B.L. Tozer (Basil)

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Interview 16th July 198]

T was in chage of EMR at Harvell (but repensible only for the physics and electrical engineering) in the early 1950s, then in charge of proceeder and argonisation for Zeta, then in charge of EMPK at Culham. I yeart precisity 3 hours with him, and he just talked.

T said that EMR pre-daked Harwell, and starked when billish industry started on this, that and to get British industry started on this, that or the other. It nos done by Willow in London, under the anspires of the old tube allays group. T's first main work (under Willion i London) ho to use DSIR money to equip British universities with particle accelerators. All this work was on a cost + & basis, and the universities themselves were not equipped to handle it. There were 6 large worksats with the big electrical Jims (M.V. EE, GEZ etc). The emphasis then shifted to accelerators for Harwell and though the MRC for medical work i hargeled and though the MRC

Other than the nucleotor work, other large curticants included that with ICI, and a contract with GEC, dating from the hube alloys days, which gave Harvell ours to their rescand habs for any work on a tosterestaries no propit basis. The difference between cost + and no profit us anodennic, as the overheads were fried accordingly and all the early contracts were exentially bosed on a gentleman's agreement as to an appopriate overhead rake. At this stage, anadring to T. things were expanding to fast that anything could be tried. And Cozhavill would import anything, to long as the chap was enthusiastic A lot of nork us storted, and their was a lot of dead ends.

Another large field for EMR has instrumentation, again not only for Harnell but the for universities, horgeitals, with defense, etc. These were very extensive contracts, with the firms being encouraged to develop to a brood general genification and sell, Marnell taking a royalty. Other fields covered by large contracts from the pre-Harvell days were for electromagnetic expositions, mass gentrameters, and centrifuges, the latter inducted on a such it and see brois and hidden i the GEC contaret. This was ended, Knowled being dissetisfied with the just before news from Germany yearked off a knewed inherest i the field, Kindamental use on graphite constituted another large church of the GEC contract, and was very well dure.

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Since Harvell's sequivements were very specialized the contracts did net often lead to large sale production. But Philips made some linear anederators commercially, and they, Vleney of and Mullad's made instruments. Philips and Mullad's posed a problem, since they were commercially in separable, but Philips were not OK from the security angle.

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At this point T left EMPR (Kempwaidy) and huned to the Fusion programme. His memories 1 its mights were have and in accurate, but some ideos emerged. Thomson's palant application has for a device to make Photon im, and use possed on the Phomic Grengy Office by the Palant Office. They aid that Thomson would not take rule a palent on this, and possed it to Tozer to but out. They have to be Thomson with Coloroft, and an appendent us reached on what he could and would not do at Imperial College - to make matters work, one of his students working on it was a security visk.

Meanwhile Thoremann us also nothing on the idea and had gone to Harvell for help. Skriner, who would sign anything, gove him cake blanche to draw anything he liked from the stores and he book chairs and everything.

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and refused, but suggested that if the work could not be done at Imperial it should be done under Allibore at AEI. For a comple of years the AEI north nos hypervised entriety by Thomson; then Ky insisted or proper control and it up taken over by Ware. But they ended up just togging along kehind Harvell. Craggs at liverpool had also keen miched in carly Jusim nork, but dropped out when it became clossified .

One of the biggest EMR contracts T handled was the proton linac. This suffered from the faut that there is smore expertise in the disting divisions of Hawell that = either CMR or industry, with the walk that the preinfraction was modified night up to the lost minute. I said that Met-Vick were a very herivarchical organization, in which each department operated under a chief orginar and Als director independently of the others. Big contracts would entail one department networky sub-contracting to the other with resulting chaos. Moreover this sub-contracting nos not always on the sime certing bousing os the original Hornell contract. The who AEI organisation (M-V, GER, BTH etc) us initially disjonited. GER for example were anable to wordinate design and production, so that having made a prototype they used then - and only the - find that they could not protone it . English thertine wee apalling, with their search dyabaent run by a beneident dictator, J. K. Bourn, and nith a brally

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findal structure which preserved their good angineers from having any say in things. Electronics from i general war problematic, of they couldn't keep their shaff

T said that all fims hook in deselopment continuts in the hope of getting a production order. But the herelopment always needed their best men and a very high proportion of their skills, while the requirements were very rarely displicated, so that the production orders didn't offer arise. The firms nativally get fed up with this, and by 1958-7 very few of them were prepared to another development contracts. Gen of a production order did ensue, the channes of carly obselence were high.

T said that ther we rome pressures on where to place northe. Revelopment areas were preferred, and defence equivements always had privinty. At one days the Administs even set up on Electronics Ksark and Revelopment contracts coordination committee to allocate privities.

High accure equipment proda problem as only one frim (threads) was any good at it, and they was getting less efficient as they open from a family fin (threads even said prove at hinde) to a big one, without changing their organisation. Here as elsewhere the problem arose of the expertise keining at Markell and : the late 1950, Markell was reconsiting bearily from the firms with which they had been in anbout, mining clations.

Boch on Jusici, T said that Zeta nor me of the four messful Met-Vich contracts, and three smeasful because I nos conducted from Harwell, with men from Met-Vich kunded to join the derign keams. T thought that classification, isoinked on by the Americans, clowed down the Jusim programme quite a bit, and that the effects of suddan derlossification dowed it down even more. Talking of the plans for Zeta 2, T said that me problem on the agenda was to delemine the begigget load that would be carried by wood or waid - and was the size I device anticipated.

T said that spectronopy by the Justin programme noss assisted by rescarch antipats with Millards, Ferranti and Met-Vich, as well a ky a contrad with Garton at Imperial Cullege, who extended the field into the allier widek and to my ranges wholly as a result of AEA support. These were other University mucas stories too, especially in the development of massivement kerlingtes.

At Culham, T instituted the prostice of attaching university chaft and especially exact students. This us one method of converting money into chaft when the latter were limited, and it was after abused, leading to a lat of not-quite -

-relevant usarch as at Harwell in the bork anoft days. It also allowed people who could not work for the AEA (mainly preigness) to be used at Culham, or if the security people got antenned even at Oxford. In general he thinks it had a very kerepicial effect, injecting new ideas and promoting dre norhing writers with the universities. Talking about security, T coid that one of his jobs of Culham was to keep revets out of what were unclassified Laboratories. This mainly entailed making pre ea - Anke people left everything behind them. Martelli he said nos very naive. He was I a Gurotan attachment to Culhan and came fully compared to handle any kind information he might hind - but did not find any.

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Back on ICSE, T said that he had keen soddled with priornial control I the project, when it huddenly became apparent that there us in fact no oreall estimate in caliberate, Indeed such nos the uncertainly with respect to each of the imponents that they have their estimates had to be quaded from A (fried-price b P (no idea). Most use in the lower end of the rale. Gen when the project us finally concelled, many items had still not keen properly control, and the estimates that did excist were both rague and low.

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of the physics deputments at the universities and said that there into several professors and a roboting head of departmente (he sted livergood) were the nurk successful. He then went on the control the British and American prostries = separt of EMIR and the use of industry. The Americans would singely circulate all possible manufactures and place half a dozen contract i prealled, one or two of which would nucled. This was effective in stimulating industry, but rather expensive. Harvell would, at least after the early days. Wat basic research thouselves. Only after some time would they thish of hindring a firm to make what us required, and they would then give a very tight specification is to materials, following, safety, etc.

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I finally monght T back to what heid said about paied price contracts, and he said that the kig twibble was that while the contracts and legal branches insided on extremely tright mording of the CMR contracts - which in Itself put off prims from undertaking the work -, they always backed down when it came to a contractor not meeting the requirements: they would rever press their legal claims. This, and the publism of cleaning industrial chaff for security, were his two kig headaches.

Interview BL (Basil) Tozer on 16th July 1981

Tozer was in charge of EMR at Harwell (but responsible only for the physics and electrical engineering) in the early 1950s, then in charge of procurement and organisation for ZETA, then in charge of EMR at Culham. I spent precisely 3 hours with him and he just talked.

Tozer said that EMR pre-dated Harwell and started when Cockcroft send messages back from Canada to get British industry started on this, that or the other. It was done by Wildon in London, under the auspices of the old Tube Alloys group. Tozer's first main work (under Wilson in London) was to use DSIR money to equip British universities with particle accelerators. All this work was on a cost basis, and the universities themselves were not equipped to handle it. There were 6 large contracts with the big electrical firms (Metropolitan-Vickers (MV), English Electric (EE), General Electric Company (GEC) etc). The emphasis then shifted to accelerators for Harwell and through the MRC for medical work in hospitals and research centres.

Other then the accelerator work, other large contracts included that with Imperial Chemical Industries (ICI), and a contract with GEC dating from the Tube Alloys days which gave Harwell access to their research labs for any work on a no-profit basis. The difference between cost and no-profit was academic, and the overheads were fixed accordingly, and all the early contracts were essentially based on a gentleman's agreement as to an appropriate overhead rate. At this stage, according to Tozer, things were expanding so fast that anything could be tried. And Cockcroft would support anything so long as the chap was enthusiastic. A lot of work was started and there were a lot of dead ends.

Another large field for EMR was instrumentation, again not only for Harwell but for universities, hospitals, civil defence etc. These were very extensive contracts with the firms being encouraged to develop to a broad general specification and sell, Harwell taking a royalty. Other fields covered by large contracts from the pre-Harwell days were for electromagnetic separators, mass spectrometers, and centrifuge work, the latter conducted on a switch-it-on-and-see basis and hidden in the GEC contract. This was ended, Fromberger(?) being dissatisfied with it, just before news from Germany sparked off a renewed interest in the field. Fundamental work on graphite constituted another huge chunk of the GEC contract and was very well done.

Another chuck of work, this time with the universities was on bacteriological(?) research with a view to the possibility of using bacterial(?) preferences to separate out heavy water. This was not successful. There was also liquid metal work at Cambridge University and at BTH-EE. In 1954 a substantial contract was placed for a heat transfer in sodium rig with Foster-Wheeler, Bauer being the chief protagonist. It turned out however that Aldermaston were doing almost exactly the same thing (for Lithium) and that Capenhurst were also doing a lot of work of which Harwell had not been informed. Bauer left.

Since Harwell's requirements were very specialised the contracts did not often lead to large scale production. But Philips made some linear accelerator commercially, and they, Plessey, EJ Cole and Mullard made instruments. Philips and Mullard passed on problem, since they were commercially inseparable, but Philips were not OK from the security angle. Tozer said that difficulties began to arise with the cost contracts when Harwell became more knowledgeable than the firm involved. Arguments arose as to the design, and the specification kept changing with the result that the contract would get quite out of control. This happened in the mi-1950s with accelerators. On the other hand, fixedprice contracts had their own disadvantages. The MRC neutron generator made by Philips was 1.5 years late and performed well below specification, but they ended up paying for it in full.

At this point Tozer left EMR (temporarily) and turned to the fusion programme. His memories of its origins were hazy and inaccurate, but some ideas emerged. Thomson's patent application was for a device to make plutonium and was passed in the Atomic Energy Office by the Patent Office. They said that Thomson would not take out a patent on this and passed it to Tozer to sort out. Tozer went to see Thomson and Cockcroft and an agreement was reached on what he could and could not do at Imperial College – to make matters worse, one of his students working on it was a security risk.

Meanwhile (Peter) Thonemann who was working on the idea and had gone to Harwell for help. Skinner, who would sign anything, gave him carte blanche to draw anything he liked from the stores and he took chairs and everything.

Thomson was asked to sign away the patent and refused but suggested that if the work could not be done at Imperial it should be done under (Thomas) Allibone at AEI. For a couple of years the AEI work was supervised entirely by Thomson; then Fry insisted on proper control and it was taken over by Ware. But they ended up just tagging along behind Harwell. Craggs(?) at Liverpool had also been involved in early fusion work, but dropped out when it became classified.

One of the biggest EMR contracts Tozer handled was the proton linac. This suffered from the fact that the there was more expertise in the scientific divisions at Harwell then either EMR or industry, with the result that the specification was modified right up to the last minute. Tozer said that Met-Vick were a very hierarchical organisation in which each department operated under a chief engineer and sales director independently of the others. Big contracts would entail one department naturally(?) sub-contracting to the others with resulting chaos. Moreover this sub-contracting was not always on the same working basis as the original Harwell contract. The whole(?) AEI organisation (MV, GEC, BH etc) was similarly disjointed. GEC for example were unable to coordinate design and production, so that having made a prototype they would then – and only then – find that they could not produce it. English Electric were appalling, with their research department run by a benevolent dictator JK Brown, and with a totally feudal structure which prevented their good engineers from having any say in things. Electronics firms in general were problematic as they couldn't keep their staff.

Tozer said that all firms took on development contracts in the hope of getting a production order. But the development always needed their best men and a very high proportion of their skills, while the requirements were very rarely duplicated, so that the production orders didn't often arise. The firms naturally got fed up with this and by 1956-7 very few of them were prepared to accept development contracts. Even if a production order did ensue, the chances of early obsolescence were high.

Tozer said that there were some pressures on where to place work. Development areas were preferred, and definite requirements always had priority. At one stage the Admiralty even set up an Electronics Research and Development Contracts Coordination Committee to allocate priorities.

High vacuum equipment posed a problem as only one firm (Edwards) was any good at it and they were getting less efficient as they grew from a family firm (Edwards even said grew(?) at lunch) to a big one without changing their organisation. Here and elsewhere the problem arose of the expertise being at Harwell and in the late 1950s Harwell were recruiting heavily from the firms with which they had been in contact, ruining relations.

Back on fusion, Tozer said that Zeta was one of the few successful Met-Vick contracts, and it was successful because it was conducted from Harwell with men from Met-Vick funded(?) to join the design teams. Tozer thought that classification, insisted on by the Americans, slowed down the fusion programme quite a bit, and that the effects of sudden declassification slowed it down even more. Talking of the plans for Zeta 2, Tozer said that one problem on the agenda was to determine the biggest load that could be carried by road or rail – such was the size of device anticipated.

Tozer said that spectroscopy for the fusion programme was assisted by research contracts with Mullards, Ferranti and Met-Vick as well as by a contract with Gorton at Imperial College who extended the fields into the ultra-violet and x-ray ranges wholly as a result of AEA support. There were other university success stories too, especially in the development of measurement techniques.

At Culham, Tozer instituted the process(?) of attracting university staff and especially research students. This was one method of converting money into staff when the latter were limited, and it was often abused leading to a lot of not-quite-relevant research as at Harwell in the Cockcroft days. It also allowed people who could not work for the AEA (mainly foreigners) to be used at Culham, or if the security people got awkward even at Oxford. In general he thinks it had a very beneficial effect, injecting new ideas and promoting close working contacts with the universities. Talking about security, Tozer said that one of his jobs at Culham was to keep secrets <u>out</u> of what were unclassified laboratories. This mainly entailed making some ex-AWRE people left (leave?) everything behind them. Martelli, he said, was very naïve. He was on a Euratom attachment to Culham and came fully equipped to handle any kind of secret information he might find – but did not find any.

Tozer said that when the Russians announced a very high temperature in a tokamak the Americans did not believe them, but Culham, with their exceptional knowledge of measurement techniques offered their services, went to Russia and found an even higher temperature than had been claimed. Tozer thought that had Culham gone ahead with ICSE Pruy(?) would have been able to convert to a tokamak very quickly and would not, in particular, have been held up as they were by electricity supplies.

Asked about the LTR advisory committee, Tozer said that Schönland just forgot about it.

Back on ICSE, Tozer said that he had been saddled with financial control of the project when it suddenly became apparent that there was in fact no overall estimate in existence. Indeed such was the uncertainty with respect to each of the

components that their estimates had to be graded from A (fixed-price) to P (no idea). Most were in the lower end of the scale. Even when the project was finally cancelled, many items had still not been properly costed and the estimates that did exist were both vague and low.

Going back to accelerators, Tozer told me that he had once worked out the ratios of initial approval to final cost and found ratios(?) from 1:1 to 1:5, averaging 1:2.8.

At this point, Tozer came to a temporary halt, and I was able to ask a question, to which he replied that before the Authority was set up, Harwell was totally autonomous and that everything that did go through the Ministry of Supply was simply rubber-stamped. He then worked his way round (how I did not note) to his expertise of the physics departments at the universities and said that those with several professors and a rotating head of department (he cited Liverpool) were the most successful. He then went on to contrast the British and American priorities – a repeat of EMR and the use of industry. The Americans would simply circulate all possible manufacturers and place half a dozen contracts in parallel, one or two of which would succeed. This was effective in stimulating industry but rather expensive. Harwell would, at least, after the early days, start basic research themselves. Only after some time would they think of finding a firm to make what was required, and they would then give a very tight specification as to materials, tolerances, safety etc.

Tozer did not recall any duplication of EMR work by different AEA establishments and he said that a list of contracts was exchanged. Nor was there any real problem of technical feedback between the establishments. There were internal problems though, and it was particularly difficult to stop scientists approaching firms direct.

Back on university research Tozer said that given the specialised equipment involved, work on a given subject had to be concentrated. They therefore tried to build up centres of excellence and did this in many cases: liquid metal chemistry at Nottingham; spectroscopy at Imperial; lasers at Imperial and Belfast etc.

I finally brought Tozer back to what he'd said about fixed-price contracts and he said that the big trouble was that while the contracts and legal branches insisted on extremely tight wording of the EMR contracts – which in itself put off firms from undertaking the work – they always backed down when it came to a contractor not meeting the requirements; they would never press their legal claims. This, and the problem of clearing industrial staff for security, were his two big headaches.

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