

TSR.2 Memories, by Bob Nash

Or rather, Memories of Warton, 1957-1965

The following covers the period April 1957 to May 1965 when I was employed at Warton Aerodrome and therefore includes more than just TSR.2 memories.

I joined The English Electric Company Ltd at Warton Aerodrome on Monday 8th April 1957 as a Trainee Draughtsman at an initial salary of £8.14.6 per week. I know these facts to be correct, even after fifty years, as I still have my Letter of Engagement for Weekly Staff signed by C. F. (Freddie) Wills who was the Chief Draughtsman – Aircraft Division.

Prior to joining English Electric I was working as a fitter at Hawker Aircraft (Blackpool) Ltd where I made various parts such as the airbrake and the blisters for collecting cartridge links for the Hawker Hunter. At times I used to wander round to the wing assembly test bay and watch the undercarriage being extended and retracted; it was this that sparked off my interest in power hydraulic systems. During the autumn of 1956 I enrolled for the first year (S1) of the Ordinary National Certificate in Mechanical Engineering course at St. Anne's College of Further Education (the building on Clifton Drive South next to the Carnegie Public Library) where Engineering Drawing was taught by Charles Rhodes who was the Training Officer in charge of the drawing office school at Warton. On the closure of the Blackpool factory in March 1957 I applied for training as a draughtsman (the accepted next step up from the shop floor – remember the Likely Lads?) at both Warton and at a government training scheme at Liverpool. The offer of a place on the government scheme came through first, but I preferred to work at Warton so I went to the Personnel Dept to enquire whether the initial "we'll see" response to my application could be made more positive. Consequently, I received my letter of engagement.

The next, and, I rather suspect, the last, course in the Drawing Office School did not start until the July of that year so for a period of about three months I worked in the Mould

Loft which was under the overall supervision of Jim Wright. The mould loft, a term inherited, as a lot of aeronautical terms were, from the shipbuilding industry was where individual prototype components were drawn out full size on aluminium alloy (dural) sheets. Originally, in a shipyard, the mould loft was located in the actual loft above the design office, or in the loft of the sheet metal fabrication building or plate shop, hence the name mould loft. At Warton, the process started with the dural sheet, which measured 4ft by 8 ft, being placed horizontally on an agitating machine and covered with glass balls of about one inch diameter. Agitation of the sheet caused the balls to roll around and change the normally shiny silver surface into a fine matt grey finish, the balls wearing themselves away in the process. After washing, the sheet was placed on one of the large tables and the loftsmen drew out the parts full size from the information contained on the printed drawing issued from the Drawing Office. Initially, the location points for both straight lines and points on a curve were drawn using 9H pencil to an accuracy of ten thou, ie 0.010 inch, by means of a 12 inch steel rule divided into one hundredths of an inch and a magnifying glass! The final shape was drawn using straight edges, and Perspex splines weighted down with specially shaped lead weights to define curves, with a drawing pen filled with a special thin ink-like paint, which dried in seconds and left a line a few microns thick – it could just be detected by running a finger over it. Two colours were used, red and green – I can't remember exactly but I think red was for the outlines of a part to be cut out of sheet material and green was for the bend line that it had to be folded to, and thus defined the outline of the tooling to be used to make the part.

When finished, complete with all the lettering and numbering required, the sheet was washed and then covered with printers ink. A second washing removed all the excess ink and left only the drawn lines and text black. The sheet was then covered with a gelatine mat about 4 inches thick and passed through a pair of rolls which transferred the black ink lines to the gelatine mat. Three more dural sheets were prepared by painting them individually blue, brown and green; these were then passed through the rolls with the gelatine mat so that the inked lines were transferred onto each of the coloured plates. In order for the information on these coloured sheets to be more legible they were dusted with fine aluminium powder that adhered only to the ink, the

excess being brushed off, leaving the lines and characters bright silver against the coloured ground. As I remember, the brown sheet went to the toolroom for any jigs and tools required to make the part to be manufactured. The green sheet was cut to the drawn lines to produce the prototype item; and the blue sheet went to the Inspection Dept as their reference information.

As a trainee I wasn't trusted with drawing any production parts; but I do remember, after a few weeks practise to learn the technique of "lofting" that, on my own initiative, I drew out full-size the nosewheel bay of the Lightning with the nose undercarriage leg in both its retracted and extended positions. Apparently this had never been done before, but I understand that this exercise was carried out on the TSR.2.

At the beginning of July I went into the Drawing Office School where, for the next six months Charlie Rhodes taught me to draw anything from a simple cleat, properly dimensioned, to the aerofoil of a slant rib in a Canberra wing or a space diagram using the two views back principle to obtain the true spacing of two lines shown crossed in plan and elevation. I have always valued this period of training – and I still have the notebook containing the drawing exercises I did in 1957. I have never come across anybody in general industry who has received this type of technical drawing training.

Just before Christmas 1957 I completed my training and was introduced to the Drawing Office – my ambition to be a draughtsman had been achieved! The D.O. was in two parts located in what were originally adjoining hangars. In one was located the Structures D.O., whilst in the other, to which I was transferred, was the Systems D.O. which contained the Fuel, Cabin Air, Hydraulics and Electrics Sections. There was also a section that dealt with the Query Notes that were raised by the manufacturing, assembly and flight test departments whenever a problem arose within any area of any aeroplane, at that time the Canberra and P1 - the name Lightning not having been allocated until 23rd October 1958.

It was this section I joined, and under the guidance of George Elliot, the Section Leader, soon got into answering the queries, altering the drawings, recording the alterations and

reissuing the drawings without too much supervision. This led to me being given my first design job – a throttle stop for the experimental rocket assisted take-off Canberra that was being used by D. Napier & Son Ltd to test fly their Double Scorpion rocket motor. Apparently it was considered that if the rocket motors ignited automatically as the normal jet engine throttle levers were pushed into full power for take-off the combined thrust would simply rip the wings off. Consequently, I designed a stop device which allowed the pilot, without looking, to push the throttle levers forward to a pre-determined thrust position to start the take-off run after which, to obtain maximum thrust from the jet engines and to ignite the rocket motors, he had to physically lift a lever to raise a latch pin onto the profiled cam face to allow the throttle levers to move to the fully-forward position.

The details of my design which had to take into consideration the curvature of the throttle quadrant and a serrated stop and mounting plate to allow fine adjustment of the stop position are shown on Drg No E-B8-4-6295 dated 06.05.58, a copy of which I still have.

In March 1958 a collection box came round the office for somebody who was getting married. Whilst contributing I just happened to mention that I, also, was getting married on the 22nd March. I was rather overwhelmed and grateful at the way another collection was quickly organised; and we still have the good wishes card produced by the girls in the tracing office.

Another job I remember was the design and installation of a lubricating oil receptacle which was mounted on the aft face of the main spar in the port wheel well of the Canberra. An alternator was situated within the leading edge of the port wing and a cooling vent was located in the leading edge panel. However, under certain aerodynamic conditions the lubricating oil was sucked out of the alternator casing and splattered all over the undercarriage leg and the wheel well, resulting in a big clean-up job. I remember walking through the flight shed about a year later and, sticking my head into the Company's experimental Canberra, seeing my oil bottle installed. I have seen the production version of my design installed on a number of Canberra aircraft at various air shows and museums.

At one point I had to deal with a query concerning a production problem on the P1 Lightnings being built at the Dick, Kerr works in Strand Road, Preston. I decided that it was necessary to go to Strand Road to see the problem for myself. Having obtained all the relevant drawings from the print store I put them in my brand new leather brief case that my wife had given me as a wedding present just a few weeks earlier.

Still a little unsure of myself I went to my Section Leader George Elliot, explained briefly the problem, and asked his advice on what I should do. Now George was the most jovial man I have ever met – always laughing and very friendly; he did, however have a tendency to swear, quite vulgarly at times, but still in a friendly way and completely without malice. "Bob" he said, in reply to my question, "you're the f***ing draughtsman, you f***ing well go down there and you f***ing well tell 'em what to f***ing do". In retrospect, I reckon this was best advice I have ever been given throughout the whole of my engineering career!!

The other thing that I remember about this incident is that when I arrived on site at Strand Road I found that on one side of a gangway, which ran the length of the shop, was a line of P1 fuselages in their assembly jigs, whilst on the other there was what appeared to be a huge marine diesel engine being run on test, which made the two different types of engineering seem a bit incongruous, being almost side by side. I have a videotape of George Elliot and F.D.(Don) Crowe (who was at one time Chief Stressman and became a director at Warton) when they appeared on a television programme talking about the aircraft industry in the 50s and 60s; unfortunately it is on Betamax so I can't play it. George used to wear a cap in the D.O. as his desk was directly underneath a ventilation fan in the ceiling; he appears, complete with cap, in the TSR.2 farewell photograph in the "English Electric" book in the Images of England series published by Tempus Publishing Ltd.

Shortly after, I think about June or July 1958, I moved to the P17 Project Office. The P17 was the English Electric response to the Operational Requirement 339 which detailed the

requirement for a supersonic bomber capable of low level terrain following flight below radar screens to deliver a nuclear bomb at up to 1000 miles radius.

My first job was to make a one tenth scale model of the pilot's and navigator's cockpits, showing the layout of the instruments on the panel and of the navigation aids located on the consoles on each side of the cockpits, a new innovation at that time. The cockpit interior was painted a matt mid-grey colour instead of the traditional matt black. As this was in the Cold War period I put the ordinates for a sortie to Moscow and back into the pre-programmed navigation system – the word computer wasn't in use at that time.

Moving back onto the drawing board, I spent six weeks drawing a major bulkhead six different ways, by which time I had decided that the design of aircraft structures was not for me! Fortunately, on the board to my right was a senior designer by the name of Darby Dowman who was designing the hydraulic system; and he was at the stage where he wanted some assistance to get the drawings out on time. So, by a stroke of good luck, I was able to achieve my other ambition, namely to work on power hydraulic systems.

The P17 project did not last long as talks were going on in the background which led to the merger of English Electric Aviation with Vickers Aviation to form the British Aircraft Corporation (BAC). With the disbanding of the project office I joined the Hydraulics Section in the Systems D.O. The Section Leader was Jack Hall, who had spent the war years in charge of the installation of the hydraulic system in the Halifax bombers built at Strand Road and Salmesbury. He was a well-known figure in the aircraft industry where he was known as Hydraulic Jack! The only work going on at that time was on the Lightning – the F3 version was being designed and I worked on various parts of the hydraulic system, mainly piping runs in the wing and fuselage. I remember designing the installation of the first Palmer Aero filters with sintered stainless steel elements.

It was sometime in this period (about May 1960) that I had to have an epigastric hernia operation. The timing was unfortunate on two accounts. First, I was at the A1 level of

the HNC Mech Eng course – and due to this illness, later involvement with the TSR.2 test programme and its eventual cancellation, resulting in my leaving Warton and moving to Sheffield, I never did achieve getting my HNC which I have always regretted, but I made up for it later by attaining other qualifications. Secondly, we were just about to move into our first house.

The first time I went into St Anne's War Memorial Hospital (alas, no more) I was prepared for theatre only to be told that as I had a cold they could not operate – it was a case of "they painted me green and sent me home". A week later I returned to the hospital, had the operation and stayed there for a week to recover. It was during this time that the house deal was completed, so my wife had to move all our belongings from her parents' home, where we had been living for a year, to our new home using the Silver Cross pram we had bought second-hand for our first son. I arrived by ambulance. I was run-down for a long period and had to have penicillin injections twice a day. On returning to work, I arranged to have the injections at the Medical Centre. In the end it became quite a laugh as, on dropping my trousers to reveal my buttocks, the nurse would say "Which side is it this time?" as she tried to relieve the pain somewhat by alternating the injection points.

Eventually, with the formation of BAC, officially, on 1st July 1960 the specification and shape of the TSR.2 emerged, looking significantly similar to the twin engined P17 rather than the single engine Vickers proposal to meet the OR339 specification. At the time it was explained that the aeroplane was designated the TSR.2, the TSR standing for Tactical Strike and Reconnaissance and the 2 because it was the second aircraft to have this designation, the first being the Fairey Swordfish, although, at the time, there was some conjecture that the T in this case might have stood for torpedo. Following the Vickers system, the Company designated the aircraft as Type 571; and all drawing numbers started with these three digits.

I had two major design tasks on the TSR.2. The first was the design of the reservoirs for the Flying Controls and the General Services hydraulic systems. The two types of reservoir were basically the same but the capacity of the

General Services reservoir was about twice that of the Flying Controls. I don't claim that they were original design as the principle on which they operated was based on those of the Lightning. However, they did contain some original design content; I still have a copy of Drg No. 57185 Sh 515 General Assembly of the "Controls" Reservoir.

The second job was the installation of the pipework in the weapons bay, including the flexible hoses for the jacks that operated the weapons bay doors. Before I could start I had to have security clearance at atomic level, as I would come into contact with classified material, such as the LABS document which described the Low Altitude Bombing System, which was one of the ways a nuclear bomb could be delivered. I understand that the police did make enquiries about me from our neighbours.

The names of two colleagues that I recall from that period in the D.O. are Bill Bowen, who worked on the Lightning and spent some time at RAF Coningsby when the first Lightning squadron was formed there; and John Manners whom I used to amaze when playing tennis with him on the shale courts in Ashton Gardens, St Anne's, by getting so much back spin on the ball when returning his service that when it touched the ground on his side of the net it bounced back onto my side before he could play it. There was also a Neville, unfortunately I can't remember his surname, but I do know he worked at Canadair in Montreal for a few years to avoid doing National Service in this country, as I did.

Two other names I remember are Milton Wreakes, a senior designer and Henry Pyptuik. Henry, an electrical Section Leader in the D.O. was Polish and was rumoured to have chicken for dinner every Sunday (at a time when chicken was an expensive luxury food) to make up for the deprivation he had suffered during the war. The story was, at the time, that, when a party of Luftwaffe pilots visited Warton to test fly and assess the Lightning for possible purchase by the West German government in Bonn, the Company, rather than engage the services of a professional interpreter opted to take up Henry's offer to act as interpreter. Apparently his opening words to the German visitors were "You must excuse my German, but I learnt it in one of your concentration camps". I

understand that this was followed by a period of silent embarrassment!

By the middle of 1962 the bulk of the D.O. work for the TSR.2 had been completed and most of the production drawings had been issued to the various manufacturing facilities and sub-contractors. The emphasis was now directed at completing the testing of the hydraulic system and components. This work was carried out by the Mechanical Test Dept. and I was transferred there in the August of that year. Mech Test, headed by Harry Abraham, the Chief Experimental Engineer, was always considered the senior engineering department at Warton and I considered myself very lucky to be there. At last I could get some practical hands-on experience of hydraulic systems and components.

The TSR.2 hydraulic test rig was laid out to simulate the actual aircraft. Although built of structural steelwork the positions of all the hydraulic equipment, components and piping were in the exact position they were on the aeroplane. The idea was that eventually the chief test pilot, Roland Beamont, would be able to sit in the cockpit and "fly" the rig as though it was the aeroplane. I remember a moving map being made out of Duralay carpet underlay which was painted grey with features of the landscape painted in darker shades of grey and black. It was a continuous loop about eight feet wide that passed over rollers about ten feet apart, one above the other, so that it could be placed in front of the pilot and moved down to simulate the aircraft flying over the ground at low level – a far cry from today's flight simulators.

Harry Abraham's assistant was an experienced practical engineer called Ken Jepson. I remember three things about him. First, if you were in conversation with him discussing some technical topic he would give you his attention 100%, ignoring any telephones that may be ringing, even his own in his own office, or anybody else trying to get his attention. Secondly, after taking a reading with an AVO meter, meticulously turning the arrowed dials back to the zero position, a habit I still observe when using my own AVO. And, thirdly, he appeared to have a body system, I'm sure there is a medical name for it, that completely ignored changes in ambient temperature. He always wore a white or pale blue short sleeved shirt, summer and winter and was known, on

many occasions, to have gone out onto the apron in the middle of winter when there was snow on the ground in just his short shirt sleeves to carry out some task on a Canberra or Lightning.

I joined the General Services Hydraulics section, which was lead by John Denney and comprised Ken Williams, John Singleton, Bill Rigby, Andy Crum, Ronnie Richardson, Lew Devolder and one other person who's name, I think, was Wally Jordan, but I am not sure. John Denney, who had been a 2Lt in the army during his National Service, was a great section leader who was very fair and always backed his engineer in any dispute. I understand that he eventually became Managing Director of the British Aerospace site at Prestwick; sadly I noticed his name in the "with regret" column of the April 2001 issue of The Aerospace Professional, the magazine of the Royal Aeronautical Society, having died at the age of 66, only four years after retiring.

Each engineer had a specific role to play in the testing of the hydraulic system, although Lew Devolder and Ronnie Richardson stayed on the Lightning system and Wally Jordan specialised in filtration and looked after the cold chamber which was maintained at minus 40 degrees (engineers will know that °C and °F are the same at -40). Ken Williams looked after the miscellaneous sub-systems and John Singleton was responsible for the undercarriage. Andy Crum was a great character whose remit was the servo-operated variable intake cones, which controlled the shock wave in the air passing through to the engines, and the auxiliary air intakes which opened during ground running and taxiing.

It was whilst testing this system that the pipes suddenly burst for no apparent reason; but from the results of the instrumentation recording the event Andy was able to diagnose a condition known as a "standing wave", which is a type of hydraulic pressure resonance whereby a pressure peak travels at sonic speed from one end of the pipe run to the other gaining in magnitude until something gives way, in this case a pipe, spewing out oil and thus potentially draining the system. If this had happened on the aeroplane during flight a dangerous situation would have occurred, although there were two hydraulic systems each for the general services and flying control circuits.

This kind of testing, to establish the full characteristics of the systems and components, and to discover any faults in either design or performance, especially prior to a first flight, was the *raison d'être* of the Mechanical Test Dept. Andrew, as Joyce, his wife prefers him to be called, left Warton a year after I did and also came to Sheffield to work at the company I eventually joined; he worked on the development of hydraulic servosystems for controlling the loads of steel rolling mills. Later he went to the USA where he still lives, owning his own steelworks company there. I keep in contact with Andrew and Joyce every Christmas.

Bill Rigby's main job was the airbrakes system. The four airbrakes were located just aft of the wing on the upper and lower "corners" of the almost rectangular section rear fuselage. They were operated by ball screw-jacks, a type of low friction screw mechanism that used ball bearings that recirculated within the jack casing. During the intense period of testing leading up to the first flight Bill found that, on occasion, the screw-jacks locked up with the airbrakes in the closed position; which meant that if this happened during flight the airbrakes could not be extended.

This news was relayed to Roland Beamont at Boscombe Down who made the decision to accept the situation for the first flights. However, in order to overcome this possible problem he made the decision to fly the aeroplane with the airbrakes not quite fully closed but restricted such that there was about a one inch gap between the aft edge of the airbrake and the fuselage side. This is why, in all the photographs that that were taken of XR219, the only aeroplane to actually fly, the outline of the airbrakes can be seen as black lines against the white surface finish. And whenever a photograph was published it elicited, within our test section, the cry (almost) "Ah, Bill Rigby's airbrakes"!!

My first job was to test the hydraulic reservoirs that I had previously designed. I was able to adapt a test rig that had previously been used to test the Canberra undercarriage jacks within a high temperature cabinet. The two designs of bladder type reservoir, pressurised by air to 5 psi, were mounted in turn within the cabinet and connected to two jacks such that

their retraction and extension caused hydraulic fluid, in this case DP47 (later designated Silcodyne H) instead of the, up to then, standard DTD585, to be withdrawn from and returned to the reservoir. The u/c jacks were operated through a bell-crank by another jack connected to the test department hydraulic ring main and controlled through a selector valve that was sequenced continually by a pre-programmed timing device. The cabinet could be heated up to the working temperature of the fluid, 120°C.

Once these tests were completed the reservoirs were mounted on the aircraft test rig and piped into their respective systems for functional and performance tests. On completion of any test a full report had to be written which, after approval by BAC management was sent to the Air Ministry. I remember starting my first ever report by stating that the reservoirs were of an excellent design and met all the performance criteria and that this was due to the person who had designed them, ie me! It was pointed out that, though this might be true, it was not the kind of wording that could be submitted within an official report.

During my time at Warton I was paid weekly, payday being on Thursday. After getting married I made a habit of regularly putting some money into our joint account. This entailed making the short journey to Lytham where, after making my deposit at the (then) Midland Bank, I went to the chip shop round the corner for my lunch. After being in Mech Test some time, one of my colleagues who noticed my absence from the canteen each Friday asked me where I went. Thereafter, I was always accompanied by Andy Crum, Bill Rigby and another friend, a Scot who was on the Flying Controls section, but whose name I cannot remember.

My first main job on the TSR.2 test rig was the nose undercarriage which comprised a quite complicated hydraulic system that included a first order servo mechanism as part of the nosewheel steering assembly. The positional feedback comprised a bicycle type chain that rotated a sprocket fixed to a shaft. At the top of the shaft another chain rotated a second sprocket which was connected to the linkage that neutralised the steering control valve once the required steering angle was achieved.

Another innovation was that the nosewheel leg could be extended, I think about 30 inches, in order to raise the nose of the aeroplane for rough field take-off, the idea being to blast it off the ground at the C_L max angle of attack without having to rotate the fuselage/wing about the wheel centres. However, after the first few flights it was decided that this feature was not required. At some stage the nose undercarriage had to undergo a major overhaul and modification during which the extension feature was to be removed.

Now, the whole of the TSR.2 programme was being controlled by the Programme Evaluation and Review Technique, or PERT, which is a system that was devised by the Americans for the Polaris project. It comprised a series of Events and the Activities (and length of time) required to achieve them. The name of each event was drawn in a circle and the activities were represented by lines joining them.

Hence the Critical Path taking the longest period of time could be established. I decided to try out this technique for myself by applying it to the nosewheel modification. However, to make it more easily readable I drew two concentric circles for each event, and then used different colours in the ring to show whether the event was mechanical, machining, electrical, hydraulic or assembly in the rig. I remember Harry Abraham, on seeing the colours remarking that it added extra time to drawing the diagram. I was able to tell him, however, that the modifications would take six weeks to complete, at which he was somewhat dismayed; but I was proved right, it did take 6 weeks to complete.

One day I had to bench test the nosewheel steering/shimmy damping twin pressure relief valve. The hydraulic system working pressure on the TSR.2 was 4000 psi and the valve was set to blow off at 4500 psi. As the pressure from the rig I was using was slowly building up somebody I had never seen before, smartly dressed in a sports jacket, walked past me and crossed about 20 feet in front of the rig. At that very moment the relief valve blew, ejecting a stream of oil horizontally at high velocity that struck this person right in the middle of his back, drenching him in oil.

I eventually took over the testing of the whole of the undercarriage system, that is the main undercarriage as well as the nosewheel. Having completed all the functioning and performance tests, it was necessary to carry out limited endurance testing in order to complete 250 hours of test running in order to clear the whole of the system for first flight. In order to achieve this in the shortest possible time so as not to delay the first flight a system of shift working was introduced that increased the working day from 6 am until 10 pm. The canteen provided tea and toast at 8 am for the morning shift and a light meal at 4.30 pm for the afternoon/evening shift. On a number of occasions I found myself working both shifts consecutively.

Generally speaking, everybody went to work smartly dressed, usually in a suit; anybody on our section who did not conform we playfully referred to as being "a scruff". When working on the rig we wore protective white coats. However, when working overtime on Saturday mornings we "relaxed" our dress by wearing a sports jacket and cavalry twill trousers with suitable shirt and tie.

It was on a Saturday morning that, still being responsible for the reservoirs, I decided to "top up" the hydraulic systems. The hydraulic fluid, Silcodyne H, was stored in a 45 gallon barrel on a stillage placed next to the grille covering the pit for the port main undercarriage leg. To transfer the fluid to the pump for filling the system I had a 3 gallon plastic container; this fitted conveniently under the tap on the barrel. Having opened the tap my attention was distracted and I walked away to discuss some topic with one of my colleagues. About 45 minutes later I remembered that I had left the oil running into the container and returned to the barrel, only to find that about 30 gallons had overflowed and run into the undercarriage pit. At the time Silcodyne H, which was a new type of hydraulic fluid, cost about £25 per gallon so the value of the oil in the pit was £750, which equates to about £20,000 today. Although it was approaching mid-day, ie clocking-off time, the shop labourer was absolutely marvellous and immediately donned his waterproofs and Wellingtons and went down the pit with a shovel and buckets and scooped up the oil, together with all the water, sand, dirt, cigarette ends, floor sweepings, bits of paper, cigarette packets and anything

else that had passed through the grille covering the pit. The following Monday morning I confessed my sins to Harry Abraham and John Denney, both of whom had already heard about the incident on the grapevine – you can't keep something like that secret. The dirty fluid was passed to Wally Jordan who placed it, first of all, in the cold chamber to freeze the water content, he could then remove the ice; he then removed all the solid contaminant by passing it through the strainers and aircraft quality filters he had in his Filtration Lab. I think about 90% of the contaminated oil was eventually recovered.

Another of our friends in Mech Test was Tony Barnett. During his National Service he was an RAF pilot; but he suffered from vertigo and couldn't bear to go onto the platforms on our hydraulics rig. He was in charge of the fuel test rig which comprised two semicircular rack and pinion tracks set at right angles to each other and above these there was a platform on which the aircraft fuel tank, basically the wing, was mounted. This allowed the wing tank to be rotated in pitch and roll, simulating the aeroplane movements, so that fuel flows etc could be checked out.

When, as I do occasionally at Royal Aeronautical Society lectures, I meet people who are working at Warton now I ask them if they know why the centre section of the hangar type building that can be seen from the main road on the Freckleton side of the main entrance to the site is raised up about 10 ft above the original roofline. I have heard a few interesting guesses, but the reason is that it was raised to accommodate the TSR.2 fuel test rig, it was that high!

First flight of the TSR.2 took place on 27 September 1964, but as it took place at Boscombe Down we were not able to witness it. For all the people who worked at Warton the highlight of its brief flying career occurred on 23 January 1965 when Beamont brought XR219 back to Warton. I was one of the crowds of people allowed onto the apron area in front of the flight test hangars to see it arrive.

It flew in at about 200 ft from the Freckleton end of the runway at just under Mach 1. This meant that it had almost disappeared from view out to sea in the direction of Lytham

before the sound of its approach reached us on the ground. After a couple of slow speed circuits, accompanied by the chase Lightning and Canberra, the TSR.2 landed and taxied to a halt outside the hangars, with the Lightning and Canberra lined up behind it. I have, among my memorabilia of photos, drawings, magazine and newspaper articles dating from the time, six official photos taken by the photographic department that record this event.

When the final blow came and the TSR.2 was cancelled, in spite of the rumours and discussions, speculation and conjecture, it still came as quite a shock. There was still a strong belief that despite the previous year's cancellation of the Hawker P1154 (a design for a supersonic v/stol Hunter), the Saunders Roe SR53, a hybrid turbojet/rocket powered fighter and the Hawker Siddeley HS681 stol tactical transport aircraft, that the TSR.2 would survive the government cuts.

All work on the project ceased almost immediately the news was announced and a period of quiet resignation ensued before the mass redundancy programme was put in place. There had been wide press coverage about the various aircraft projects for quite some time. One item that caught my eye was a letter from a director of a company in Sheffield that was printed in 12 March 1965 issue of "The Engineer" magazine. It was to the effect that whilst sympathising with the people in those factories where redundancies had already taken place, the claims of their leaders that breaking up design teams would be disastrous and result in "draining brains abroad" was contrary to his experience when advertising locally for competent design draughtsmen to work on "projects involving automation of mining machinery and development of other complex hydraulic circuits". He had had only two replies and neither applicant was suitable.

Probably because of the word "hydraulic" I kept (and still have) this letter, which also gave the name and address of the company. In April 1965 I wrote a letter to this director, outlining my credentials, in which I said that as I was myself now in a position of impending redundancy, perhaps he would offer me a job. The net result was that following an interview and a week-end looking at housing in the area I decided to leave BAC. My main reasons were that I had a young family to provide for; I had gained a tremendous amount of training

and experience which I felt could be put to good use elsewhere in industry, to my own personal benefit; and that having been involved in one big aircraft project almost from start (with the P17) to finish, at best, it could only be repeated and would probably seem to be an anti-climax.

Although on the weekly staff, I let Harry Abraham know of my intention of leaving in a few week's time. He was grateful to me for telling him as, only that morning, he had been informed that he had to make four more people redundant – so I was on the top of his list; and it meant that I received the redundancy payment, which helped when moving house, etc. I learned later that I was going to be transferred to the Wind Tunnel which, I am sure would have been interesting; however I have maintained my interest in aeronautics through my radio controlled aeromodelling interest.

As a farewell gesture, Bill Rigby, who also had found another job, and I and our wives were invited by John Denney for dinner at his home in Preston on the evening of Sunday 23 May 1965 shortly after we had both left Warton. And so, in a way, ended an era. After telling me that I would be made redundant, Harry Abraham said that I would be paid up to the end of the month but that I did not have to return to work. A week or so after leaving the Warton site I happened to be outside our local shops opposite the Halfway House Hotel on St Anne's Road, Blackpool when I heard the sound of jet engines. Looking up, I saw the TSR.2, accompanied by a Lightning and a Canberra in formation, one on each side, flying almost overhead whilst making its farewell flight over the Fylde. (Editor's note – this is what Memories is all about, because the TSR.2 never flew again after cancellation on April 6, despite BAC's attempts to get funding and permission to do so.....)

Although not directly relevant to the TSR.2, but with a strong Warton connection, I will end these memories with my "Isn't it a small world?" story. Bob Sharples, who worked in the Structures D.O., on the Controls Group (he is in the photograph of this group in the "English Electric" book mentioned earlier), lived not far from me in Blackpool. For about 18 months, up to the time I started shift working on the TSR.2, he used to walk to my house, and I brought him to Warton in my car, returning home with him in the evening.

Three nights a week, during the winter months, we went to Blackpool Technical College before returning home. Almost exactly a year after leaving Warton, that is, about June 1966, my wife and I, together with an old school friend of mine and his wife who live in the Lake District, were having a meal on a Saturday evening in the Lobster Pot restaurant in Blackpool. There was a large group of people at another table and, although we didn't take much notice of them, I thought I recognised one or two faces, I think Bill Bowen was one I remember.

Unexpectedly, Bob and his wife Eileen, whom I hadn't noticed previously, came across to our table and said that they were pleased to see us so they could say goodbye as they were going to Canada the following Monday, Bob having taken a design job with Canadair in Montreal. Five years later, in April 1971 I was at the Edmonton International Airport in Alberta, Canada awaiting the arrival of a colleague on the Air Canada flight from London. As I stood there a small woman came up to me and said "It's Bob isn't it, Bob Nash?" I replied that it was and that although her face seemed familiar I was sorry I could not remember her name. "It's Eileen" she said, "Eileen Sharples; and Bob's over there" pointing to a figure standing by the wall. They were at the airport to meet his mother who had won a big Star Bingo prize that had paid for her flight and a holiday in Canada. And so I met up with them again about 5000 miles from (my) home. Apparently Bob had handed in his notice at Canadair immediately his contract was completed and moved to an aviation company based at Edmonton Industrial airport where he was Chief Designer. I later visited them at their apartment in Edmonton; and I still keep in contact with them every Christmas.

And so ends my memories of eight great years.

EurIng R. A. Nash CEng MIMechE MIED MRAeS