

International Networks and Aircraft Manufacture in Colonial and Postcolonial India: States, Entrepreneurs and Educational Institutions, 1940-64.[†]

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This paper examines the beginnings of aircraft manufacture and maintenance in India by exploring the early history of Hindustan Aircraft Limited (HAL)—India’s premier producer of military aircraft—from its establishment (1940) to the inauguration of its best known locally designed aircraft (1964). Scholars have seen HAL’s beginnings primarily as an instance of colonial imperatives subjugating indigenous enterprise (the company was promoted by industrialist Walchand Hirachand and later taken over by the colonial government). This paper, on the other hand, emphasises the multiplicity of actors and the broader, often extra-imperial networks that played a role in HAL’s development. The plant in Bangalore was commissioned by a team of American engineers under W.D. Pawley, who would arrange for manufacturing licences, machinery and materials through his American company, Intercontinent Corporation. These American experts supervised a team of Indian engineers and technicians; the factory was run by the US Army during the latter years of World War II. Other crucial actors were the princely government of Mysore, which provided land and concessions for the factory; German and Germany-trained experts who worked in HAL’s design teams in the post-Independence period; and the Indian Institute of Science, which provided HAL with trained personnel and research facilities.

I Introduction

This paper examines the beginnings of aircraft manufacture and aeronautical engineering in India through the early history of Hindustan Aircraft Limited (HAL, established 1940). It

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traces the development of the company until 1964, when it launched two of its better known locally designed aircraft, the Maruta and the Kiran. Promoted by industrialist Walchand Hirachand and his associates, HAL was set up with the assistance of the Mysore Government, which provided half of the initial capital, land, and other facilities for the company's factory in Bangalore. The company, which was acquired by the Government of India soon afterwards, played a crucial role in the assembly and repair of warplanes during World War II, when it was temporarily managed by the US Army. In the post-Independence period, it became a key supplier of aircraft to the Indian Air Force among other customers. Its successor company continues to be India's premier producer of military aircraft.

There is as yet no detailed historical study that examines the founding and development of Hindustan Aircraft, although the broad timeline of events in the company's early years has been described in passing by historians of science and business in India.¹ They have tended, following the point of view of actors like Walchand,² to see HAL primarily as an instance of colonial imperatives subjugating indigenous industrial entrepreneurship. J.N. Sinha talks of 'the cold response' of the colonial government to Indian proposals to build an aircraft industry,³ while R.K. Ray remarks that 'the Government of India not only refused to extend any assistance at all, but positively sought to obstruct Walchand's strenuous efforts', and that in general, India during World War II 'really missed splendid opportunities of initiating heavy industries on a large scale.'⁴

Recent work in the history of technology underscores the need to understand Indian science and technology not merely through the lenses of 'colonial' and 'national' science but also as part of broader, extra-imperial networks and against the backdrop of international politics.⁵ This paper extends this historiographical emphasis by examining various sources, including wartime files in the India Office Records, archival material at the Indian Institute of Science and the National Archives of India, the aeronautical industry press, and biographical accounts of key actors.

I argue that the colonial government's position on the setting up of an aircraft factory was not entirely uncooperative; its response was more nuanced, influenced both by political considerations and wartime requirements. Nevertheless, the aircraft industry in India owed its establishment to multiple actors: the governments of India (colonial and postcolonial), Mysore, and Britain; the United States Army Air Force during World War II; German and German-trained experts, particularly in the postwar period; American and British business interests; and educational institutions. This multiplicity of actors and interests continued to characterise the post-Independence period, when the government's short-term military needs competed with Indian scientists' (and its own) desire to focus on research leading to the indigenous development of aircraft.

¹ Sinha, *Science, war and imperialism*, pp. 108-111; Ray, *Industrialization in India*, pp. 255-6. Piramal, *Business Legends* deals with the HAL story briefly (ch. 9), but only until 1942, when Walchand's interests were bought out by the colonial government.

² See Khanolkar, *Walchand Hirachand* (Walchand's official biography).

³ Sinha, *Science, war and imperialism*, p. 111. Of HAL and other ventures, Dietmar Rothermund writes that '[t]he British ... were not inclined to support the growth of new industries that would compete with them after the war [World War II].' Rothermund, *An economic history of India*, section 9.2.

⁴ Ray, *Industrialization in India*, pp. 255-6.

⁵ Bassett, 'MIT-trained swadeshis'; Bassett, 'Aligning India'; Ramnath, 'Engineers in India' ch. 1 and ch. 6; Phalkey, 'Introduction'.

II The British government, the GOI, and proposals for an aircraft factory

The main promoter of the company that became Hindustan Aircraft, Walchand Hirachand (1882-1953), hailed from a Jain family settled in Sholapur. Walchand began his career as a construction contractor and soon developed a marked enthusiasm for starting industrial enterprises. In the 1930s, having acquired a reputation for risk-taking and diversified into shipping and sugar manufacture, he began making serious efforts to inaugurate automobile and aircraft manufacture in India.⁶

According to the standard narrative of the birth of the aircraft project, Walchand's interest was first kindled in October 1939, when he happened to meet a prominent American executive, William D. Pawley, on a flight from San Francisco to Hong Kong. Pawley (1896–1977), who would later become an influential diplomat, was at this time the president of Intercontinent Corporation, New York, and Director of the Central Aircraft Manufacturing Company (CAMCO) in Kuomintang China, which was building planes for the Chinese national government.⁷ Walchand promptly asked Pawley if he was willing to help open a factory in India, and cabled the colonial government with a proposal to sell them aircraft required in the war that had just broken out in Europe, if the government would provide the necessary help. His repeated messages made little impression on the 'lethargic' government until mid-1940, when Walchand, then in Simla on other business, managed to bring his proposal for aircraft manufacture to the attention of the relevant officials. By this time the war in Europe had progressed, France falling to Nazi Germany, and the British government conceded it was no longer in a position to supply fighters to India in the event of an aerial battle there. China, too, was in need of aircraft in the face of Japanese aggression. Pawley was invited to India, and came in July 1940 along with a senior engineer, McCarthy, Jr., his legal adviser and manager, George Sellett, and his brother, E.P. Pawley to participate in talks with Walchand and the government. A few days later, the government had agreed provisionally to the proposed factory, and placed a tentative order worth \$10 million for trainers, fighters and bombers along with spare parts (pending approval from London).⁸

But a close study of the correspondence between Simla and London suggests that this picture of a slumbering government is not entirely accurate. It does seem plausible that the Walchand-Pawley scheme got lost in the thickets of government bureaucracy for a few months. But the government was quite cognizant of the need to consider aircraft production. As early as September 1939, a month before Walchand's initial cables, the Viceroy (Linlithgow) had initiated a discussion on whether aircraft could be produced in India. Shortly thereafter, a group of Calcutta-based businessmen had come forward with a proposal for aircraft manufacture, and both colonial and 'home' governments (henceforth GOI and HMG respectively) set about evaluating it carefully.⁹ In fact this group had sent their representative to put the proposal directly to the Air Ministry in the UK, asking for financial assistance from HMG. The proposal was considered by the Supply Committee,¹⁰

⁶ Khanolkar, *Walchand Hirachand*; Ray, *Industrialization in India*, pp. 176 and 280-1.

⁷ Khanolkar, *Walchand Hirachand*, p. 345; Carrozza, *William D. Pawley*.

⁸ Khanolkar, *Walchand Hirachand*, pp. 347-52, quoted text from p. 348.

⁹ Economic and Overseas Department, India Office, No. 1879/40, 'Possibility of the establishment of an aeroplane manufacturing industry in India. Views of the Government of India, following an investigation conducted by the Director of Civil Aviation', in IOR/L/E/8/1711 (India Office Records, British Library, London). All subsequent official letters, telegrams and memoranda cited below are from this file (IOR/L/E/8/1711) unless otherwise specified.

¹⁰ A.M.D.P., '188th Progress Meeting. Proposals to Manufacture Aircraft and Train Pilots in India', Copy, Secret, 11 November 1939, in E&O No. 1879/40.

and A.H. Self of the Air Ministry requested F. Tymms, Director of Civil Aviation in India, to investigate the proposal informally and talk with the backers of the scheme. The Ministry was not in favour of HMG investing capital, as it was unlikely that the scheme 'would enable India to contribute towards the present war effort in the manufacture of all-metal aircraft'. In the long term, though, the proposal had possible advantages, particularly in its potential to provide '[military] aircraft for the Far and Middle East' by utilising Indian resources and labour. In addition, civil aviation in India was likely to grow, so 'there would seem to be a considerable commercial incentive for the creation of an indigenous aircraft industry on a long term basis, and the Government of India would, no doubt, wish to consider the possibility of encouraging an enterprise of this nature.'¹¹ Tymms, along with the Chief Inspector of Aircraft, proceeded to Calcutta. There they met the putative promoters of the factory, who included the heads or officials of the Indian Jute Mills Association, the Tata Iron and Steel Company, the Indian Iron and Steel Company, Braithwaite, Jessop, and the Aluminium Manufacturing Company. They also 'made a preliminary technical survey of the resources available' for composite and all-metal planes respectively, concluding 'that the resources of India both for the production of special metals and in machining ... are greater than was supposed.'

Tymms felt that as the utility of the proposed factory to the war effort was not guaranteed, the scheme should be evaluated at least partly 'on the strategic and national advantages to be derived from the permanent establishment of the industry and its associated industries through the medium of the war impetus.' It was with this in mind that its backers wanted to manufacture not just airframes but aero engines; the machinery for the latter could be put to other uses in peace-time.¹² In April 1940, as a more detailed follow-up, the GOI's Department of Supply requested the 'Air Ministry to send a small expert commission to India to make a rapid investigation of the facilities available'.¹³

If the GOI seemed cautiously optimistic, the Secretary of State for India, Leo Amery, was positively enthusiastic about the prospect of building aircraft in India. According to a draft note prepared by his office to be forwarded to the Air Ministry,

Mr. Amery is of the opinion that the proposal should be considered on the assumption that the war may last for several years ... In view of this possibility, and of the likelihood of a universal expansion of air services, both military and civil, ... the question should, in his opinion, be studied from the point of view of considering a bold programme of all metal construction, including engine construction. The possibility of the use of plastic construction might also be investigated.¹⁴

Amery's enthusiasm was not shared by William Maxwell Aitken, the Baron Beaverbrook, whom Churchill, the incoming Prime Minister, appointed head of the newly established Ministry of Aircraft Production (MAP) in May 1940.¹⁵ Beaverbrook was charged with increasing the number of planes available to Britain, and was not inclined to do anything that he thought might endanger that goal. In June, as France was being overrun, Amery wired Linlithgow that 'Lord Beaverbrook ... cannot spare anyone for technical mission

¹¹ [A.H. Self/ Air Ministry] to F. Tymms, 5 December 1939, in E&O No. 1879/40.

¹² F. Tymms, 'Aircraft Construction in India. Note by the Director of Civil Aviation (India),' 25 January 1940.

¹³ [Wood?], Secretary to the Government of India, to Under Secretary of State for India, London, No. 12122, 8 April 1940, in E&O No. 1879/40.

¹⁴ Enclosure 'A', in E&O No. 1879/40.

¹⁵ Boyce, 'Aitken, William Maxwell'.

[which the GOI had requested] at this moment'.¹⁶ Amery and Beaverbrook, 'Leo' and 'Max' to each other, were to be involved in an epistolary tug-of-war over the next couple of months.

Meanwhile, as the war progressed, observers on the subcontinent began to worry about India's preparedness to repulse attacks, especially from the air. The GOI, feeling the pressure of 'the tide of public opinion', was in dire need of aircraft, 'if only because of their reassuring effect'.¹⁷ The situation thus had two related aspects: India needed aircraft from a strategic point of view; and the GOI needed, in order to maintain its political legitimacy, to appear responsive to Indians' demands, one of which was to produce aircraft in India.¹⁸

It was in this climate that the Walchand-Pawley proposal caught the GOI's attention. On 6 July, shortly after the Simla meeting with Walchand, Pawley, and their associates, the GOI's Department of Supply sent a telegram to the Secretary of State in the India Office giving him details of the scheme. A new, preferably private, company was to be established by Walchand, with Pawley in charge of running the factory and arranging for materials and technicians, mainly from the USA.

What predisposed the GOI to support this scheme when it had other options, like the Calcutta proposal with high-profile supporters? It is very likely that they were swayed by two factors. First, progress on the latter had hit a roadblock as the requested experts from Britain were not forthcoming; second, Pawley's presence lent the new scheme an air of concreteness. He, unlike the Calcutta promoters, had built aircraft before. The GOI reported that they were 'favourably impressed by Pawley, whose actual performances [in China] under conditions of greater difficulty than exist in India are most impressive'. Further, there was the prospect of relatively quick results: Pawley's contacts with the Curtiss Corporation (for which he was the sales agent in China) meant he could get components for assembly in the near future. There was also the question of his CAMCO plant in China, which had been relocated a number of times for strategic reasons and was currently at Loiwing near the Burmese border. The prospect of Japanese air raids and of the closure of the Burma Road (through which materials shipped from America were transported to Loiwing) added another angle: in the event of the factory having to be abandoned, its machinery and technicians could be shifted wholesale to the new site in India.¹⁹

The official telegram of 6 July was accompanied by a 'Private and Personal' one from Viceroy Linlithgow to Secretary of State Amery. In it, Linlithgow indicated that internal political considerations were playing as heavily on his mind as the threat of external aggression.

The whole of India is teed up for proposal of this kind: the feeling that we can, and demand that we should, embark on aircraft manufacture are very strong, and nothing will so strike the imagination of India and inspire confidence ... to pursue war to a victorious conclusion. Conversely, any reluctance or delay in pursuing this proposal, of soundness and practicability of which we are ourselves convinced, would have serious political repercussions ... *Walchand is an astute publicist* and would see to it that worst possible construction would be put on refusal to proceed with this venture by wholly

¹⁶ Draft telegram, Secretary of State to Viceroy, 6 June 1940.

¹⁷ Extract from private letter, Linlithgow to Amery, 6 June 1940.

¹⁸ Extract from private letter, Linlithgow to Amery, 13 June 1940.

¹⁹ Decypher, Telegram 2394, GOI, Dept. of Supply to Secretary of State for India, 6 July 1940. Also see Carozza, *William D. Pawley*.

Indian Company.²⁰

On 11 July a meeting took place at the India Office to discuss the Walchand-Pawley proposal. It was attended by officials of the India Office, the Burma Office, the Air Ministry, and the Indian Civil Aviation Directorate.²¹ The MAP declined to send a representative, saying it was not interested in a manufacturing scheme that would only bear fruit in the long term,²² and it was known from Amery's discussions with Beaverbrook that the latter would not countenance a factory that might divert to India any Britain-bound American materials or machinery for the construction of bombers or fighters. He did not, however, mind if India bought materials for trainers from the USA.²³ Meanwhile, at the meeting, the representative of the Burma Office suggested that an independent opinion be sought in America to judge whether Pawley would indeed be able to get the required material from the USA as he had claimed he could.²⁴ In the days that followed, Amery exchanged messages with one William Robinson, who had been connected with the inauguration of aircraft production in Australia. Robinson assured him that he thought the Walchand-Pawley scheme practicable and on the whole 'very attractive'.²⁵ (Not that this would, in the opinion of one India Office functionary, persuade the MAP. 'I suppose Ld. Beaverbrook is impervious to any one else's opinion.')²⁶

Meanwhile, Amery prepared to inform the GOI that they could go ahead with the proposed factory, as long as they stuck to trainers (unless it became an absolute necessity to produce bombers or fighters).²⁷ But now Beaverbrook objected to this too. 'My dear Leo,' he wrote, '... It is true that we are not purchasing trainer aircraft. But any interference would not only put up prices, but would also disturb the organisation we have built up.'²⁸ Amery stood his ground, arguing that India buying 'a few trainer engines which you do not want, through an organisation which is already buying for China' could hardly affect the MAP's operations. 'My lamb really cannot muddy the water which your big, bad wolf is drinking upstream!'²⁹

Meanwhile Linlithgow and his government began to send Amery strongly worded telegrams arguing for the scheme to go ahead as originally envisaged – i.e., it should be allowed to make not only trainers but also bombers and fighters. Further arguments were added in support of starting a factory. For instance, it was suggested that it could perform a useful additional function as a centre for the repair of military planes. Further, the Viceroy would soon be confronted more directly with Indian opinion when his Council was enlarged (in the autumn of 1940), adding a number of 'non-official' members (which would mean Indian politicians).³⁰ In view of the GOI's clear stance, Amery approached Arthur

²⁰ Telegram, Viceroy to Secretary of State, 7 July 1940. Emphasis mine.

²¹ 'Note of a meeting held at the India Office on the 11 July 1940, to consider the Government of India's telegram No. 2394 of July 6th concerning a proposal for the manufacture of aircraft in India'.

²² Ibid.; G. Simmons, MAP, to E.W.R. Lumby, India Office, 10 July 1940.

²³ A note by 'M.J.C.' [most likely M.J. Clauson of the India Office] dated 19 July further qualified this. Beaverbrook, he suggested, was not in favour of India making trainers either, but did not have the *locus standi* to prevent it, because his Ministry was not engaged in buying trainers in the USA.

²⁴ 'Note of a meeting held at the India Office on the 11 July 1940'.

²⁵ Various letters and telegrams, June-August 1940. Quoted phrase from telegram, Robinson to Amery, [1?] August 1940.

²⁶ W.D. [Croft], handwritten intra-departmental memo, 1 August [1940].

²⁷ (Draft) telegram, Secretary of State to Supply Department, GOI, c. 16 July 1940.

²⁸ Max [Beaverbrook] to Amery, 15 July 1940.

²⁹ L.S.A. [Amery] to Beaverbrook, 16 July 1940.

³⁰ Various cables and letters, including Viceroy's telegram of 29 August 1940.

Greenwood, Chairman of the Production Council, to break the deadlock.³¹ Greenwood, in turn, advised Amery to take the matter up with the War Cabinet.³²

The War Cabinet took up the question on 4 September 1940.³³ The Secretary of State reiterated the benefits of a factory in India that could be used for the repair as well as for the construction of warplanes, and that the Viceroy was very keen on it. Beaverbrook repeated his objections, focusing on the question of aero-engines, which, he said, were urgently required in 'all the Dominions', and which consequently had to be bought in total by Britain. The Vice Chief of Air Staff felt that the scheme might not be useful 'on a short term view'. The Prime Minister, Churchill, pointed out that Germany, whose warplanes were at that moment engaged in combat with the RAF, would likely ramp up aircraft manufacture in the occupied countries, and Britain 'must be prepared to meet aircraft production on a European scale.' This was only possible if they 'used the most efficient centres of production'; they 'must not dissipate [their] resources.' The War Cabinet resolved to reject the Indian factory proposal for the moment, but said they might look at the scheme again in a couple of months.³⁴ They appear to have kept their word, and in December 1940, the Battle of Britain over, the Walchand-Pawley scheme finally received the go-ahead, on the condition that all production inputs must be obtained from countries other than Britain or the USA.³⁵

III Setting up the factory

Walchand now needed capital, land, and resources to import raw materials and machinery. He tried to raise funds from another of his concerns, the Scindia Company, but the shareholders were not interested. He then approached a number of princely states, some of whose Dewans he knew well, and eventually elicited interest from the state of Mysore.³⁶

Walchand proposed to the Mysore government that the factory be built in their state with their cooperation. A private limited liability company would be set up, with an authorised capital of Rs. 4 Crore (40 million). Shares worth Rs. 40 Lakh (4 million) would be issued to start with, half of these to be bought by the Mysore government and the other half by Walchand and associates. The latter would form a private limited company called Messrs. Walchand Tulsidas Khatau Ltd., which would be the managing agents of the aircraft company, and appoint three of the five members to the board of directors (the other two to represent the Mysore government). The Mysore government approved this proposal. In addition to Rs. 20 Lakh worth of stock, they provided a number of concessions to Hindustan Aircraft, Limited. HAL would pay no tax on income earned from supplying aircraft to the GOI; the Mysore government would grant free land where possible, or acquire private lands for the company at the latter's expense, and make available '[w]ater and power ... at rates obtaining for large industrial concerns.'³⁷ In April 1941, the Government of India put in Rs. 25 Lakh, and the board was reorganised; the GOI, the

³¹ See L.S.A. [Amery] to Arthur Greenwood, M.P., 29 July 1940.

³² Greenwood to Amery, 17 August 1940.

³³ Copy of cypher telegram (No. 5268), Secretary of State to GOI, 6 September 1940.

³⁴ 'EXTRACT from War Cabinet Conclusions' of 4 September 1940 (typescript).

³⁵ Khanolkar, *Walchand Hirachand*, p. 354; Piramal, *Business legends*, Kindle location 3650; Singh, *History of aviation*, p. 252.

³⁶ Khanolkar, *Walchand Hirachand*, pp. 355-7; Piramal, *Business legends*, ch. 9.

³⁷ G.O. No. D. 3663-3723—I. & C. 216-40-16, February 11 1941, in Mysore Government Proceedings, February 1941.

Mysore government, and Walchand's managing agency contributed three directors each.³⁸

William Pawley's role in the new company was crucial. As per an agreement between him and HAL dated 23 December 1940, the company 'desire[d] to obtain the assistance of Pawley who has experience essential and necessary for erecting, equipping and successfully operating such factory'. The Mysore government would shortly grant the company a 200-acre plot near Bangalore for building a factory and runway. Pawley was asked to produce a 'proper lay-out and all necessary and proper plans, designs, specifications, measurements and other details' for an aircraft manufacture facility spread over 125,000 square feet. Pawley was also to identify the 'machinery and other equipment' required, which the company would purchase in the USA. Significantly, he would have full charge of the management of the factory, deciding whom to recruit and how much to pay them.³⁹

Meanwhile, Pawley's Intercontinent Corporation had acquired on behalf of Hindustan Aircraft a licence allowing them to manufacture Intercontinent-Harlow PC 5 Trainers and spare parts from materials also to be procured by Intercontinent.⁴⁰ The Corporation also purchased from the Chinese government one Vultee V12D Bomber (probably as a prototype), material to build 27 more such aircraft, and three 'Wright Cyclone model 2,600 AB engines with 2 speed supercharger', and rented from China '[j]igs, tools and fixtures' for a period of eleven months.⁴¹

It is not clear how Pawley was able initially to procure material from the USA, given the condition under which the factory had been set up. Gita Piramal writes that after the initial machinery had been obtained from the Chinese government, 'the condition seems to have been met more in the breach.'⁴² Perhaps the MAP relaxed its stance (Beaverbrook resigned in April 1941).⁴³ More likely, the inauguration of lend-lease⁴⁴ in March 1941 removed some of Britain and India's constraints in sourcing aircraft and machinery from the USA. At any rate, it is clear that from around 1942 HAL was getting component materials from the USA on lend-lease (more below).⁴⁵

In Bangalore, Walchand's brother Lalchand Hirachand and two technical experts from other Walchand-promoted companies, Varadarajan and Maganlal Shah, joined Pawley, McCarthy, Sellett, and some of Pawley's experts from his Chinese factory. They worked together to put up the new factory in a matter of weeks.⁴⁶ The factory was inaugurated in January 1941, and began assembling a Harlow PC-5A, a two-seater. It delivered its first aircraft to the government in August that year. A year later, HAL had built and carried out a test flight for its 'first indigenous design, a nine-seat troop-carrying glider of wood-and-fabric construction'.⁴⁷

The agreement with Pawley stipulated that the employees 'shall include about sixteen American citizens possessing technical skill and experience in the art of manufacturing aircraft.' This included managers, department heads, and a chief accountant. They would be paid salaries similar to those in the USA, plus a premium. Other than the American experts,

³⁸ Piramal, *Business legends*, ch. 9.

³⁹ 'Agreement between Hindustan Aircraft and William Douglas Pawley', Document No. 4, in 'Documents of Hindustan Aircraft Ltd'.

⁴⁰ Document No. 10, in *ibid*.

⁴¹ Document No. 12, in *ibid*.

⁴² Piramal, *Business legends*, Kindle locations 3704-8.

⁴³ Boyce, 'Aitken, William Maxwell'.

⁴⁴ 'lend-lease', *Encyclopaedia Britannica* online, 2014 (<http://www.britannica.com/topic/lend-lease>, accessed 25 September 2015).

⁴⁵ Khanolkar, *Walchand Hirachand*, p. 364.

⁴⁶ Khanolkar, *Walchand Hirachand*, pp. 357-9; Carrozza, *William D. Pawley*, p. 111.

⁴⁷ Singh, *History of aviation*, pp. 252-3.

the factory staff was to be made up of 'Indian engineers, technicians, mechanics and other employees'. If necessary, some individuals of other nationalities could be appointed. The American experts, who would be employed for a fixed period, were expected to instruct the Indians, so that the latter could take over the working of the factory after the Americans' departure.⁴⁸

Walchand's biographer writes that '300 Indian engineers highly trained in mechanics and nearly two thousand skilled workmen' were working '[u]nder the direction of 22 American technicians as of 1941.'⁴⁹ A 1943 feature in the American illustrated magazine *Life*, on the other hand, shows two photographs, one of the 'American staff' and the other of the 'Indian staff', each numbering around 40. The Indians, according to the caption, were 'recruited from among the alert young men of progressive Mysore, where education is free.'⁵⁰

The state of Mysore, and in particular Bangalore, was indeed a key source of Indian engineers and technicians for Hindustan. The Indian Institute of Science (IISc), Bangalore had been inaugurated in 1911 upon the initiative of industrialist J.N. Tata and his successors, as an institution for 'research and ... advanced training in selected branches of Science and Engineering.' When HAL was established, the Court of the Institute saw an opportunity, and founded an Aeronautical Engineering department in December 1942.⁵¹ Dr V.M. Ghatage of HAL functioned as 'officiating head' of the department until the arrival of Dr R.G. Harris of the Royal Aircraft Establishment, who became Professor and department head in 1945. As of 1946, there was also an Assistant Professor, two lecturers, and 'two or three research scholars in receipt of stipends who have undergone the certificate course in Aeronautical Engineering at the Institute.'⁵² Around 20 students were trained each year from 1943 to 1945. They were engineering graduates, but the course was conducted 'at a standard lower than Post-graduate level, in view of the fact that the students ... had no background of aeronautical experience'. The course was comparable to the bachelor's level courses at the California Institute of Technology (Caltech) and the Imperial College in London.⁵³ Most of the early graduates of the course found jobs 'in the maintenance and overhaul establishments engaged in war work.'⁵⁴ In addition to IISc, Bangalore was home to other institutions that could provide engineers and technicians for the aircraft factory: the Central College, the Government Engineering College, and the Sri Jayachamarajendra Occupational Institute.⁵⁵

IV Exit Walchand and Pawley: the war years

The formal entry of Japan into the war had underlined the strategic importance of the HAL factory. The GOI decided that 'the Air Forces, both our own and the American Air Force, would require services [at the factory] which would render commercial operation virtually impossible.' The government also wanted to have the option of destroying the factory if it ever seemed in danger of falling into Japanese hands. They 'therefore bought out Walchand and his friends, and sterilized the Mysore interest.' The former were paid Rs. 45 Lakh (their

⁴⁸ Document No. 4, in 'Documents of Hindustan Aircraft'.

⁴⁹ Khanolkar, *Walchand Hirachand*, p. 359.

⁵⁰ 'American makes planes in India', *Life*, 22 March 1943, pp. 30 and 32.

⁵¹ 'Aerospace engineering: history', <http://www.aero.iisc.ernet.in/page/history>, accessed 22 September 2015.

⁵² *Report of the United Kingdom aircraft mission* (Delhi: Manager of Publications, 1946), p. 19. Hereinafter cited as UK Mission Report.

⁵³ UK Mission Report, p. 19.

⁵⁴ *Ibid.*, p. 19.

⁵⁵ *Ibid.*, p. 27.

initial investment of 25 Lakh, plus 20 Lakh as compensation). The Mysore Government agreed to step back for the duration of the war and two years beyond, so that the GOI had complete managerial control. The GOI had to retain Pawley, whose services were handsomely remunerated under the original contract, ‘as he virtually controlled the American personnel’ at the factory. The GOI found the entire exercise ‘damnably expensive’, but took over Hindustan Aircraft in April 1942.⁵⁶

That same month, William Pawley’s CAMCO factory in Loiwing was bombed by Japanese raiders and the site rendered unusable.⁵⁷ Equipment salvaged was transferred to Bangalore. Since this was technically Chinese property, HAL agreed to produce in return 50 single-engine Vultee Bombers for China’s government.⁵⁸

Around this time, the American Technical Mission (1942) visited India to make recommendations on the country’s industrial production during the war.⁵⁹ The Grady Mission (as it was also known) emphasised the need to focus on the repair, maintenance and assembly of American aircraft in India during the war, and the building of more airports safe from aerial attack. India was going to become an important base and stopover for Allied planes in the Asian side of the war. In terms reminiscent of the MAP’s position a couple of years earlier, the Mission suggested that aircraft production was best left to the USA, which was scheduled to turn out 60,000 and 75,000 aircraft respectively in 1942 and 1943. India needed as many repair facilities as possible. ‘It would be unfortunate if this program were to be diverted by an abortive attempt to establish an airplane manufacturing industry in India.’⁶⁰

Soon after this, the GOI arranged to let the US Army Air Force (USAAF) use the Hindustan Aircraft factory for repairs. The United States Commander was to have ‘technical control [and would] appoint resident advisers, whose advice [would] be accepted’ unless the Chairman (Sir John Higgins, representing the GOI) thought the GOI should intervene. Among other things, this was expected to ‘remove the friction which has been perceptible between the Company’s American personnel and the R.A.F.’⁶¹ In 1943 the GOI turned over the running of the factory to the Tenth United States Army Air Force. The factory’s manufacturing contracts (with the Indian and Chinese governments) were cancelled, at great cost, and it was converted almost entirely into a repair centre.⁶²

Pawley’s role now began to diminish. Signs were already visible in 1942, when he was in the US trying to procure materials. A.C.B. Symon of the Indian Purchasing Mission in Washington, D.C. reported to W.M. Yeatts of the American Purchasing Section in the GOI’s Supply Department that while his office felt India should undertake procurement through lend-lease, Pawley was against it, thinking it would take more time. Pawley was a suave negotiator used to making rapid deals,⁶³ and, Symon felt, he was ‘finding it difficult to realise that his influence in high quarters here in present circumstances is far less than may

⁵⁶ Extract, E.M. Jenkins to W.D. Croft, 13 April 1943, in IOR/L/E/8/1711; Khanolkar, *Walchand Hirachand*, pp. 363-5; Piramal, *Business legends*, ch. 9. The quoted text is from the first source (the extract from Jenkins’s letter).

⁵⁷ See R.C. Wertz to W.D. Pawley, 18 June 1942, ‘CAMCO and the fall of Loiwing’, on writer Daniel Ford’s website (<http://www.warbirdforum.com/loiwing.htm>, accessed 26 September 2015).

⁵⁸ Extract, Jenkins to Croft, 13 April 1943.

⁵⁹ Lockwood, *The Indian bourgeoisie*, pp. 154-5.

⁶⁰ Typescript extract from American Technical Mission Report, 20 May 1942, in IOR/L/E/8/1711.

⁶¹ Extract, Jenkins (GOI) to Croft (India Office), 13 July 1942.

⁶² Extract, Jenkins to Croft, 13 April 1943; ‘Hindustan Aircraft, Ltd.’, *Flight*, 27 August 1954, p. 296. All issues from *Flight* cited here were accessed via the online scanned archive at <https://www.flightglobal.com/pdfarchive/index.html>.

⁶³ Carrozza, *William D. Pawley*.

have been the case in pre-war days.' He was also struggling to get material from the US Air Corps. The RAF Delegation in the US, on the other hand, was doing an effective job sending out tools to India, and it might soon prove necessary to 'take the whole thing out of Pawley's hands and deal with it through the R.A.F. Delegation who are giving us the fullest possible co-operation.'⁶⁴ Nor did Pawley find the going easy in Bangalore. A GOI official reported in 1943 that he was 'heartily (and I think unjustly) disliked by the Americans, and in the changed conditions is not really needed.' Consequently, the government was 'trying to get him "organised out" of the business, and ... he [had] agreed.'⁶⁵

Under the USAAF, the Hindustan Aircraft factory swiftly scaled up its capacity and its workforce.⁶⁶ It operated in three shifts and had some 15,000 workers. The engine (overhaul) department was hived off, and conditioned engines at the rate of 300 a month.⁶⁷ The factory, functioning as the 84th Air Depot of the USAAF, repaired and serviced Catalinas, P-38 Lightnings, B-25 Mitchells, B-24 Liberators, C-46 Commandos and C-47 Dakotas, as 'Bangalore became the centre for all major overhaul and repair work on US aircraft'. The war years left 'thousands of Indian workers [with] thorough training in all aspects of aircraft and engine maintenance'.⁶⁸

While HAL was under the direction of the USAAF, it continued to receive substantial assistance from the Indian Institute of Science. As noted earlier, IISc had begun an Aeronautical Engineering department in 1942, and some of its graduates were employed in HAL during the war. But the Bangalore-based department also served as a research and testing facility for the HAL factory, building a wind tunnel largely financed by the GOI.⁶⁹ Other IISc departments, Electrical Technology in particular, also cooperated closely with HAL. At one point during the war, '[o]ver a dozen of the students of this department [were] occupying positions of responsibility in the design, production, inspection and radio departments of the Hindustan Aircraft Ltd.'⁷⁰ HAL was also interested in the department's work on '[t]he use of optical methods for the precision testing of gauges' and had plans to work with the department (which had rigged up a special generator) to try and produce magnesium through electrolysis.⁷¹

V The post-war years: Towards manufacture

At the end of World War II, the GOI was free once more to consider the original purpose of HAL: the manufacture, and not just maintenance, of aircraft. Moreover, when the US Army left, demand for the factory's services fell, and a new programme had to be found for it in peacetime.⁷² In this context, the Government of India requested the British MAP (which soon after this became the Ministry of Supply and Aircraft Production, or MSAP) to constitute a mission to advise on the potential for beginning aircraft manufacture in India for the civil sector and the Royal Indian Air Force.

⁶⁴ Extract, Symon to Yeatts, 24 June 1942, in IOR/L/E/8/1711.

⁶⁵ Extract, Jenkins to Croft, 13 April 1943.

⁶⁶ Singh, *History of aviation*, p. 253.

⁶⁷ 'Hindustan Aircraft, Ltd.', *Flight*, 27 August 1954, p. 296.

⁶⁸ Singh, *History of aviation*, p. 253.

⁶⁹ Undated typed note, 'A brief statement of the part which the Indian Institute of Science has been taking in war-effort', [1940s], p. 5. Courtesy IISc Archives, Bengaluru.

⁷⁰ *Ibid.*, p. 2.

⁷¹ *Ibid.*, pp. 4-5.

⁷² Singh, *History of aviation*, p. 253; 'Hindustan Aircraft, Ltd.', *Flight*, 27 August 1954, p. 296.

The United Kingdom Aircraft Mission consisted of J.V. Connolly and L.R. Barnett of the MSAP, and J.D. North and S.P. Wordley of the Society of British Aircraft Constructors. They spent around a month touring India in March-April 1946, visiting various private industrial enterprises, the Hindustan Aircraft works, and the Indian Institute of Science, and meeting with officials of the Government of India.⁷³

Unsurprisingly, the Mission recommended that the HAL factory be made the centre of aircraft production. It was the only factory in the country where full assembly of aircraft had been undertaken; it had even constructed and tested a glider of its own design in the early years. IISc, the Central College, the Government Engineering College, and the Sri Jayachamarajendra Occupational Institute in Bangalore could act as sources of trained personnel, and the salubrious climate of Bangalore would be suitable for foreign employees should they be required.⁷⁴

The factory, however, would need to be ‘reorganised’ (i.e. downsized), as the wartime scale of operations could not be expected to continue.⁷⁵ The number of aircraft required to be built or maintained would still be small, at least for civilian purposes. The Director-General of Civil Aviation informed the UK Technical Mission that government plans for flights carrying passengers, mail and freight would translate to a demand of about 30 planes, 20-30 seaters ‘of the DC.3 or Viking class’. He estimated that the total annual demand for planes required for commercial use, private ownership and flying clubs combined in the period 1946-50 was 65. This was projected to increase gradually to 120 in the period 1961-65.⁷⁶

The Mission insisted that ‘a firm order should be placed with the reconstituted company for the manufacture and development of a locally designed aircraft’.⁷⁷ As HAL’s design team worked on the indigenous aircraft, a Technical Director appointed from outside India was to provide guidance, but keep at a distance and allow the team to learn from its mistakes.⁷⁸ The Mission also stressed that HAL should take more direct responsibility for the training of personnel for the expanded factory. For skilled labour, they recommended a five-year programme of apprenticeship beginning at the age of sixteen, with instruction either at a vocational institute or in a school in the factory.⁷⁹

Meanwhile, although many of the American engineers employed at HAL had begun to leave the company when their contracts ended,⁸⁰ concerns emerged in some quarters about the continued reliance on foreign experts. In 1946 a petitioner claiming to be the Chief Engineer at HAL wrote to Sardar Vallabhbhai Patel, the GOI’s Home Member (the Indian National Congress was at the helm of a recently formed Interim Government) that Indians at HAL were marginalised and underpaid, while the company was becoming a ‘dumping ground for some of the Britishers who were brought from England during the war for [the] Supply Department as so-called “Experts”’.⁸¹ Addressing the claims, the Member for

⁷³ UK Mission Report, pp. 1-3.

⁷⁴ *Ibid.*, p. 5 and pp. 26-7.

⁷⁵ *Ibid.*, p. 5.

⁷⁶ *Ibid.*, p. 16.

⁷⁷ *Ibid.*, p. 6.

⁷⁸ *Ibid.*, p. 30.

⁷⁹ *Ibid.*, p. 39.

⁸⁰ In 1945 several American employees of HAL requested permission to stay on in India and start other businesses. See ‘Policy in relation to American Nationals desirous of settling [sic] up business in Mysore.’ File No. 10/26/46. GOI, Home Department, Poll (E) Section. Digitised Public Records Home Political, National Archives of India (NAI). Digital Identifier: PR_000003016781. All digitised records of the NAI cited here were accessed via <https://www.abhilekh-patal.in>.

⁸¹ A. Mitra to Vallabhbhai Patel, 13 November 1946, in ‘Discrimination against Indians in The Hindustan

Industries and Supplies (the department concerned with HAL) questioned the authenticity of the letter, but acknowledged that—while he was keen on promoting Indian talent—the country, ‘in the matter of aircraft, ... must be prepared for some time to come to appoint the most efficient personnel she can find irrespective of nationality.’⁸² As we shall see below, Indian design expertise was developed to a considerable extent in the subsequent decades, although engineers and designers from various other countries were often involved, either as employees or as consultants.

VI HAL and aircraft manufacture in Independent India

After Independence, HAL continued to be overseen by the Ministry of Industries and Supplies until it was shifted to the Ministry of Defence in 1951.⁸³ In 1952 a new branch of the company was established in Barrackpore near Calcutta for the reconditioning of Dakota aircraft. In the early 1960s the government set up new factories at Kanpur’s Air Force Station and—under the name of Aeronautics India Ltd.—in Nasik, Koraput, and Hyderabad for specific projects. These facilities were merged with HAL’s existing ones in October 1964 to form a new company called Hindustan Aeronautics Limited.⁸⁴ This section addresses the period from Independence (1947) to HAL’s reorganisation (1964), with occasional comments on later developments.

Although maintenance and overhaul still accounted for a large part of the company’s activities,⁸⁵ the story of HAL after Independence was one of two competing modes of aircraft manufacture. The first consisted of the Indian government’s efforts to become self-sufficient in aircraft manufacture by promoting indigenous design and development. The second was the production of military trainers and fighters under licence from well-established international companies, a route that the Indian government frequently took.

It was the latter option that was chosen when, around a year after the UK Mission’s visit, a start was made on manufacturing. In 1947, it was reported that the GOI had placed an order for Percival Prentice trainer aircraft. Initially the components for 20 trainers were to be sent to Bangalore to be assembled there, and the subsequent planes would be built ‘under licence from the Percival Aircraft Company’ of the United Kingdom.⁸⁶ The first of these was test-flown on 30 April 1949.⁸⁷ As the needs of the Air Force scaled up, HAL chose licensed production on several occasions. By the time of the 1964 reorganisation, it had signed agreements with the DeHavilland Company (UK) to build the Vampire, a jet fighter; with Folland Ltd. (UK) to produce the minimalist Gnat fighters; with Sud Aviation (France) to build Alouette III helicopters, rechristened ‘Chetak’; with Bristol Aero-Engines Ltd. (UK) to manufacture Orpheus turbojet engines; and—beginning a long partnership—with the USSR government to build the supersonic MiG-21 fighter planes.⁸⁸

Aircrafts, Bangalore’, File No. 2/4 (Nov. 1946), Digitised Private Papers of Sardar Patel, NAI. Digital Identifier: PP_000000006264.

⁸² John Matthai to Vallabhbhai Patel, 18 December 1946, in *ibid.* On the Interim Government, see Riddick, *History of British India*, p. 118.

⁸³ *Ibid.*; ‘Glimpses of traversed path (1940 till date)’, PDF file downloaded from the website of Hindustan Aeronautics Limited (hal-india.co.in).

⁸⁴ ‘Glimpses of traversed path’. On Barrackpore/Calcutta, see also ‘Hindustan Aircraft, Ltd.’, *Flight*, 26 August 1955, p. 330.

⁸⁵ Alastair Pugh, ‘Around Hindustan Aircraft’, *Flight*, 19 December 1958, pp. 939-41.

⁸⁶ ‘Percival Prentice under licence’, *Flight*, 15 May 1947, p. 445.

⁸⁷ ‘Indian Prentice airborne’, *Flight*, 19 May 1949, p. 587.

⁸⁸ ‘Glimpses of traversed Path’; ‘Hindustan Aircraft, Ltd.’, *Flight*, 26 August 1955, p. 330; ‘Hindustan Aircraft (Private) Ltd.’, *Flight*, 23 August 1957, p. 283. On MiG-21s, Chetaks, Gnats, and Vampires, see respectively:

Although HAL could theoretically produce aircraft for civilian/commercial as well as military purposes, it was increasingly bound up with the Indian defence establishment (as the list of aircraft discussed above indicates).⁸⁹ The shift to the jurisdiction of the Ministry of Defence in 1951 was symbolic of this development. The decision, in fact, was precipitated by a report from the General Manager of the DeHavilland Company, who in late 1950 had made an inspection of HAL's progress in producing Vampires, concluding that the staff was behind schedule, and highlighting several areas of concern.⁹⁰

In parallel with licensed production, HAL began putting in place a programme of indigenous design. This was headed not by a foreign expert, as the UK Mission had suggested in 1946, but by Vishnu Madhav Ghatage, who had returned to the company in 1947 after a spell of five years on the faculty of IISc's Aeronautical Engineering department. He brought with him a team of graduates from that institution, and helped set up a Design and Development Department at HAL. Ghatage, who had done his doctoral work under the famous German aerodynamics expert Ludwig Prandtl at Göttingen in the 1930s, was to remain central to design efforts at HAL until his retirement in 1971.⁹¹

In 1948, HAL began working on the designs of two trainer aircraft, the HT-2 and the HT-10. The HT-2, designed by Ghatage, was 'the first aircraft of wholly Indian origin to be put into production.' The engine was not designed in-house, though; the HT-2 used a Cirrus Major III engine (155 h.p.), with tandem seating for the flying instructor and the trainee. Weighing 2,240 lb, the plane was 25 feet long and had a wing span of 35 feet. The HT-2, which was successfully flown in a 1951 test, could achieve a maximum speed of 130 miles per hour.⁹² Soon there was serious thought of exporting, particularly to Asian countries, '[t] his unpretentious but efficient basic trainer'. A demonstration tour abroad was on the cards, and the HT-2 had been praised by the well-known German aircraft designer Dr Kurt Tank.⁹³ By 1958, the HT-2 was being described as 'the standard *ab-initio* trainer for the I.A.F. and the Indian Navy'; it was being 'used also by the civil aviation training establishments for basic flying training.'⁹⁴

By the mid-1950s, the HAL factory had expanded considerably from its post-war position. It now spanned 1,100 acres and had around 10,000 employees in all.⁹⁵ In the 1960s two more prominent aircraft came out of the Hindustan Aircraft stable: the HF-24 Maruta fighter and bomber, and the HJT-16 Kiran, a jet trainer. Kurt Tank, who had praised the HT-2, was an ace designer formerly associated with Focke-Wulf in Germany, where he had designed key fighter planes for the Luftwaffe. At the end of the war he had moved to

'MiG', *Encyclopaedia Britannica* online, 2015 (<http://www.britannica.com/technology/MiG-Soviet-aircraft>); 'Chetak', Hindustan Aeronautics Limited website, https://hal-india.co.in/Product_Details.aspx?Mkey=54&lKey=&CKey=26; 'Folland Gnat', BAE Systems website, <https://www.baesystems.com/en/heritage/gnat>; 'De Havilland DH 100 Vampire', BAE Systems website, <https://www.baesystems.com/en/heritage/de-havilland-vampire> (all URLs accessed 7 October 2019).

⁸⁹ See also Pugh, 'Around Hindustan Aircraft'.

⁹⁰ 'Vampire Production by The Hindustan Aircraft Ltd.—Desirability of transferring this Company to the Defence Ministry', File No. 2/432, 1950, Digitised Private Papers of Sardar Patel, NAI, *passim*. Digital Identifier: PP_000000006161.

⁹¹ 'Then and now. Dr V.M. Ghatage: designer of planes', *The Week*, 29 June – 5 July 1986, p. 54; Singh, *History of aviation*, p. 253; 'Vishnu Madhav Ghatage', Mathematics Genealogy Project (North Dakota State University, Fargo), <http://www.genealogy.math.ndsu.nodak.edu/id.php?id=115380>, accessed 27 September 2015; 'Ludwig Prandtl "Father of modern aerodynamics"', DLR website (German Aerospace Center), http://www.dlr.de/100Jahre/en/desktopdefault.aspx/tabid-2565/4432_read-7449/, accessed 22 September 2015.

⁹² 'Hindustan HT-2', *Flight*, 27 August 1954, p. 284; 'Glimpses of traversed path'.

⁹³ 'Aircraft of the Commonwealth', *Flight*, [26?] August 1955, p. 295.

⁹⁴ Alastair Pugh, 'Around Hindustan Aircraft', *Flight*, 19 December 1958, pp. 939-41, here p. 939.

⁹⁵ 'Hindustan Aircraft, Ltd.', *Flight*, 26 August 1955, p. 330.

Argentina, where he worked for a number of years before the Indian government invited him, around 1956, to help HAL build its first locally designed fighter plane. Tank and his team of German and Indian engineers (18 Germans and 25 Indians to begin with) worked on the project designated HF-24 or Maruta over the next eight years, until the first two finished planes were handed over to the Indian Air Force (IAF) in May 1964. The Maruta was a plane with 'highly swept wings, a needle nose and a graceful ... fuselage'. Powered by two Bristol Siddeley Orpheus 703 turbojet engines (put together at HAL), the first version (Mk 1) could fly at supersonic speeds, and carry arms weighing approximately 4,000 lb.⁹⁶

Working independently of Kurt Tank, Ghatage and his design team were charged with bringing out the first indigenously designed jet trainer, the HJT-16 or Kiran. Beginning in April 1961, the work of this team (15 engineers to begin with, rising at one point to 35) was placed on the backburner for a while as HAL focused on the Maruta. But it gathered momentum again after the Maruta came close to completion, and the first Kiran flew in September 1964. A trade magazine described the Kiran as 'a wholly conventional, workmanlike aeroplane' that catered to the requirements of the IAF while providing essential features for Indian conditions, like air conditioning. Powered by a Bristol Siddeley engine, the Viper 11, the Kiran had adjacent seating for instructor and pupil in a 'spacious' cockpit.⁹⁷ The jet trainer was a success: by 1977, well over a hundred Kirans had been supplied to the air force and the navy.⁹⁸

Throughout these developments, the Indian Institute of Science worked closely with HAL. As we have seen, V.M. Ghatage had been loaned by HAL to IISc in 1942 to serve as the first head of the Aeronautical Engineering department. He served in that position until 1945, then remained as a faculty member until 1947, when he returned to HAL. Subsequent heads of the department included R.G. Harris (1945-48) of the Royal Aircraft Establishment in Britain; Oskar G. Tietjens (1949-54), who, like Ghatage, had been a student of Prandtl at Göttingen; and Satish Dhawan (1955-62), who had a PhD from Caltech. It is not known whether Ghatage had recommended Tietjens, but he was part of the committee (in his capacity as Chief Designer at HAL) that appointed Dhawan as head of department.⁹⁹ Like HAL, IISc was under the ultimate control of the Government of India. It was overseen by the Ministry of Education, which, in some situations, took decisions in close coordination with the Ministry of Defence, the Ministry of Finance, the Ministry of Industries and Supplies, and the Directorate General of Civil Aviation.¹⁰⁰

IISc's postgraduate course in aeronautical engineering underwent many transformations. The initial certificate course (which ran until 1946) consisted of a year's instruction and four months' practical experience at HAL. It was replaced by a two-year diploma (DIISc)

⁹⁶ 'India's Hindustan HF-24 Joins the IAF: Maruta', *FLIGHT International*, 2 July 1964, pp. 16-17; Zukowsky, 'Kurt Tank'.

⁹⁷ 'Hindustan HJT-16 Kiran: India's primary trainer', *FLIGHT International*, 11 March 1965, p. 371.

⁹⁸ 'Military aircraft of the world', *FLIGHT International*, 5 March 1977, p. 592.

⁹⁹ '50 years of Aerospace Engineering Department' [1992], photocopied pamphlet (courtesy IISc Archives), pp. 2-4; Bhat and Sreenivasan, 'Roddam Narasimha', p. 298; 'Indian Institute of Science Bangalore. Appointment to the post of Professor & Head [of] Dept of Aeronautical Engineering'. File No. F 8 - 41/54, 1954. Digitised Public Records, Ministry of Education, NAI. Digital Identifier: PR_000003042750.

¹⁰⁰ This was clearly illustrated in the decision-making process followed when a new head was to be appointed to the aeronautical engineering department, or when funds were sought for the department's expansion. See 'Indian Institute of Science Bangalore. Appointment to the post of Professor'; and 'Indian Institute of Science, Bangalore. The meeting of the Expert Committee to consider the proposed Development Programme of the Department of Aeronautical Engineering.' Ministry of Education, Section T-I. File No. 8-23/50. Digitised Public Records, Ministry of Education, NAI. Digital Identifier: PR_000003042533.

course, which was reclassified as a Masters course (ME) from 1958, when IISc became a 'deemed University'. In its first 15 years, the department granted a total of 42 certificates and 58 diplomas. In addition, a customised six-month programme was offered to existing staff at HAL. Soon the Aeronautical Engineering department began to admit research students at the Masters and doctoral levels, although their numbers were small until the 1970s.¹⁰¹

The department was well equipped for research as well as teaching demonstrations. Its infrastructure included a 7' x 5' closed circuit wind tunnel that had been inaugurated in 1944, supplemented by a 14' x 9' open circuit wind tunnel, opened in 1959 (O.G. Tietjens had begun designing the latter in 1949). HAL made use of both tunnels to carry out studies. The larger tunnel, in particular, was used in developing the HF-24 (Maruta) and HJT-16 (Kiran) aircraft.¹⁰² Thus IISc supported HAL and the aeronautical industry in many ways: by providing it with trained personnel, by affording it research and testing facilities, and through the research undertaken by its faculty members.¹⁰³

Although the facilities at IISc were helping create a new generation of Indian aeronautical engineers, HAL continued to make use of international experts in some roles in the 1950s and '60s. At various times, engineers from British firms like Percival and Bristol spent time in Bangalore to guide HAL's production aircraft under licence from those companies. To the private chagrin of officials representing British trade, they were not the only ones. In the late 1940s, Rumanian and Czech experts visited HAL. One of them advised on the possibility of producing aircraft engines, and reportedly tried to interest HAL in the Steyr Daimler Puch diesel engine. Some of these visitors were allegedly 'at pains to decry British products. In this they found a ready helper in the Hindustan designer, Dr. Ghatage, who was trained in Germany and affects to admire German aircraft products ...'¹⁰⁴ While the concerns about Ghatage's preferences appear exaggerated, HAL's German connections were indeed notable in the matter of experts. The central role played by Ghatage and Tank (and the German engineers who worked under Tank) at the company, and by Tietjens at IISc, has been described earlier. Much before Tank, in 1949, there were reports that HAL had engaged Willy Messerschmitt, who had also designed aircraft for the Luftwaffe, although it is unlikely that he actually visited or made a substantial contribution to HAL.¹⁰⁵

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Two decades after Independence, HAL had some significant achievements to its name. In addition to supplying the IAF with fighters produced under licence, it had brought out a few locally designed planes, such as the HT-2 trainer, the HJT-16 jet trainer (Kiran), and the HF-24 bomber (Maruta). Yet V.M. Ghatage, who served the company through all these

¹⁰¹ '50 years', pp. 3, 4 and 14.

¹⁰² Ibid., pp. 6-7 and 22; Tietjens, 'Der Windkanal'.

¹⁰³ On the department's research work, see '50 years', pp. 15-22.

¹⁰⁴ 'India', *Flight*, 22 August 1958, p. 288; Confidential Memorandum, Office of the Senior U.K. Trade Commissioner in India, New Delhi, 31 March 1949, in IOR/L/E/8/3622; 'Extract from report of Mr. C. Gault, Deputy High Commissioner, Madras on a visit to Mysore, July, 1948. POL. 25/1/7. Typescript in IOR/L/E/8/3622 (file titled 'Aircraft Industry in India: Including Manufacture of Railway Coaches by Hindustan Aircraft Limited, Bangalore.') The quoted text is from the last of these sources (Gault's report).

¹⁰⁵ 'News from India', *Flight*, 15 December 1949, p. 757; 'Willy Messerschmitt', *Encyclopaedia Britannica* online, 2015 (<http://www.britannica.com/biography/Willy-Messerschmitt>, accessed 22 September 2015). With the Allies forbidding an aircraft industry in Germany after the war, German aircraft engineers plied their trade in various countries including the United Arab Republic, Argentina and Spain. See Edgerton, *Shock of the old*, pp. 123-4.

developments and became known as the *Bhishmapitamaha* (grand patriarch) of the Indian aircraft industry,¹⁰⁶ expressed regret at two things as he looked back on the period. First, the government had, in his view, not given the aircraft industry enough opportunities to develop its indigenous design and construction capability. HAL's operations had become tied almost exclusively to the needs of the IAF, and time-bound strategic needs meant that the government increasingly opted for production under licence.¹⁰⁷ Secondly, even when local design was undertaken, he felt the government had not placed enough faith in Indian designers. He was not pleased with the decision to bring in Kurt Tank and set up a parallel design team, led by German engineers, for the Maruta project. A distinguished former student, S.R. Valluri, met Ghatage at Caltech in 1956, soon after Tank had been engaged. 'There was a look of disappointment on his face,' Valluri recalled later, 'and I felt I was seeing a beaten man.'¹⁰⁸

More research is needed on the later development of HAL, but a glance at the company's subsequent trajectory suggests that some of Ghatage's apprehensions were borne out. Aside of Tejas, a light combat aircraft (LCA) commissioned in 1993 and delivered to the IAF in 2016, there have been few high-profile local designs. The Maruta was decommissioned in the 1980s as the Orpheus 703 engines it relied on were insufficiently powerful for its purposes. Crucially, despite sporadic attempts to design aero-engines in India, that has yet to come to fruition: even the Indian-designed aircraft have always used foreign-designed aero-engines.¹⁰⁹

VII Conclusion

American collaboration, Indian capital, Walchand Hirachand's energies, and the policies of princely Mysore played important roles in the birth of aeronautical engineering in India. Existing accounts have focused on Walchand's efforts to get permission to manufacture aircraft in India, and emphasised the colonial government's uncooperative stance. This account has argued that the government's position was a far more layered one that depended on domestic and international political considerations, and above all, on the exigencies of war time. Churchill and Beaverbrook (occupied with developments in Britain and Europe) appeared to show little interest in India's aerial defence; the colonial government in India, on the other hand, expended considerable energy on assessing proposals from business groups (European and Indian) to undertake aircraft manufacture in India. Indeed, the GOI had been considering the issue even before Walchand's proposal. They were motivated by two concerns: the increasing need for India to have a modicum of aerial defence capability, and the fact that the demand for aircraft had become a rallying cry for those who felt that the colonial government was not representative of Indian interests. Viceroy Linlithgow's communications in particular reveal a clear belief that it

¹⁰⁶ Anantha Krishnan M., 'Bhishma of HAL: legend lives on', *Times of India* (Bangalore), 6 December 2003.

¹⁰⁷ Mahindra, 'Aircraft industry pioneer'; MR, 'Around town'.

¹⁰⁸ S.R. Valluri, 'Top designer, great teacher', *Deccan Herald*, 16 December 1991. See also Mahindra, 'Aircraft industry pioneer'.

¹⁰⁹ Ajai Shukla, 'Engine of indigenisation', *Business Standard* online, 21 December 2015 (https://www.business-standard.com/article/opinion/ajai-shukla-engine-of-indigenisation-115122101122_1.html, accessed 10 October 2019); Ajai Shukla, 'Taking Tejas forward', *Business Standard* online, 5 July 2016 (https://www.business-standard.com/article/opinion/ajai-shukla-taking-tejas-forward-116070401158_1.html, accessed 11 October 2019); 'Then and now. Dr V.M. Ghatage'; Mahindra, 'Aircraft industry pioneer'; Pugh, 'Around Hindustan Aircraft', p. 941; Sebastien Roblin, 'India's disappointing Marut jet fighter proved itself in combat', *The National Interest* online, 13 August 2017 (<https://nationalinterest.org/blog/indias-disappointing-marut-jet-fighter-proved-itself-combat-21875>, accessed 11 October 2019).

was in the interests of political stability to heed these demands. Consequently, he became a keen champion of the Walchand-Pawley proposal for an Indian factory. L.S. Amery, Secretary of State for India in London, was also an energetic proponent of the scheme.

The United States played no small role in HAL's fortunes (if indirectly at first). Indeed the prospects for establishing an aircraft factory depended not only upon the policies and patronage of the colonial government, but also on the ability of Indian entrepreneurs to identify technological partners who would sell them machinery and manufacturing know-how while undertaking to train a future generation of Indian engineers. William Pawley's contacts and reputation in China played an important part in HAL finally getting the green signal. Again, world politics (as opposed to localised colonial concerns) were important: had Britain and America not been engaged in trying to support (despite declared neutrality) Chiang-Kai Shek's Chinese government as a bulwark against Japanese expansion, Pawley would not have set up his CAMCO factories in China. It is conceivable that the meeting with Walchand came as a godsend to Pawley, who knew that his Loiwing factory was in a perilous situation, and could now think of shifting his Asian base to India.¹¹⁰ After Walchand and Pawley's exit, the USAAF's management helped consolidate HAL's reputation as a centre for repair and overhaul.

Some continuities are apparent in HAL's trajectory after Independence. Experts like V.M. Ghatge continued to play an important role, as did the educational institutions of Mysore state, particularly the Indian Institute of Science. The UK's advice was sought during the transition to manufacturing, and HAL continued to have a strong relationship with the British aircraft industry. And while the local design and manufacture of aeroplanes received more attention than they had previously, military requirements continued to dictate the direction of HAL's development, keeping both aircraft maintenance and licensed production centre stage.

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¹¹⁰ See Carrozza, *William D. Pawley*.

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