

## From Derek Hargreaves ex English Electric Flight Test

The reminiscences which follow are the product of a shaky brain, not necessarily accurate and contain opinions which are mine only. They have nothing to do with and carry no approval from any official or company organisation.

I felt that 'the fifties' were halcyon days for the military aircraft industry. Fuelled by the Cold War, this period saw the design, development and production of classic jet powered aeroplanes such as Canberra, Lightning, Valiant, Victor, Vulcan and Buccaneer, all of which were leading edge icons of their day.

As far as individual job satisfaction and security were concerned, we seemed to be on the crest of the wave. But 1957 changed all that when the Conservative Minister of Defence, Duncan Sandys, produced a White Paper which proposed that there would be no more manned military aircraft and that the roles of defence and attack would be achieved by the use of rockets!

Such a policy seemed to be a breathtaking piece of political idiocy derived from George Orwell and pushed by some keen rocket salesmen but perhaps it was a serious but premature proposal to take account of blossoming missile technology or a riposte to an emerging RAF Operational Requirement or a stratagem to reduce public expenditure or to achieve the collapse/contraction of the whole aircraft industry – maybe all four!

At Warton, most of us at the less rarefied levels got on with the outstanding development of current aircraft with a vague awareness that all our 1950's military aeroplanes may be at risk and that our future was getting less certain. I recall a suggestion that the Canberra, already being used by the RAF in a low level toss bombing role, could have its wings clipped and its Service clearance speed increased to 500 knots to provide a stopgap offering.

It was another two years before the Sandys policy was shelved and responses to the Operational Requirement sought but the awarding of any contract was conditional on the merging of the plethora of aircraft companies in a way acceptable to the Government. My memory also seems to register that it would be a requirement for procurements of sub systems to be undertaken direct by the Ministry of Defence not involving the airframe constructors, a process which appeared to be designed to cultivate problems.

I think there was a feeling of shot gun wedding about this life line but the sword of Damocles wielded by MoD focussed lofty minds to propose the marriage of English Electric, Vickers and the Bristol Aviation Companies to form the British Aircraft Corporation, later to be joined by Hunting Aircraft.

I have no idea how the decision was made to award the project to B.A.C. Perhaps it was on cost grounds, previous development and production programmes, vast practical expertise in supersonics, military test pilot experience, even our Chief Executive's insistence that any dealings with MoD must always be open and honest, may have played an important part in the decision making.

Some months later I was visiting RRE Pershore to assist with a handling problem on a radar nosed Canberra and was introduced to the mess as a visitor from English Electric. I gently pointed out that we were now the British Aircraft Corporation to which my sponsor replied 'Ah yes, but we like to think of you as English Electric'!

With Sir George Edwards from Vickers leading then TSR.2 project coupled with the large concentration of meetings and metal at Weybridge, I certainly felt as though Warton was a subcontractor during the design and prototype build stage. There also appeared to be a substantial amount of duplication in most disciplines but some of this was clearly necessary to cover the geographical separation of the two planned sites when development began (Warton and Boscombe Down).

However, some system of detail monitoring of progress was essential and PERT (Programme Evaluation Routine Technique) was introduced to fulfil this need. This system had been devised in the USA to procure Polaris and was dependent on the periodic input of progress from all the programme contributors. I was never sure how well this worked with TSR.2 but I think that first flight of the first prototype in a condition to undertake meaningful trials was at least some 12 months late compared with mid design/build predictions although there is no doubt that much of this was due to political pressures for an early maiden flight and major engine problems, namely, shaft whip.

The flight development locations almost took care of themselves with handling, performance, and engineering systems being scheduled for the splendid Warton facilities with its proximity to low level and supersonic flight areas and armament ranges, but with most of the Nav/Attack work scheduled from Boscombe Down to be near Vickers and the sub-contractors' manufacturing sites. Overall flight test control would, however, be exercised from Warton.

However, the price which had to be paid was Vickers' insistence that we should accept the appointment of a Chief Flight Test Engineer from the staff at their establishment at Weybridge. Naturally, we were disappointed that local promotions, which should have followed internal Warton moves, now seemed unlikely.

The Ministry of Defence had ordered that final assembly and the first flight of TSR .2 would be undertaken from Boscombe Down near Amesbury in Wiltshire, as had happened on Lightning some 10 years earlier. This meant the location of a 'civilian' labour force at this Government establishment where we would be constantly under the eye of the local Civil Servants and having to use many of their facilities. Initially, there was some coolness to our requests for help from some areas of the establishment who were quite unaccustomed to the long hours worked in industry, including overtime, night

shifts and weekends to say nothing of the administrative support needed by a large contingent of people living away from home. Eventually, reasonable relations were developed for the provision of the necessary support.

I arrived at Boscombe Down in the Spring of 1964 with a small team of engineers to assist in the pre-flight work of familiarisation, ground testing of the various systems leading to engine runs, taxiing and flight. Myself and two colleagues, after settling in the Bridge Inn at Upper Woodford some 15 minutes drive away from Boscombe Down, set up the Flight Test office, remote from the build hangar, but next to our Chief Test Pilot's office.

I had not been on the site more than half an hour when the telephone rang and the Vickers Site Manager asked me to go over to his office for a chat. After a warm welcome he spelt out to me that the Vickers were in overall control whilst the aircraft was in the hangar but, as his senior shop floor supervisors had not been involved in a first flight before, all the outside activity would be an English Electric responsibility. An exception was Works Inspection where Warton staff would work through a senior Weybridge man.

A particular problem of this working arrangement was that the job of our Flight Test Instrumentation engineers, who had to get their equipment installed and working during the frenetic activity on the assembly and basic engineering systems, was difficult, to say the least. I think that, eventually, specific time slots were reluctantly arranged to facilitate the embodiment and calibration of the essential flight test instrumentation.

The first TSR.2 prototype, Serial Number XR 219, was already joined together and was in the process of being fitted out with equipment. It was a dramatic sight even though I had previously seen the wooden mock up at Weybridge. It had been blasphemously christened 'Christ' as this was usually the spontaneous utterance that most people emitted when they first saw it at close quarters. Without doubt it was impressive with a length of 86 feet, a wing span of 37 feet, a height to

the top of the fin of 23 feet and weighing almost 30 tons before any fuel or armament was installed. The wing area was a mere 700 square feet, specifically to permit an acceptable platform at the required low level high speed of 800 knots. This compared to the 500 knots and 960 square feet of the Canberra which was only 40% of the TSR 2 weight. It had a wing sweep back of 60 degrees and in the engine pen were two enormous Bristol-Siddeley Olympus 22R multi spool engines which would eventually be capable of delivering over 15 tons of thrust each thus giving the aircraft a near vertical climb capability at low fuel levels.

The systems in the aircraft were, of course analogue based and relatively bulky compared with today's digital technology. Nevertheless, at this time, there was little doubt in my mind that what I saw before me was a superb example of British design, engineering and manufacture, which was probably ahead of any production military aircraft existing in the world. The future looked extremely interesting and promising and we looked forward keenly to the job ahead.

However, the euphoria wobbled a bit when we learnt that, following an earlier accident on a test aircraft, the engine manufacturers had destroyed another engine on their test beds at Bristol due, it was believed, to shaft whip at high powers and which was not preceded by any significant warning. As engine runs were scheduled for the very near future, Bristol-Siddeley continued ground running tests at reduced power and set about trying to find a solution to their problem.

Other system testing continued in the hangar where our Chief Test Pilot, W/Cdr Roland Beamont, was involved whenever possible to familiarise himself with the cockpit environment. The electrical system, a Weybridge responsibility, as presented gave him particular trouble and I recall warm exchanges between the cockpit and Weybridge engineers as to what should be happening to the displays.

The day arrived when we pushed the aeroplane out into the

fresh air, the first job being to crank up the engine starter which, after some tweaks and changes, eventually functioned satisfactorily. Within a few days, we were in a position to try to start an engine. We had procured a caravan and furnished it to provide communication with the cockpit and the on board instrumentation system during ground engine running. (Let me interject here to extend my regards and compliments to another 'Memories man', Arthur Boswell, who spent many hours with us in the 'caravan') It was positioned some twenty yards from the aeroplane and clear of the line of the exhaust turbine – just in case! However, before this, a critical modification was embodied consisting of a length of rope, anchored in the cockpit, to allow the Bristol Siddeley engine runner (Phil Pearce) to evacuate the aircraft quickly in the event of an unscheduled occurrence.

After many attempts and adjustments by the Bristol-Siddeley engineers we had ignition and exercised all the systems that we could according to a programme which we had devised during the previous months.

Things seemed to be progressing fairly well when, one evening during a post-engine run inspection, small blobs of metal were found lying on the ground running pad behind the aircraft. In view of the problems the engine manufacturers were having, this did nothing for our confidence and an internal inspection was carried out to verify the integrity of the engines before we progressed further.

The main engines were given a clean bill of health, much to our relief, so other possibilities had to be examined and suspicion fell upon the air started gas turbine. It was removed and dismantled on the shop floor surrounded by a large number of spectators and, when significant blade damage was found, a loud cheer went up. After a metallurgical examination to verify that the blobs of metal were, in fact, identical to the blade material from this machine, we continued the main engine work with a new starter motor.

Great pressure was exerted on us to get the aeroplane flying

as soon as possible as there was to be a parliamentary general election in October 1964 and the prospects for a continuing Conservative Government to support the project had begun to look bleak. Accordingly, the fitting and testing of all the non-essential equipment was cancelled to speed up the first flight and Bristol Siddeley had limited dry power (to 98%?) with an override to 100% in emergency only. They had also devised a warning system to alert the pilot if the dreaded and catastrophic shaft whip problem raised its head so that he could take appropriate action.

A feature of these new engines was that, compared with earlier military power plants we had been used to, they produced a very significant level of smoke, a problem which would have to be sorted out before production and entry into service. The place where we were ground running the engines was a location known as the 'Pear Drop' upwind of an adjacent farmer's field of wheat and he bitterly complained about the trail of soot running for several hundred yards across his crop. As we had fitted the 'Pear Drop' with special hold down gear to restrain the aircraft at maximum power we could not, in the present circumstances, move to another location but, I believe, he was subsequently compensated for damage by the Ministry.

Eleven taxi trials ensued during August and September during which we had some work to do to modify the door which opened when the enormous brake parachute was streamed but eventually we were ready to go for a flight. Following a final fast taxi run checking that the nose wheel lifting speed, steering and braking were acceptable, the aircraft took off just before half past three on Sunday afternoon, the 27<sup>th</sup>. September 1964 with an audience of hundreds watching the whole operation from the Andover Road and dozens of Ministry men who had travelled down from London for the occasion.

The flight was uneventful and, because of pressure from Vickers, we did not try to lift the undercarriage in flight as this was not their custom. My role was to remain in contact with the pilot, Mr. Beamont, throughout the operation and to offer

advice if problems arose. For this purpose we had converted an old small motor van and fitted it with radio equipment so that we could follow the aircraft closely along taxiways to observe the functioning of the steering, brakes and control surfaces right up to the point of take off.

The flight lasted for 14 minutes and was accompanied by a Canberra from Warton to be of assistance if needed and, particularly, to ensure that vital flight information, such as speed and altitude being presented in the TSR 2, was correct. A reception was given afterwards to celebrate the event but, by the time my team and myself had arrived after seeing the aircraft into the hangar, the drinks were finished and the comestibles scoffed! However, we had our own private 'do' later at the High Post hotel just up the road from the airfield.

The period up to first flight had been exhausting with a sandwich lunch on the Pear Drop most days, much late activity leading to a nightly dash into Salisbury for a few schooners, a steak and a discussion of something other than aeroplanes. One night our topic concerned the optimum cross sectional area of the chip. This so impressed a lone earwigger at the next table that he ordered another bottle of wine for us claiming to be a Director of Berni Inns and that we had shed new light on the subject. *(Editor's note: a few years later, as a member of Derek's Jaguar flight test team, I too was dispatched to monitor trials at Boscombe. One day, Derek and a few others came down from Warton for some vital reason, and in the evening he decided we should go for Schooners and a "TSR.2 steak" at the Berni. Now, 35 years on, I know why!!)*

The first flight was totally political and proved little except that TSR.2 could, in fact, fly, at least in a take off and landing configuration. The next step was to augment its build standard so that we could start flight trials in a meaningful way. This meant a big breakdown of the aircraft again followed by further ground testing to clear the new systems being introduced and this was expected to take up to three months to complete.

During this lay up, an incident occurred on the second prototype which, had we been clever enough, could have been recognised as a harbinger of the future. The transport of the fuselages, wings and other major items from Preston and Weybridge was a task which the Ministry of Defence would not trust to the aircraft companies as, perhaps, they considered it a specialist job beyond our capabilities. I believe the work was contracted out under the direct supervision of MoD and we were all crestfallen when the whole fuselage of the second prototype (XR220) fell off its trailer as it was being unloaded outside the Boscombe Down hangars. (*Editor's Note: several other Memories recall this, see also Photo Album Page 540.*)

Fortunately, because of the very robust construction, repair work was carried out which allowed its build to be continued such that the second prototype was fit to begin its flight development programme in Spring 1965.

It was never easy to keep concentration on one's work with uncertainty about the project being spread around even when, prior to the election, the Preston Labour candidate was assuring Warton and Preston labour forces that their jobs were safe (*See Photo album page 503*). TSR.2 would not be cancelled by his party! Also, certain sections of the press were agitating for the cancellation of the aeroplane, a journalist called Mary Goldring was a particularly venomous opponent whilst a trade union leader claimed that the aircraft was not strong enough for the job!

However, in October 1964, as expected, the Labour Party won the general election and took over the reins of Government. The new Minister of Defence was called Lord Shackleton and the news coming out of his office was not at all encouraging. We struggled on and had resumed ground running by mid December when we received a visit to our caravan on the running bay. Suddenly, the door opened letting in an icy blast of air and there stood Sir George Edwards, the British Aircraft Corporation Chairman. Wearing a pork pie hat and speaking through his clenched teeth as usual, he said 'I've just come to

wish you a happy Christmas and I hope you all have your jobs at this time next year'!

Further ground engine runs were dogged by vibrations of a sufficiently disturbing level which caused pilot opinion to be sought. Quite correctly, the question of safety was an engineering decision, not the pilot's, which went right to the top of the airframe and engine companies. I think we had an engine change and we made the second flight in late December.

The first attempt to lift the undercarriage was made and Vickers, who were responsible for its design, sent down two of their senior people to see what we were doing. The aircraft took off and climbed to some 5000 feet to give us a margin in case of problems and I was stationed in my radio van, in contact with 'Bee', with the Weybridge designers listening in to our exchanges. At the agreed speed, the undercarriage was selected up and the result was very perplexing. The nose wheel retracted and locked satisfactorily, the port main wheels unlocked but stopped half way and the starboard unit never moved. On looking round for the experts, I saw them engaged in deep discussion some way from the van oblivious to my bleats for advice.

'Bee' asked what to do now? The only thing I could think of was to ask him to apply a modest amount of 'g' followed by some yaw if that didn't work. 'Which way and how much?' came the short response. Nothing changed and the big worry now was that we may not be able to lock the gear down again. Taking a deep breath, I asked 'Bee' to select 'down' and was most relieved to hear that we had three green lights.

The undercarriage had, of course, operated many times on jacks in the hangar without problems and, after landing, we repeated the operation when everything worked properly. After a lot of head scratching it was decided to try to simulate air loads on the main undercarriage legs by rigging up a Heath Robinson device with blocks and tackle – the legs did not move! A few days later we embodied the first

modifications but it took another seven flights with changes between each flight before we got things working correctly.

These flights revealed a further phenomenon in the form of a severe lateral shake at the instant of touch down of such a magnitude as to cause the pilot some temporary disorientation. After adjustment to the main wheel bogie angles we managed to reach a temporarily acceptable standard but clearly more work was needed by the undercarriage experts.

On the tenth flight, when we got the undercarriage up correctly for the first time, we immediately increased speed in cautious steps to over 500 knots at low altitude in considerable air turbulence where the pilot reported a relatively minor response whilst the chase aeroplane, a Lightning, was affected quite significantly. At least, the signs were that we had got the aerodynamics right for low level high speed flight!

We now believed we had the aircraft to a standard where we could take it back to Warton and get on with the vast amount of work in front of us. After presenting our case to MoD they agreed and the transit to Warton was made on the fourteenth flight on the 22<sup>nd</sup> February 1965 during which, for the first time, the aircraft exceeded M 1.0.

After I had heard 'Bee' contact Warton Air Traffic satisfactorily, I parked the radio van, jumped into my car and belted up the road to Warton where the whole factory had been allowed out to view the aircraft's arrival. We settled down to a more normal routine flight test process when, on the 6<sup>th</sup> April 1965, it was announced in Parliament that the whole project was cancelled forthwith. I was in a meeting at the time with the Chief Engineer, Don Crowe, who was, normally, a well-spoken quiet man but, when his secretary brought him the news, his language degenerated to that of the gutter! His mildest remark was 'That swine Harold Wilson is a snivelling bastard' and nobody disagreed with him.

The shock waves at Warton were profound and even the most rabid local supporters of the Labour Government were totally speechless, recalling the election address to a mass meeting at Strand Road in Preston where the Labour candidate had promised them that the TSR 2 would not be cancelled. It soon became clear that, as the forward work level had taken a swingeing blow, a very high level of redundancies would follow and, within a matter of weeks, every office and shop in the company lost very experienced staff from which US industries benefitted

On a personal and domestic note, the build up to the TSR.2 operation had been a very high pressure period involving a lot of time away from home with only the odd weekend snatched during the last 10 months. Amongst the people who supported TSR.2 at the build site, it seemed that the divorce rate reached epidemic proportions as wives and families came a poor second to progression to first flight. Sadly, this and our work at all levels and in all disciplines in the companies were wasted at cancellation – a time when we were convinced that we would be able to satisfy the requirements of the Royal Air Force. As they say, 'the rest is history' but, in spite of this appalling political disaster, phoenixes have continued to emerge.