In fact it is Sussex flint mines that appear to have supplied a great preponderance of Britain's flint axes. The products of other well-known flint mines such as Grimes' Graves seem to have been artefacts other than axes. The Sussex mines have attraced much serious study and have an extensive literature in the publications of classical archaeology. This is, of course, more than justified by their antiquity; by the fact that their products are recognisable after manufacture and distributuin; and, therefore, by the light their study can throw on ancient communications and trade. Similar considerations, though for later periods, apply to mined building stone. As the flint mines have been relatively thoroughly studied, and lie so far outside the generally accepted province of industrial archaeology, they are not considered further in this paper. A useful summary of what is known of European flint-mining in general, including data and references for Sussex, has recently been published.[3]

Underground Quarries

As noted above, primary sources tend not to specify the open or subterranean nature of quarries until late last century. Many a field historian is, I imagine, puzzled by documentary references to quarries, or to 'quarry' place - and field-names, when no open pits, or even filled ones, are detectable. The words 'quarry field', virtually mutually exclusive in the case of openworks, are not so when the quarry is subterranean. One of the several good reasons for working underground was the consequent preservation of the usefulness and value of the surface land; another was the existence of sounder, unweathered, rock below the frost-shattered or cambered zone at outcrop; and a third the avoidance of a requirement to shift worthless overburden. In the present study, records for pre-1872 quarries are considered. In most cases, fieldwork will be required to determine which were openworks and which subterranean. It is not improbable that there are more subterranean cavities in Sussex than is generally suspected.

Domesday Book (1086) mentions few extractive industries. Of a total of eight workings for stone, or stones, of various kinds mentioned in the survey, Sussex has half of them! There were three building-stone quarries (quadraria), at Grittenham (SZ 9421), Iping (SZ 8523), and Stedham (SZ 8622). The only other such quarry listed was that at Taynton (Oxfordshire). Two 'pits' (fossae) for stone, or perhaps stones, are listed for Limpsfield in Surrey. And of the two millstone quarries (molaria) one was at Bignor (SZ 9814) in Sussex, the other at Whatton (Nottinghamshire).[4]

Martin (1827) mentions a 'compact building - stone, which has long been quarried at Pulborough' and (1828)[6] reported that:

> ... the lower beds of sand become more compact, and are quarried at Pulborough and Petworth, for excellent building-stone ... the stone is a sandstone from the lower part of the Hythe Beds, and has been extensively worked at that town for several years, and was used by the Romans ... Pulborough Church was built of this stone in the 16th century ... Arundel Castle (the keep) and Town Hall, as also the piers at Littlehampton ...

Hunt's (1860)[7] pioneer list of 'quarries' in operation in 1858 indicates 45 workings in Sussex (in addition to clay pits and a sand working at Hastings) although only the following, from the accompanying notes, were clearly worked for building-stone:

> Blackbrook Wood, Clayton - Sussex Marble - 'for buildings and lime' (TQ 3417).
>
> Chilley, Pevensey - Wealden Sandstone - 'impregnated with bitumen employed in the construction of Pevensey Castle'.

Hillstone Pit, Pulborough Bridge Wharf and Station - Sandstone (TQ 0418).

Pitt's Hill, Coultershaw - Sandstone (SZ 9719)

Stammerham, Horsham - Horsham Stone - 'used in many churches'.

Steyning, Shoreham - Chalk - 'The Priory of St. Pancras, near Lewes' (TQ 1711).

Street Green, Lewes - Sussex Marble - 'Buildings in Lewes, &c.' (South Street is at TQ 3918).

St. John's Common, Cuckfield - do. (TQ 3024).

Tilgate Forest, Horsham - Tilgate Stone - 'local buildings only'.

Tillington, Arundel - Whinstone ('the name by which the marl of the Lower Green-sand is distinguished in Western Sussex' - 'local builldings only' (SZ 9521).

Wisborough Green, Horsham - Sussex Marble - 'buildings in Horsham' (TD 0525).

The Hillstone pit at Pulborough was in 1858 owned by Col. George Wyndham, the quarryman being one John James Boxall. Annual production of 400 tons is quoted. The stone cost two and a half pence per foot 'rough'; 4d per foot cube cut; and 4d to 6d per foot run. The Pitt's Hill quarry at Coultershaw was also owned by Wyndham, the quarryman here being James Wakeford. Output was '580 loads of 54 cu. ft.' per annum, and the stone cost '4d per cube foot; load of 54 cube feet small size, 2s 6d'. It had been used for Tillington Church and schools; part of the church at Petworth; and the bridge at Wisborough Green.

It seems possible that the underground galleries at Pulborough known to have been worked latterly as sand mines (q.v.) may have originated as subterranean quarries - the Pulborough sand rock is a particularly friable sandstone.

At any event, there is a clear cluster of ancient and well-attested quarrying sites on the Lower Greensand of western Sussex. Intensive documentary research, and much fieldwork, will be necessary to locate these quarry sites and to determine which, if any, of them were subterranean.

Pulborough and other sandstones provided an acceptable stone for rural settings, and were even capable of being sawn as ashlar or worked as freestone; but for the finest prestige work for ashlar, carvings, and mouldings a finer-grained rock such as Chalk or (in Surrey at least) firestone (calcareous sandstone from the Upper Greensand) was preferable. There is a strong case for suspecting that Sussex may have other underground quarries, perhaps in these formations. They would (as in Surrey[8]) have yielded stone for prestige work. The particular value of the 'firestone', from the Upper Greensand, or of hard chalk ('clunch') from the Lower Chalk, was that these were 'freestones', capable of being cut or carved in any direction without flaking or splitting, and readily worked to a fine surface either for ashlar or for intricate ornamental work or mouldings.

Many Sussex churches from the Conquest onwards contain ashlar or carved work in Caen stone from Lower Normany where, too, the quarries were underground.[9] Transport via the river Orne and thence by sea made Caen stone economically competitive with native stones at such times as Lower Normany was governed by, or at peace with, England. Pelham's[10] study revealed, as might have been expected, that Caen stone was used only within easy reach of the Sussex harbours and navigable rivers. North of the chalk downs, native stone predominates in the older buildings.

Iron Mines

Topley[11] devoted an entire chapter to the Wealden ironwork and mines, which was quoted extensively by Straker (1931). His descriptions portray the mines as simple 'bell-pits', although occasionally interconnected by 'levels' or adits. However. as the last Wealden iron furnace ceased operation in 1828, Topley's was not first-hand information. [Editors note: A definitive date of February 1813 is given in Sussex Industrial Archaeology Society's Newsletter No. 39 July 1983]

Scott[12], clearly accepting the 'bell-pit' view, reported that a survey of 'minepits' at Hartfield (TQ 4735):

> ... has shown extensive exploitation of iron ore over a long period with possible connections with the Roman ironworks at Cansiron. Over 200 'bell pits' have been plotted.

Recent work by members of the Wealden Iron Research Group, however, including the examination of intentionally or accidentally excavated iron mines, has failed to reveal a single convincing bell profile. Rather, vertical-sided pits 3 - 5 metres wide, and around 10 metres deep, seem to have been the rule. Up to five thin layers of ore are found within the depth of each pit.

It is possible that the last mines worked, in the Ashburnham (TQ 6814) area, were more elaborate than simple 'day-pits', as the limestone mines (q.v.) which evidently succeeded them were deeper and of more complex layout. As Cleere and Crossley[13] are expected to provide a definitive account of current knowledge of the Wealden iron industry, this question is not pursued further here.

It remains to describe the first 'modern', and last, Sussex iron mine. When the railway from Tunbridge Wells to Hastings was made through Wadhurst (opened in 1851), several beds of clay-ironstone were exposed (some was thrown out in the making of the Wadhurst tunnel) which were subsequently worked as ore at Snape Wood (TQ 6230). Topley (op. cit.) reported Le Neve Foster's notes on the short-lived Snape mines of 1857 - 58:

> The mine was commenced in August 1857 and abandoned in September 1858; the ore was sent into Staffordshire. The iron-stone was worked on both sides of the railway, just west of the 53rd milestone, by levels and cross-cuts. On the north side of the railway only one bed was worked, this was 1 foot 9 in. thick, underlain by a hard sandstone. The roof is sometimes bad and required timbering. On the south side of the railway two beds were worked, only one of which could be examined, as the level contained much water; this bed was two feet thick. In this level the ground was softer and required more timber. The beds of ironstone were very irregular, but were found to be better on the south side than on the north side; in both cases, however, the beds died out suddenly and re-appeared at intervals. Several shafts have been sunk from the higher ground. The ore, a clay-ironstone, was sometimes calcined on the spot. A great deal of raw ore still lies by the side of the railway.

Straker[14] published a photograph of the Snape mine (TQ 633302), and Pearman[15] reports that the two entrances:

> ... were filled in to make a road and the remaining post-war shaft filled after two Boy Scouts were temporarily stuck down it. ... The 'Miners' Arms' is now a private house.

Coal Trials

We turn to Topley again for the most comprehensive record of the several unsuccessful investigations for coal in Sussex:

At various times there have been reports of the existence of coal in Sussex, and some attempts have been made to sink to coal seams which were supposed to lie beneath the surface ... There is a general surface resemblance of the Weald to some coalfields, which has seriously misled many persons in former days ... The discovery, in 1801, of a bed [of lignite] somewhat thicker than usual, gave rise to much discussion. This was found (in Ashdown Sand) in the bed of a brook dividing the parishes of Heathfield (TQ 5920) and Waldron, and from it was obtained "a block of jet black and pure coal of the Kendal (Cannel) species, nearly resembling the size of a stout man ... A blacksmith whose shop was at hand, took away enough of the uncovered beds to suffice him for a fortnight, and he declared that he never worked more pleasantly or with a better fire ..."

During the years 1804 - 9 a shaft was sunk at Bexhill (TQ 7407), at a great cost, in hopes of finding coal. Some seams of lignite were passed through, reported to vary in thickness from 2 feet 3 in., to 4 feet 6 in.; the thickest seam is said to be of bad quality ... These seams are thicker than any known to occur at the surface; and, supposing the section to be reliable, it is very remarkable that the shaft should happen to be sunk at a spot where these beds, usually thin and very inconstant, had attained their greatest known thickness. It is. however, very doubtful if these beds really were found, or there would surely have been some more serious attempt to work them. Lower speaks of sanguine adventurers being induced to sink a shaft here, and he adds, "adventurers of another kind encouraged the scheme and fictitious specimens of coal were brought to the surface".

A note in the Monthly Magazine[16] reported that :

The success which attended the research for coal at Bexhill, has stimulated others to similar pursuits, in situations equally promising. At Rotherfield (TQ 5529) several men are actively employed in boring, and at Maresfield some good specimens have been obtained.

Townsend,[17] 'speaking of fruitless searches for coal', said he understood that 'a similar trial, with similar success, has been made near Horsham'.

Limestone and Sandstone Mines

All the evidence, or lack of it, suggests that the Wealden iron furnaces generated no requirement for limestone to assist smelting. The ore contained iron carbonate and often sufficient calcareous matter, as well, to be self-fluxing. There was no need for independent limestone workings. The Wealden iron industry was in decline in the 18th century, and the last furnace, at Ashburnham (TQ 6816), went out of use in 1828. It sppears that, in that district at least, limestone mining (perhaps using the same methods, workforce, and skills) supplanted iron-ore mining during the later 18th and early 19th centuries. These limestone mines yielded stone for lime-burning, and evidently also for random rubble walling. Young[18] informs us that:

Besides the lime burnt from chalk, another great supply from limestone is drawn from the bowels of the earth, in the Weald.

Of this, the Earl of Ashburnham is almost the sole proprietor, and the greatest lime-burner in all the kingdom; the spray-faggot of all his extensive woods being cut down as fuel for his kilns. These lime-works are situated in a valley surrounded by woods; ... Orchard-wood, Dallington-forest (TQ 6420), &c. The shaft by which we descended is four feet by five, boarded, with ladders for the men to go and return from their work, which is 80 feet deep, more or less; through this the stone is drawn up in barrels, of 5 cwt. to each, one descending while the other ascends.

Young reports, further that the kilns were worked fron April to November, and cites monthly production figures totalling 121 000 bushels for those months during 1792.

Hunt's[7] 1858 list of 'quarries' (sensu lato) contains the following limestone workings, some of which were assuredly mines:

Archer's Wood, Battle - Sussex Limestone 'burnt for lime' (? TQ 7418).

Ashdown, Pippingford - do. do.

Blackbrook Wood, Clayton - Sussex Marble 'for buildings and lime' (? TQ 3417).

By the time Topley (op. cit.) was compiling his memoir limestone mining had largely ceased, but he was able to draw on notes made by Charles Gould whilst that Survey officer was examining the Battle area from 1858 onwards. Gould, besides inspecting relics of the mines, was able to interview 'intelligent men who had actually worked in the pits, and are no doubt reliable.' From such sources we gather that, at Limekiln Wood (TQ 7219):

> ... The bell pits, where of any depth, require five men to sink them. Two remaining at the windlass, while the others work below. A circular shaft, 4 feet in diameter, is sunk for 20 feet. The quarrymen then commence to bell it out, increasing the diameter with the depth, so that eventually the base of a pit, 50 or 55 feet deep, is as much as 20 feet across. No timbering is necessary, unless, as is sometimes the case, the quarrymen proceed to drive out horizontal galleries from the base of the pit.
>
> The amount of water in these pits is rarely great, and pumps were seldom erected; but "pinnocks" or square timber troughs, 8 inches square, were laid down from one pit to another, and so continued to lower ground.

Estimates of the cost of the lime 'furnished by a Quarryman at Limekiln Wood' included royalty to the landowner of two pounds two shillings per kiln; 'payment to quarryman for extracting the stone and burning it' five pounds ten shillings; 'cost of team to carry the stone to the kiln, &c.' ... one pound ten shillings; and 'cost of wood for fuel; about 2 000 faggots, at 3s. 6d. to 4s. per hundred' from four to five pounds.

A kiln of a total capacity of about 640 bushels cost some fourteen pounds. Lime, if purchased 'at the kiln from the lime-burner, instead of the whole kiln having been contracted for' cost 6d. per bushel if burned from "Grays" limestone, or 7d. if burned from "Blues"; it was 'delivered into Hastings at 2d. per bushel more.' The Blue limestone, it was noted, 'makes by far the best lime for building purposes, but the Grays are by many considered equal to the Blues for agriculture'.

At Archer Wood (TQ 7418) (Gould's notes continue):

> ... The quantity of Greys ... was but small, and in consequence of their being near the surface they were extracted by bell pits in the ordinary manner.
>
> With respect to the Blue limestone, however, the miners proceeded in the following manner:-
>
> The general dip of the strata having been ascertained to be towards a point a little west of south, they commenced by sinking a main pumping shaft, upon the north side of the valley formed by the small stream which traverses the wood; and at a depth of about 60 feet two levels were driven out to the right and left respectively, at a slight angle to the strike of the beds. These, which

were called the wet levels, constituted the southern boundary of the workings, and served to drain the whole of the excavations subsequently made. Two pumps were mounted in the main shaft, and were driven by the power derived from an overshot wheel.

Although Gould, as reported by Topley, had found the Ashburnham limestone mines out of use by the 1850s, it appears that some work was recommenced at or about the time of the Sub-Wealden boring at Netherfield (TQ 7118) (1872-75) and the first development of the Sub-Wealden Gypsum mine at Mountfield (TQ 7320).

Sussex, having been transferred to the North Wales & Isle of Man (&c) mining inspection district by the 1890s, found itself with a new (and subsequently renowned) Inspector. Clement Le Neve Foster, whose lists of mines, and reports, were models of thoroughness, recorded that although in 1893 and 1894 only the Sub-Wealden Gypsum mine was at work, by 1895 'new mines' were listed at 'Black Brooks' (TQ 6521) (Brightling area); 'Perch Hill' (TQ 6622) (also Brightling); and 'Woodlands' (TQ 7118) (near Netherfield). All three new mines worked 'calciferous sandstone', although to what uses this was applied is not recorded; and all three were active at least until 1900, after which date the records tend to be largely summaries only, containing much less local detail.

The following statistics are recorded:

Black Brooks mine (Brightling)

Owner: Percy Tew, Brightling.

Agent: W.A. Haviland.

Men employed underground 5 (1895)

Men employed above ground 0 (1895)

These particulars remained much the same for the following five years, except that the underground workforce rose to nine in 1897, fell to eight the following year and 1899, and fell back to six in 1900. The 1898 - 1900 figures also include men at Perch Hill.

Perch Hill mine (Brightling)

Owner & agent: as for Black Brooks.

Men employed underground 3 (1895)

Men employed above ground 0 (1895)

These particulars, too, remained unchanged, except that underground workers totalled six in 1896, five again in 1897; the 1898 - 1900 figures are included with those for Black Brooks.

Woodlands mine (Netherfield)

Owner: S. Crowhurst, of Netherfield.

Agent: the same.

Men employed underground 4 (1895)

Men employed above ground 2 (1895)

There was some fluctuation in numbers of men at this working, which may in part have reflected changes in management - C.A. Egerton becoming the owner in 1899, and firstly J. Lulham and R. Stonestreet (of Dallington), and then S. Crowhurst presumably the former owner) taking over as agents.

Men employed underground and above ground at Woodlands were as follows:

	1895	96	97	98	99	00
Underground	4	6	6	6	3	2
Above ground	2	5	0	0	2	1

A Geologists' Association excursion visited the Heathfield and Brightling area on 22 June 1901, and the published report (Dawson, 1901) confirms the active operation of bell pits in that year:

> ... inspected a few of the very numerous "bell-pits" which are sunk in the neighbourhood for the extraction of the Purbeck Limestone. The Director (Charles Dawson) pointed out the mode of working, viz., by making a well three or four feet in diameter, and digging down to about forty feet, when the limestone is reached. The cavity above the stone is then 'belled' on all sides to a diameter varying with the stability of the strata. The stone is then removed, and four small arched lateral chambers are dug at four equi-distant points in the side of the bell-shaped cavity, so as to extract as much stone as the pitman is able without endangering his life. The stone is conveyed to the top by means of a trug-basket and an exceedingly primitive windlass. The relation of the working of these pits in connection with the so-called "dene-holes" has already been discussed (Dawson, 1898a, 1898b).

Thus it appears that limestone mining recommenced, briefly, at the end of the last century, albeit displaying reversion to primitive techniques. To what extent (as with chalk Deneholes) open shafts remain, or partially blocked ones are liable to re-open from time to time, local knowledge may be able to inform us.

Sand Mines

Mining for sand is exceptionally common throughout the south-east.

The Marehill site has already been considered briefly on the grounds that the galleries there may have originated as stone quarries. Twentieth century sources, however, identify them as former sand mines. The site, between Marehill and Broomershill, (variously identified in the literature as at TQ 063193, TQ 065185, or TQ 066189), is located from field investigation at TQ 06451865, on the east side of the minor road, immediately to the south of the farm).

Bristow's[19] description of the 1982 visit is also accompanied by photographs (one of them printed upside down!) of the entrances. The workings are described as follows:

> ... the abandoned sandpit (TQ 065185) at Marehill where the Pulborough Sandrock has been dug for moulding sand. Much of the extraction was formerly from an open pit, but some was also worked in sloping galleries dug parallel to the dip ... At Marehill ... the uppermost 0.3 m (of the Pulborough Sandrock) is iron-cemented and here forms an excellent cap rock to the galleries. Above this the Marehill Clay commences abruptly ... As the sandpit was worked down-dip the overburden of clay increased. Some of the clay was probably used for brickmaking, as formerly at Pulborough (TQ 044187), but it was probably the increasing thickness of overburden which led to the sand being extracted from galleries ... The presence of these galleries is known to few of the local inhabitants and it would require only a little more degradation of the openings for them to be completely blocked and for the galleries to become 'unforeseen geological hazards' in a future development.

The published photographs of the workings do certainly give an impression of a pillar - and - stall mine worked for disaggregated sand, although of course the former cutting of squared blocks of stone for building is more likely to have left recognisable evidence of such work further into the workings than the degraded entrances which are shown.

Pearman's (1984) rough survey of the site indicates some 15 galleries extending up to 22 metres southwards (down dip) in an east - west distance of about 45 metres. The ceiling height is about 1.6 - 1.8 m. and the total length of galleries is at least 190 metres. He reports that:

> Little documentation has so far come to light ... local residents who say that the mine was active in 1918. The contractor's name was Perrier and the sand digger was Tom Nickham. The sand was shipped to the Midlands from Pulborough Station for use as moulding material for iron-castings. In 1946/7 the mine was derelict and was taken over for a spell by Colonel Nichols for mushroom growing. He is said to have abandoned this after a roof fall. ... The eastern series of passages is intact. It slopes into the hill at about 15 degrees and features the remains of the mushroom beds. ... The western series is backfilled and can only be partly entered by crawling. There is scope for extending the survey by digging ...

Hunt[7] records that in 1858 a Mr. C. Sharp was working sand at Hastings - perhaps at the well-known St. Clement's 'Caves' (TQ 8209) site, or at other of the small diggings along the cliff foot. White (1928) confirms that:

> ... at Hastings and St. Leonards, much sand has been extracted by means of underground workings, such as the well-known St. Clement's Caves, which are three acres in extent ...

A rumoured sand, or sandstone, mine south-west of Crowborough (at Poundgate, TQ 491289) proved on investigation to be a series of very shallow tunnels and associated trenches which seem more likely to have been the work of sappers in training than economic mining.

Chalk Mines

Subterranean workings specifically for chalk (as distinct from flint mines) can be classified as quarries for hard chalk worked in squared blocks for building (already considered); or as mines for disaggregated chalk for lime-burning and other uses dependent principally on its chemical properties.

As with flint mines, the distribution of chalk quarries and chalk mines is very uneven throughout the Chalk outcrop. Deneholes, chalk-wells, and small chalk mines are characteristic of waste ground between fields in agricultural districts, where they yielded 'marl' for treating the clayey or acidic soils which often overlie chalk downland. The larger chalk mines seem to be more a feature of late Victorian/early 20th century brickyards, in which chalk was mined from below Tertiary brick clays for admixture in the brickmaking material. Although 'agricultural' mines would be expected especially below the 'Clay-with-Flints' veneer on the South Downs; and 'brickfield' mines under the thin cover of Tertiary clays etc. of the Sussex coastal plain on the then outskirts of developing Victorian towns, I am not as yet aware of any identified sites.

Gypsum Mines

The Sub-Wealden Borehole (1872-76) near Netherfield (TQ 71941930) was intended by its leading promoters as a purely scientific exercise, to commence in the oldest, and stratigraphically lowest, beds outcropping in the Weald and to examine the

strata below them. It may be, though, that some of the lengthy list of financial supporters hoped workable coal would be found. By 1874 a surprisingly thick sequence of Lower Cretaceous and Jurassic beds had been penetrated (to Oxford Clay).

Baxter[20] records that:

> The boring was commenced in August, 1872, by a society of gentlemen, with Professor A.C. Ramsay as chairman, and was carried to a depth of 1 018 feet, when an accident happened to the rods, and it was found impossible to continue the work. A new boring was commenced in February, 1875, and continued to a depth of 1 905 feet, when another accident occurring, the work was abandoned. The cost of the two borings was over £6 000.

Not surprisingly, no coal better than the already familiar thin Lower Cretaceous lignite seams was found. But, at various depths from 130 to 160 feet, thick seams of gypsum were revealed. Further technical details of the borings are given by Topley[21].

Kemp & Lewis [22] reported that:

> Gypsum having been discovered, the next thing was to endeavour to make some practical use of the circumstance. This idea occurred to two different sets of men: one party coming from Leicestershire, hailing Mr. Bosworth as their leader; and the other from Surrey, consisting, for the most part of directors and others, connected with the Dorking Grey Stone Lime Company (operators, since 1865, of the limeworks at Betchworth (Surrey)). The Leicestershire party soon got to work, and sank a shaft, within about 60 yards of the experimental boring, on land belonging to Mr. C.A. Egerton. He gave every facility for the work, and granted a lease to the Leicestershire gentlemen above mentioned, who had been strengthened by the addition of one or two well-known Sussex men. At this juncture the two rival parties met, and, after talking matters over, decided to work jointly, and formed the Sub-Wealden Gypsum Company Limited (incorporated 10 May 1876). The company, at that period, had no thought of manufacturing plaster, as it was understood that there was an abundant market for gypsum in the lump. The shaft, which had then reached the upper seam of gypsum, was 4 miles from the nearest railway-station (Robertsbridge), and 1 mile from the nearest available road. Consequently nothing could be done until a railway siding had been arranged for and put in, and a tram-way had been constructed to commect the siding with the shaft, over a mile away. No building-materials of any importance, or machinery of any weight, could be got to the shaft without the tramway, so there was considerable delay. However, these troubles were overcome at last, and in the year 1876 some gypsum was sent away.

Baxter[20] described the mine in its earliest years:

> [The works] ... were commenced under great difficulties, as the materials and machinery for sinking the shaft had to be carted over a hilly country, and in part over field roads and through plantations, the cost of carriage being in winter as high as one pound per ton ...
>
> The beds of gypsum are fortunately from six to seven feet high. In these seams headings are driven about six or seven feet wide, in which are laid tramways as the work proceeds. The gypsum is drilled ... to a depth of three or four feet, and ... blasting cartridges are inserted ...
>
> After blasting, the stone is placed in small trucks or trollies on the tram-road, and shunted to the mouth of the pit into a cage, whence the trolly and material are raised by steam power ...

The Home Ofice's published Mineral Statistics give production figures as follows for the period 1882 - 1884:

Year	tons gypsum raised	value at mine (pounds)
1882	8,750	9,479
1883	8,720	9,450
1884	7,178	7,537

These figures show Sussex to have been a small but significant producer of gypsum. Total UK production in 1882 was 101 872 tons, worth £58 145. Sussex's one mine produced more gypsum than Durham's, or than Staffordshire's two; about the same as Cumberland's one mine; but far less than the three Derbyshire and nine Nottinghamshire workings.

One William Finlay was manager in the 1880s (he was also very closely connected with the Dorking Greystone Lime Co. Ltd.); and 33 men were employed. It appears that Alfred Garner Hastings, with 11 men, operated a rival mine at Woodlands, although no output figures appear for 1883. In 1885, Hastings' mine is still listed, but with neither workforce nor output.

Sussex was later transferred into the North Wales & Isle of Man mining inspection district and, for the 1890s, it is to the very full reports of Clement Le Neve Foster that we turn. He lists W.J. Kemp as agent for the company in 1893.[23] Foster's statistics for the mine for 1893 - 1900 are:

Year	Men under ground	Men on surface	Tons gypsum raised	Value at mine pounds
1893	15	22	6162	3083
1894	14	26	7627	3677
With an annual increase until :				
1899	28	60	18454	6229
1900	27	60	17768	5730

Whether the slight decline in 1900 is significant is not known, but the Sub-Wealden Gypsum Co. Ltd. was wound up on 26 October 1903, following an extraordinary general meeting on 14 January which had resolved on amalgamation with the Kingston-upon-Soar Gypsum Co. Ltd., a new company, The Gypsum Mines Ltd., being formed. The new company was subsequently replaced by the British Gypsum Co. Ltd., incorporated 19 October 1925 and based in Loughborough, [24] and this company's name was changed by special resolution to British Gypsum Ltd. on 20 September 1963.

The early links between the gypsum mines and the Dorking Greystone Lime Co. Ltd., at Betchworth (Surrey) continued, on a trading level if not in terms of directors in common or formal company structure, for many years. During the company's first 20 years or so there was some inter-change of works locomotives[25]. The Betchworth company, in 1875, acquired the standard gauge locomotive Charles Augustus (named after C.A. Egerton who had leased the land for the mines) secondhand from the Darfield Main Coal Co. of Yorkshire, and in 1878 disposed of it to the Sub-Wealden works. The Betchworth company's standard gauge locomotive Captain Baxter, acquired in 1877 from Fletcher Jennings & Co., of Whitehaven, was named after R.C. Baxter [20] who appears to have had an interest in the mines; and their three-foot two-and-a-quarter-inches gauge William Finlay was named after the original lessee of the

Netherfield mine site, and founder (with others) of the Betchworth company; Finlay was in 1881 in negotiation with the Westgate Common Foundry of Wakefield, on behalf of the Sub-Wealden Company, for the supply of a 'perforated revolving mill'.

As early as 1873 the Betchworth company concluded an agreement with a General Scott, the inventor of 'Scott's selenitic cement', for the development of his patents; the calcium sulphate content implied by the word 'selenitic' presumably was to have come from Sussex. Much of Kemp & Lewis' paper, although published in a mining journal, describes the manufacturing processes for calcining gypsum into various kinds of plaster. The Mountfield mine and the Betchworth limeworks jointly produced proprietary brands of plaster such as 'Sirapite', and a file of corespondence (Dorking Greystone Lime Co. Ltd., 1927 - 55) survives relating to this and other matters. Sirapite (which is still produced in Sussex) derived its name from 'Paris', spelled backwards!

White[26] informs us that:

> ... a new shaft has lately been completed to the S. of the stream, and close to the boreholes ...
>
> The main haulage-way below-ground follows the crest of the Limekiln Wood anticline, and from it branch-roads run down the dip slopes N.W. and S.E.

According to Sweeting[27], production of gypsum proceeded 'almost uninterruptedly' from 1876 onwards, apart from 'a short stoppage during the years 1906 - 07' during which, presumably, the alterations described by Kemp & Lewis were made. We learn from Dean et al. (1984) that in 1945 an 'inclined adit' was driven to replace the previously employed vertical shafts, and a 2-foot gauge track was laid into the mine. The incline was worked by a cable, and battery electric locomotives were used underground. This source reproduces a general mid-1950s view of the Mountfield works, a view of the adit mouth, and a reproduction of a part of the relevant 1930 O.S. 25-inch plan.

Gibson[28] described the Mountfield mine, recording that:

> Until 1947 Mountfield Mine was comparatively small, producing in the order of 2,500 to 3,000 tons of gypsum per week.
>
> In 1946 work was commenced on driving an adit to open up a new area to the east of the existing mine workings that had been proved by surface drilling. This adit is 430 yd. in length to the base of No. 4 Seam and was driven on a gradient of 1:55 ...

In the early 1950s,[29] plans were drawn up for a new mine to be opened near Brightling:

> The precise entrance ... was to be at the bottom of the valley of a small stream known as the Socknersh, in Rounden Wood ... To avoid the expense and disfigurement of setting up new plant at Brightling, it was decided that the gypsum mined there would be processed at the existing plant at Mountfield. There were three possible methods of transporting the ore to Mountfield - light railway, road transport or aerial ropeway. The aerial ropeway was decided upon, and it was opened to use late in 1961. The route taken ... is 3 miles and 500 yards long, and has three angle stations ...
>
> The new mine itself was started in 1961 with the driving of two parallel adits and the stall and pillar method was used ... It is estimated that the new mine can be worked economically for at least 30 years.

More detailed technical descriptions of the development of the new mine at Brightling are given [30]

> ... two mineral seams are worked at this mine (Mountfield) - the No. 1 or top seam and the No. 4 or bottom seam.
>
> Over the years demand for gypsum has increased and earlier this year Mountfield was producing a total of some 12 000 tons of mineral weekly. This was being brought out of the mine by two routes - about 3 000 tons from No. 2 shaft ... and the remainder from the adit ...
>
> With diminishing reserves at Mountfield it was imperative that fresh sources be found and worked and an exploration programme was vigorously pursued, some 100 boreholes being drilled ... These located economic deposits at Brightling, some four miles west of the existing works, and in 1957 permission was sought for the sinking of a new mine here ...

The Company itself has published some historical and practical details concerning the mines and works.

An unexpected development at the Brightling mine was the discovery that methane gas was being released from the No. 1 seam. Two workmen were injured as a result of this catching fire, and this mine has been declared an official 'safety light mine'. This status, which would have to be extended to Mountfield were the two mines connected underground, has discouraged thought of working any gypsum from under the intervening country. But Lake & Holliday [31] have indicated evidence for further gypsum deposits to the west however.

References

1. Pettus J. (1670) Fodinae Regales. London: Thomas Basset, p. 1.

2. Craddock P.T. Cowell Mr. Leese M.N. & Hughes M.J. (1983) The Trace element composition of polished flint axes as an indicator of source. Archaeometry 25(2), 135-63.

3. Shepherd R. (1980) Prehistoric Mining and Allied Industries Academic Press.

4. Darby H.C. and E.M.J. Campbell (1962) The Domesday geography of South-East England. Cambridge U.P.

5. Martin P.I. (1827) on the Geology of the vicinity of Pulborough, Sussex. Proc. Geological Society 1(2), 19 - 20.

6. Martin P.I. (1828) A geological memoir on a part of Western Sussex ... London: John Booth.

7. Hunt R. (1860) Mining Records: Mineral statistics for 1858 part II. Mem. Geological Survey.

8. Bloe J.W. (1930) Building materials in early and Mediaeval London. Royal Commission on Historical Monuments (England): An inventory of the Historical Monuments in London V, xxix - xxxii.

9. Sowan P.W. (1982) The underground stone quarries at Caen, Lower Normandy, France. Bull. Subterranea Britannica 15, 11 - 16 and 16, 3 - 8.

10. Pelham (1931) Studies in the Historical Geography of Mediaeval Sussex. Sussex Archaeological Collections 72, 156 - 84.

11. Topley W. (1875) The Geology of the Weald.
Mem. Geological Survey.

12. Scott A. (1982) Wealden Iron Research Group (report).
Kent Archaeological Review 69, p. 201.

13. Cleere H.F. & D.W. Crossley (in preparation) The Iron Industry in the Weald.

14. Straker E. (1931) Wealden Iron, pp. 101 - 108 reprinted 1969 by David & Charles.

15. Pearman H. (1984) Caves and Tunnels in South-East England 6.
Records Chelsea Speleological Soc. 14.

16. Anon. (1806) in Monthly Magazine 22, p. 95.

17. Townsend J. (1813) on the character of Moses established for veracity as an Historian, recording events from the Creation to the Deluge.
Bath.

18. Young A. (1813) General view of the Agriculture of the County of Sussex.
London: Sherwood, Neely, and Jones (reprinted 1970 by David & Charles),
pp. 10 - 13, 205 - 206, 210 - 211 and 432.

19. Bristow C.R. (1983) Field Meeting: A traverse of the Weald, 6 June 1982.
Proc. Geologists' Assoc. 94(4), 377 - 81.

20. Baxter R.C. (1881) A short description of the Sub-Wealden Gypsum Company's Works.
Reigate: Proc. Holmesdale Nat. Hist. Club 1879 - 80, 19 - 22.

21. Topley W. (1878) The History of the Sub-Wealden Boring, near Battle, Sussex, in Dixon F. & Jones T.R. - qv.

22. Kemp W.C. & G. Alfred Lewis (1907) Gypsum in Sussex (and) Discussion.
Trans. Institution Mining Engineers 33, 449 - 72; 34, 202 - 7.

23. Foster C. Le Neve (1894 - 1901) Reports of H.M. Inspector of Mines for the North Wales and Isle of Man (&c.) District ... 1893 - 1900. Home Office.

24. British Gypsum Co. Ltd. (later British Gypsum Ltd.) Companies Registration Office file CRO 209091 (incorporated 19 October 1925).

25. Townsend J.L. (1980) Townsend Hook and the Railways of the Dorking Greystoke Lime Co. Ltd.
Brockham Railway Museum.

26. White H.J.O. (1928) The geology of the country near Hastings and Dungeness, 91 - 92 and 94.
Mem. Geological Survey.

27. Sweeting G.S. (1951) The Mineral Resources of the Weald.
South-eastern Naturalist and Antiquary 55, 31 - 39.

28. Gibson W.S. (1958) Mountfield Sub-Wealden Gypsum Mine.
Mine & Quarry Engineering 24(8), 332 - 9.

29. Ellis P.B. & Turnock V. (1964) Gypsum Mining in the High Weald
Geography 49(2), 127 - 8.

30. Anon. (1963) The Brightling Development.
Mine & Quarry Engineering 29(9), 378 - 87; and (10), 422 - 9.

31. Lake R.D. & D.W. Holliday (1978) Broadoak Borehole, Sussex.
Institute of Geological Sciences Report 78/3, iv + 38 pp.

-o-o-o-o-o-o-o-o-o-

FIELD PROJECTS

The Sussex Industrial Archaeology Society is currently undertaking, by itself or in conjunction with other bodies, a number of field projects of which the following are the more significant.

Poyntz Bridge Restoration

The whole structure has been grit-blasted and given a protective paint coating. After due consideration the four longitudinal cast-iron beams will have to be replaced by steel I-beams, fortunately the external appearance will not be impaired.

Coultershaw Water Pump

Two new sluice gates have been made and will be fitted for next season. Enough water has been flowing to keep the pump working but performance would be improved by balancing the water-wheel.

Jack and Jill Mills, Clayton

The restoration of the body has been completed. A new fantackle has been made and is now operational.

Ifield Mill

The pitwheel, which was rescued from Hammonds Mill, has now been remounted on the wheel shaft. Work is in hand to re-cog the wheel and to establish foundations for the base bearing of the vertical mainshaft.

Brick Study Group

A survey of the derelict site of Berwick Brickworks was carried out. The layout and dimensions of all the buildings were recorded. Other recording is still in progress. Recording individual brickworks throughout the County is progressing.

Index of Research Articles in Issues 1 - 13

No.			Authors
1.	1970	The Ashburnham Estate Brickworks, 1840-1968	Kim C. Leslie
		The Upper Ouse Navigation, 1790-1868	D.F. Gibbs & J.H. Farrant
2.	1971	Dolphin Motors of Shoreham	M. Worthington Williams
		Lime Kilns in Central Sussex	Margaret Holt
3.	1971/2	Population Change in an East Sussex Town, Lewes, 1660-1800	James P. Huzel
		Kingston Malthouse, 1844-1971	Adrian Barritt
4.	1972	A Field Guide: Brief Notes on Each of 205 Sussex Sites of Industrial Archaeological Interest	John Hoare and John Upton
5.	1972/3	East Sussex Milestones: A Survey	Brian Austen & John Upton
		The West Brighton Estate: A Study in Victorian Urban Expansion	William F. Pickering
		A Bridge for Littlehampton, 1821-1822	J.H. Farrant
6.	1973/4	Civil Engineering in Sussex Around 1800, and the Career of Cater Rand	J.H. Farrant
		Railway Architecture in Sussex	John Hoare
		Shoreham & Ford: A History of Two Sussex Airfields	John A. Bagley
7.	1976	Railway Development in the Midhurst Area	F.H. Smith
		History of Park Watermill, Burwash	M. Beswick
		Restoration of Park Watermill (Bateman's)	A.J. Haselfoot
		Old Weights and Measures	Wilfrid Beswick
		East Sussex Milestones	Brian Austen & John Upton
		The Remarkable Cistern at Rye	Ralph Wood
		Tokens of Sussex	Jim Newmark
		Goldstone Pumping Station, Brighton	Jonathan Minns
8.	1978	Muntham Well, Findon	T.P. Hudson
		The Old Bridges at Newhaven	A.J. Haselfoot
		A water-driven Estate-water Pumping Plant at Buckhurst Park, Withyham	Hayward's Heath District Scouts' Camp 1976
		Reconstruction of Ifield Mill: Part 1: Historical Background	E.W. Henbery
		Shipowning at Newhaven in the Later 19th Century	J.H. Farrant
		A Note on Early Ironmaking in Sussex	W.R. Beswick
9.	1979	Reconstruction of Ifield Mill: Part 2: Restoration	E.W. Henbery
		Iron Making Origins & Their Early Impact on the Weald	W.R. Beswick
		Petworth Water Supply	J.E. Taylor, P.A. Jerome and A.G. Allnutt
		From Ox-cart to Steam Engine	M. Beswick
		The Hurst Green Foundry	A.J. Haselfoot
		The Chalk Pits Museum, Amberley	A.J. Haselfoot

No.			Authors
10.	1980	Burton Mill	Dr. T.P. Hudson
		Clayton Windmills	M. Brunnarius and J.S.F. Blackwell
		Building Material for Brighton	Dr. S. Farrant
		Horsebridge Watermill	E.W. Holden
11.	1981	Cobb's Mill	J.S.F. Blackwell et al
		Hastings' Trolleybus System 1928-1959	K.S. Donaldson
		Use of Clay at Ashburnham Brickworks	J. Harmer
		Thomas Durrant Miller of Merstham (Surrey) and Ifield (Sussex)	P.W. Soan
		Worthing Electricity Supply 1893-1901	Marjorie L. Morris
12.	1982	Restoration of a Tile Kiln at Piddinghoe	E.W. O'Shea
		The Barkers, Brickmakers of Piddinghoe	B.E. Osborne
		The Littlehampton Swing Bridge	A.G. Allnutt
		Recollections of Hillman's Brickyard, Partridge Green	H.J. Paris
		Trams in Hastings, 1905 - 1928	K.S. Donaldson
		Iron Working in Westfield	S. Kamer & J. Bell
13.	1983	Brick and Tile Making on the Dicker in East Sussex	M. Beswick
		The Round House, Ashcombe: A Technical Note	E.W. O'Shea
		An Early Private Estate Water Supply: Worth Priory	Worth School Lower VI Form I.A. Group
		Petworth House Ice-House	R.G. Martin
		An Old Brewery Well at Hastings	A.J. Haselfoot
		Worthing by Gaslight 1835-1901	Marjorie L. Morris
		History of St. Pancras Engineering Works, Chichester	J.G. Woodruff