

REINFORCED CONCRETE

IN BRITAIN: 1897 - 1908

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CHAPTER 7: LOUIS GUSTAVE MOUCHEL AND FERRO-CONCRETE.

Introduction.

Louis Gustave Mouchel.

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Louis Gustave Mouchel (1852 - 1908).

Introduction.

Chapter 7 considers:

- (1) With respect to Louis Gustave Mouchel's acquisition of François Hennebique's agency for his system in Britain, and his eventual success in introducing ferro-concrete there, L. G. Mouchel's professional training and abilities, his early private use of Hennebique's system, and his residence and entrepreneurial activities in South Wales.
- (2) L. G. Mouchel's establishment in Britain of a technical - commercial organisation of planning offices and licensed contractors on the lines of F. Hennebique's in France, but with certain differences, and with Hennebique's assistance including the provision of specially trained engineers and also contractors.
- (3) L. G. Mouchel's own patents for reinforced concrete and his adaptations of Hennebique's system.
- (4) The role of L. G. Mouchel and other reinforced concrete specialists in design, in practice, vis-à-vis non-specialist architects and engineers.
- (5) Projects and works, especially framed buildings carried out by or under L. G. Mouchel, that is, before 1908.
- (6) L. G. Mouchel and "rival" specialists: their earliest framed buildings (before 1908) and relations with Mouchel.
- (7) The low incidence of failures in early Hennebique work in Britain and a significant test failure in Manchester (1902), L. G. Mouchel's response to which illustrates his personal commitment to introducing ferro-concrete in Britain.

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Louis Gustave Mouchel.

François Hennebique's grandson, Robert Flament-Hennebique (1980) believes that Louis Gustave Mouchel was François Hennebique's first client in Britain.¹ An early short biography (1912) of L. G. Mouchel mentions that Mouchel had first noticed ferro-concrete in connection with proposed extensions to his business premises at Briton Ferry, South Wales and he executed (unspecified) work at Briton Ferry and "some house property" there, or elsewhere in South Wales in "ferro-concrete", prior to the construction of Weaver's Mill, (1897-8), Swansea, (thus also predating L. G. Mouchel's appointment as Hennebique's agent) and when Mouchel had, "realised the possibilities of ferro-concrete".²

An account by one of L. G. Mouchel's engineers, C. Roch³ (writing in 1958) of how Mouchel became associated with Hennebique's system has a slightly different emphasis. C. Roch recalls that L. G. Mouchel and F. Hennebique met while Hennebique was arranging the transport of materials from Nantes to Swansea for Weaver's Mill, Mouchel, as Vice-Consul in Wales for the French Government, having charge of ship movements in Swansea Harbour.⁴ However, L. G. Mouchel had already become closely involved in the scheme for Weaver's Mill, since he accompanied one of the Directors of Weaver & Co. to France (1897) to see examples of ferro-concrete construction, before the contract for the mill was signed, (Chapter 6).

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1. M. Robert Flament-Hennebique, Neuilly sur Seine; personal communication by letter, 2.8.1980. M. Flament-Hennebique notes that Hennebique records were partly destroyed in the German Occupation, so that much information is missing.
 2. The Life and Work of Louis Gustave Mouchel, F.C., vol.3, no.7, Jan., 1912, (pp.210-4), p.212. T.J.Gueritte (one of Mouchel's engineers and referred to shortly) considered the first works were the mill, Swansea, and a river wall, Southampton, 1897, (but Gueritte did not come to the U.K. until 1899): T.J. Gueritte, The First Decade of Reinforced Concrete in the U.K. (1897-1906), C. & C.E., vol.21, 1926, (pp.89-92), p.89. Chapter 6.
 3. By c. 1909, Roch was Chief Engineer, L.G.M. & Ptrs: L.G.Mouchel & Ptrs., c.1909: photog., Album, L.G.Mouchel & Ptrs., 38 Victoria Street, Westminster.
 4. C.Roch, Marseilles, letter to C.R.J. Wood, 5.6.1958, transl., 15.10.1959, (pp. 1 - 18), p.6.

C. Roch says that Hennebique's offer of the agency for his system in Britain, "being an expert judge of business flair" surprised Mouchel, because, "he was not an engineer" and he at first refused, but Hennebique's perseverance secured Mouchel.⁵

Roch was mistaken that L. G. Mouchel was not already a trained engineer, and in 1902, Mouchel was elected a member of the Société des Ingénieurs Civils de France.⁶ Concrete and Constructional Engineering (1908), not perhaps in general an advocate of the Hennebique system or Mouchel personally, described L. G. Mouchel as a civil engineer of "high inventive faculties".⁷

After a naval training at Cherbourg,⁸ (where he was born in 1852⁹), L. G. Mouchel had had an engineering education at the Government School of Mines (France).¹⁰ He then joined the engineering staff of the Department of Ponts et Chaussées, and constructed some pier and harbour works.¹¹ Mouchel's special expertise was in marine and below-ground work, but was certainly not confined to this.

There is no evidence that, as P. Collins (1959) states, L. G. Mouchel was one of F. Hennebique's "senior engineers" prior to 1895¹²

5. Ib., pp.6-7.

6. Obituary, L.G.Mouchel, Engr., vol.105, 12.6.1908, p.612. Life and Work, op.cit. (2), p.214.

7. Editorial Notes: The Late Mr. L. G. Mouchel, C. & C.E., vol.3, no.3, July, 1908, p.180. Cf: Life and Work, op.cit. (2), p.213. Chapter 8.

8. Life and Work, op.cit. (2), p.211.

9. Obituary, Mr. L. G. Mouchel, B.J., vol.27, 10.6.1908, p.485. Obituary, L. G. Mouchel, op.cit. (6).

10. Obituary, Mr. L. G. Mouchel, ib. Obituary, L. G. Mouchel, ib.

11. Life and Work, op.cit. (2), p.211. L.G.M. may possibly have met Hennebique (a public contractor - Ch. 6) while working for Department of Ponts et Chaussées and before Hennebique's develop. of ferro-concrete.

12. P. Collins, Concrete, Lond., 1959, p.76: Collins' source, op. cit. (2), p.211, does not state this.

or that,

"L. G. Mouchel had been Hennebique's partner in France",

(P. Morton Shand, 1932¹³), or that, as P. Collins (1959) further states,

"Hennebique sent Louis-Gustave Mouchel.....to Britain in 1895, when he landed at Briton Ferry in South Wales, and immediately proceeded to spread the gospel by erecting Messrs. Weavers' Granary and Flour Mill at Swansea ". 14

L. G. Mouchel had moved to Briton Ferry, South Wales, perhaps as early as 1875 (aged twenty-three) to settle as a mining engineer,¹⁵ where it seems he remained, except for short visits to France. (By the turn of the century, there was quite a French colony in South Wales, based largely on the thriving coal trade between the two countries and Swansea newspapers included reports in French.¹⁶)

Here, L. G. Mouchel (who had an "extensive knowledge" of English) initiated a number of business enterprises; he introduced patent fuel or coke making to the area, and formed the Cardiff Washed Coal & Fuel Co.,¹⁷ (subsequently a client for ferro-concrete work¹⁸). Mouchel acquired iron mines in Brittany, imported ore to South Wales, and exported coal to agents in France, and was also a ship broker.¹⁹

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13. P. Morton Shand, Steel and Concrete. A Historical Survey, A.R., 1932, (pp.169-79), p.177. Bernard E. Jones, ed., Cassell's Reinforced Concrete, Lond., etc., 1913, p.10, refers to L. G. M. as "Francois Hennebique's partner" - but not in France.
14. Collins, op.cit. (12), p.76: Collins' sources: op. cit. (2), p.211, does not state this except that erection Weavers' Mill mentioned (p.212); F.C., vol.2, 1911, p.16: refers only to Mill.
15. Life and Work, op.cit. (2), p.211. Obituary, L.G.M., op.cit. (6).
16. P.Cusack, The Design and Construction of Weaver's Provender Mill and Silos in Swansea, Open University Project, 1975, p.7. Late father of present Consular Agent in Swansea, settled, 1897, when substantial French "colonie": J. le Bars, personal communication by letter, 15.10.1980.
17. Life and Work, op.cit. (2), pp.211, 214.
18. Mouchel-Hennebique Ferro-Concrete. List of Works Executed in the U.K. 1897-1919, L.G.Mouchel & Ptrs. Ltd., Lond. n.d., Preface, 1920: e.g., p.31, Coal Washery for the Cardiff Washed Coal Co., Cardiff, 1903.
19. Life and Work, op.cit. (2), p.212.

Together with T. Gwynne, Tom Williams (solicitor) and the Rev. Henry Hughes, L. G. Mouchel, in 1892, founded the Gwalia Tinplate Company,²⁰ and shortly afterwards, Mouchel became one of the directors, ("all experienced commercial men") of a new company formed to work the Eaglesbush colliery, Neath, (and who, on the 8th of July, 1897, "were fortunate in striking a large seam of coal (when) the neighbourhood around on the occasion was gay with bunting").²¹

L. G. Mouchel became French Consular Agent for several South Wales ports, (Briton Ferry, Porthcawl, Neath Abbey and Port Talbot: Swansea, referred to by C. Roch in his account of Mouchel's and Hennebique's meeting, is not mentioned) and subsequently, Advisor for Foreign Trade for France: (Conseiller du Commerce Extérieur).²²

In 1898, L. G. Mouchel is mentioned by E. Humphreys in his, Reminiscences of Briton Ferry and Baglan, as residing in one of the "big houses" in Briton Ferry, "Mount Pleasant", being French Vice-Consul, and a director of a number of companies, of which Humphreys cites only four.²³

By the mid-1890s, L. G. Mouchel was thus a well-known and prospering businessman in Briton Ferry and the surrounding district, and a director of several important industrial companies;²⁴ he also had some influence in foreign trade through his consular and trade counselling posts.

20. E. Humphreys, Reminiscences of Briton Ferry and Baglan, Swansea, 1898, p.39. S.a. Cliff Morgan, Briton Ferry, Briton Ferry, 1977, p.75.

21. Humphreys, *ib.*, p.24. S.a: Elis Jenkins, Neath and District: A Symposium, Neath, 1974, pp.170-1, for history of Eaglesbush Colliery.

22. Life and Work, *op.cit.* (2), p.212.

23. Humphreys, *op.cit.* (20), p.29.

24. Cf: Life and Work, *op.cit.* (2), p.211.

If this is an indication of L. G. Mouchel's, "business flair", Mouchel's position also provided contacts for jobs with ferro-concrete, of which Hennebique was no doubt aware in offering him the agency. C. Roch (1958) for instance, recalled that L. G. Mouchel had,

"influential friends..... (bringing)....important jobs"

and that in London subsequently also, "Mouchel brought in lots of work".²⁵

However, L. G. Mouchel's later Partners, J.S.E. de Vesian and T.J. Gueritte (1908) spoke in addition of Mouchel's, "great personal charm" as well as his, "tireless energy".²⁶ Ferro-Concrete (1912) similarly referred to L. G. Mouchel's "magnetic influence"²⁷ and C. Roch (1958) described Mouchel as,

"perhaps more active than Hennebique", 28

(who was fairly dynamic), and either travelling about, or working in the office until 11 - 12 o'clock in the evenings.²⁹ Concrete and Constructional Engineering (1908), again summarised L. G. Mouchel's characteristics as an ability to inspire confidence, extraordinary energy, industry, and pains in matters of detail, organisational skill and singularity of purpose.³⁰ All of these characteristics perhaps were required for the propagation of a material of which nearly all architects, engineers and builders, as well as potential clients, were

25. Roch, op.cit. (4), pp.12, 15.

26. J.S.E. de Vesian and T.J.Gueritte, Directors, L.G.Mouchel & Ptrs., Obit. letter for L.G.Mouchel, copy, n.d. Cf. Life and Work, op. cit. (2), p.214: L.G.M.'s kindness and generosity.

27. Life and Work, op.cit. (2), p.213.

28. Roch, op.cit. (4), p.12.

29. Ib., p.18. Chapter 6.

30. Editorial Notes, op.cit. (7). Cf: Hennebique Methods of Calculation. Article I, F.C., vol.1, no.2, Aug., 1909, (pp.24-8), p.25: L.G.Mouchel's "indomitable perseverance" introducing Hennebique system to U.K.

ignorant and many sceptical; "singularity of purpose" seems to have particularly characterised L. G. Mouchel's last ten years of work and life.

L. G. Mouchel died at Cherbourg, where he was born, on 27th May, 1908,³¹ at 56, only a little older than Hennebique when he had obtained his first patents for ferro-concrete. An obituary notice in The Builders' Journal said that without family or hobbies, L. G. Mouchel,

"lived entirely for his work ". 32

Although after 1897, Mouchel maintained his commercial offices in Briton Ferry³³ at least initially and which, perhaps, gave him the necessary financial support for his next undertaking, he decided at about this time to make the introduction of ferro-concrete into Britain, the,

"chief object of his professional life ". 34

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31. Obituary. Mr. L. G. Mouchel, op.cit. (9). Obituary, L.G.Mouchel, op.cit. (6). There was no obituary for L.G.M. in Le Beton Arme, perhaps a measure of the autonomy of L. G. Mouchel (& Ptrs.) by this date, from Hennebique.
32. Obituary. Mr. L.G.Mouchel, op.cit. (9). Not so of L.G.M. & Ptrs. later: cricket team (1938); dramatic group, The Mouchel Players (1959-60): Album, L.G.M. & Ptrs., 38 Victoria St., Westminster.
33. Roch, op.cit. (4), p.9. Life and Work, op.cit. (2), p.212: competent managers in charge of his undertakings.
34. Life and Work, op.cit. (2), p.212. Cf: Obituary, L.G.Mouchel, op.cit. (6); since 1898, L.G.M. devoted himself entirely to ferro-concrete.

The Establishment of Technical Offices.

L. G. Mouchel had become F. Hennebique's "General Agent" for the U.K. by 1898³⁵ and his first Technical Office was in Briton Ferry,³⁶ where he lived (and had business contacts). Mouchel retained as staff his accountant, and R. J. Hughes, a gentleman engaged at 15 and taught French by Mouchel³⁷ (and who in 1909 was Company Secretary of L. G. Mouchel & Partners³⁸). By October, 1899, L. G. Mouchel had moved the office to Swansea,³⁹ (which at this time was a thriving port and business centre, as well as having a considerable French "colonie"⁴⁰).

By the early 1890s in Britain, "concrete" floors were already designed and constructed by patentees using their own systems,⁴¹ that is, by concrete (or reinforced concrete) specialists, (such as W. B. Wilkinson & Co.), but L. G. Mouchel introduced a new specialist organisation, based on Hennebique's, consisting of regional technical or planning offices and contractors "licensed" to apply Hennebique's system in particular districts.

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35. Obituary, L. G. Mouchel, op.cit. (6): acquired U.K. Agency in 1898. Silos at Swansea. Construction in Hennebique's Patent Ferro-Concrete. General Agent: L.G.Mouchel, Plan no.1, 18.2.1898, and Plan no. 2, 18.2.1898; however, these also bear the London address, 38 Victoria St., Westminster, to which L.G.Mouchel moved in 1901, suggesting copies, done later.
36. L.G.Mouchel, 38 Victoria Street, Westminster, to Brown & Polson, Paisley, June, 1901: Heading: Technical Office, Briton Ferry: (deleted).
37. Roch, op.cit. (4), p.9. Chronology of F. Hennebique and L.G.Mouchel & Ptrs., Notes collected by G.F.Crabb, 1977, Album, L.G. Mouchel & Ptrs., 38 Victoria Street, Westminster.
38. L.G.Mouchel & Ptrs., c.1909, op.cit. (3).
39. Reprint of Official Report of Commander Welsch of Ghent Fire Brigade, 29.9.1899, stamped: Hennebique's Patents. General Agent for the U.K. L.G.Mouchel, Briton Ferry. Roch, op.cit. (4), p.9, says he started at Swansea Office, 20.10.1899, but he was mistaken that L.G.M. there by "end of 1898" (p.7). S.a. Intercommunication, B.N., 5.5.1899, p.624.
40. Cusack, op.cit. (17).
41. Paul Waterhouse, reviewing, G.L.Sutcliffe, Concrete, Lond., 1893, J.R.I.B.A., vol.1, 21.12.1893, p.120.

L. G. Mouchel's and F. Hennebique's agreed terms for this purpose, based upon Hennebique providing working drawings, were that Mouchel took 12% of contractors' fees, of which 8% went to Hennebique and 4% to Mouchel.⁴²

L. G. Mouchel himself originated the term "ferro-concrete" to describe Hennebique's system in Britain;⁴³ (and he translated Hennebique's catch-phrase for béton armé, "Plus d'Incendies Désastreux"⁴⁴ to associate with it, at first a little awkwardly as, "Disastrous Fires made.....Absolutely Impossible"⁴⁵ but then improved as, "Constructions in Ferro-Concrete: Indestructible and Absolutely Fireproof"⁴⁶).

In L.G.Mouchel's first years as agent, Hennebique assisted him in various ways to establish the agency. C. Roch (1958) says that projects and working drawings were initially prepared in Paris (Hennebique's normal arrangement pending the establishment of regional offices⁴⁷) and copied in English,⁴⁸ although the first large British contract, Weaver's Mill, Swansea, was drawn up in Nantes (in October-November, 1897) before Hennebique established his Paris Office and the drawings may not have been translated as the chief executants were French.⁴⁹

42. Roch, op.cit. (4), p.6.

43. Hennebique Methods of Calculation, op.cit. (30), p.26.
Life and Work, op.cit. (2), p.212: from mining or metallurgy, as, ferro-manganese. Roch, op.cit. (4), p.12: from L.G.Mouchel's knowledge of Latin.

44. On Hennebique's drs. e.g., Moulin à Grains à Swansea, Construction en Béton Armé Système Hennebique, Toiture, Plan no. 5, 12.10.1897.

45. L.G. Mouchel to Brown & Polson, op.cit. (36).

46. L.G.Mouchel, 38 Victoria St., Westminster, Details of Enclosures, Silos, Wincolmlee, Hull, to Rose, Downs & Thompson, Hull, 1.11.1904.

47. E.g. Relevé de Travaux Executés Année 1899, Bétons Armés Système Hennebique, Paris.

48. Roch, op.cit. (4), p.7.

49. French drs. only, for Mill, found in H.C.Portsmouth's, Architect's, office, Swansea: H. Portsmouth, Architect's grandson, personal communication, Spring, 1975. S.a: Chapter 6.

Drawings for an oil mill in Liverpool (1898)⁵⁰ for example, may have been executed in Paris, or other works before or during 1899, by which time, some drawings were being executed in Britain. British works continued to have French works numbers for some years,⁵¹ (and counted towards Hennebique's total works: Chapter 6).

Establishing his own Technical Office, L.G.Mouchel, "on Hennebique's advice", first engaged an engineer, who then attended Hennebique's office in Brussels for two months' training⁵² (which, according to C. Roch (1958), proved inadequate⁵³). This was Francis Eliot, a French mining engineer (and son of a friend), who returned to South Wales towards the end of 1898,⁵⁴ bringing two young French engineers wishing to learn English, to act as draughtsmen and to translate French drawings.⁵⁵

C. Roch himself, a French civil engineer, says he joined L.G. Mouchel in Swansea in October, 1899, from F. Hennebique's employment,⁵⁶ because he said he anticipated the failure of the Brussels agency⁵⁷ (and concealing this switch from Hennebique). Before joining Hennebique, Roch had worked for three years in the Department of New Works Projects in the Municipal Offices, Marseilles.⁵⁸

50. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20), p.31: Oil Mill, Liverpool for Simonds, Hunt & Montgomery: architect, John Clarke, F.R.I.B.A., 1898. Appendix I.

51. E.g. Bureau de Londres, Le Bét. Armé, Aug., 1903, p.48.

52. Roch, op.cit. (4), p.7.

53. Ib.

54. Roch, ib., says Eliot returned to L. G. Mouchel's new agency, Swansea, end of 1898 - but see (39).

55. Ib.

56. Ib., p.9.

57. Ib., p.7.

58. Ib., p.3.

W. R. Howard (who, himself, joined L. G. Mouchel in 1906) described T. J. Gueritte, B.Sc., M.Soc. C.E. (France) as the, "most important" of the engineers from Hennebique's offices who "largely" staffed Mouchel's offices.⁵⁹ T. J. Gueritte was recommended to Mouchel by Hennebique⁶⁰ and after Hennebique obtained the contract for the Cooperative Wholesale Society's Quayside warehouse in Newcastle on Tyne, towards the end of 1899,⁶¹ Gueritte (aged 24⁶²) came to instruct the contractors, D. N. Brims of Newcastle.⁶³

According to C. Roch (1958), there was a lawsuit between L. G. Mouchel and F. Hennebique over fees following the completion of this building, which Mouchel won, but they remained on good terms and Mouchel's work was still lucrative for Hennebique.⁶⁴

From about 1899, L. G. Mouchel himself underwent several courses of training at Hennebique's Paris Office⁶⁵ and subsequently drawings were executed usually by Mouchel,⁶⁶ or by other French engineers in Britain trained by Hennebique, and L. G. Mouchel himself began to patent reinforced concrete designs.

59. W.R.Howard, Notes, 17.11.1971. S.a: Chapter 3. Cf. Roch, op.cit. (4), p.16: "Gueritte knew how to make good friends."

60. Chronology, op.cit. (37).

61. Roch, op.cit. (4), p.15.

62. T.J.Gueritte: b. 1875; d. 1964: Notes, Album, L.G.Mouchel & Ptrs., 38 Victoria St., Westminster.

63. Roch, op.cit. (4), p.16. S.a: Obituary - The Late Mr. David Nicholas Brims of Newcastle on Tyne, F.C., vol.3, no.12, p.376.

64. Roch, op.cit. (4), p.16.

65. Flament-Hennebique, op.cit. (1).

66. Charles F. Marsh, Reinforced Concrete, Lond., 1904, p.70. A Warehouse of Reinforced Concrete in Dundee, C. & C.E., vol.2, no.5, (pp.387-91), p.391.

C. Roch⁶⁷ said he drew up the first projects and working drawings for ferro-concrete work in Britain, which included silos executed at Birkenhead, a warehouse at Brentford⁶⁸ and Cold Stores at Southampton;⁶⁹ the first two were built in 1899.⁷⁰

C. Roch (1958) implies that the execution of drawings in Mouchel's office was his initiative, although it was Hennebique's policy in any case to establish regional technical offices and encourage local autonomy.⁷¹ Roch also claimed credit for persuading Mouchel to make Hennebique change the percentages of the financial arrangement in Mouchel's favour;⁷² Hennebique visited Mouchel in Swansea (that is, before 1900) to discuss this question, and the outcome was that L. G. Mouchel subsequently took 8% and F. Hennebique, 4% of the contractors' fees.⁷³

Encouraged by Roch, L. G. Mouchel decided to move to London, and in March, 1900,⁷⁴ installed the office in an apartment owned by the Great Western Railway Co. at 124, Holborn, E.C.I.⁷⁵ (The

67. Roch, op.cit. (4), p.9.

68. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20): Granary, Birkenhead, for Mersey Docks & Harbour Board, 1899, p.49. Railway warehouse for G.W.R. Co., Brentford, 1899, p.17.

69. *Ib.*, Cold Stores, Southampton, for Cold Storage & Lairage Co., 1904, p.18.

70. S.a: Project Record No. 1, (Nos. 1 - 8750), L.G.Mouchel & Ptrs., Ltd., 38 Victoria St., Westminster. Appendix I.

71. Roch, op.cit. (4), p.9. Chapter 6.

72. *Ib.*

73. *Ib.*, p.10.

74. *Ib.*

75. *Ib.* L.G.Mouchel, G.W.R. Buildings, 124 Holborn, London, E.C., letter, 19.2.1901, informing of transfer of offices to: 38 Victoria Street, Westminster, on: 8.3.1901. Technical Office for the U.K: G.W.R. Buildings, 124, Holborn, E.C.: (deleted) in: Quantities, N.E.R. wall, Hull, to Rose, Downs & Thompson, 26.7.1901.

G.W.R. Co. were an early client⁷⁶). Here (says Roch)-Mouchel and his staff rented a new but bare apartment, without W.C. or lift (oversights by the architect) and smoking chimneys.⁷⁷ They were joined here by Dufour and Gérard from the Ecole de Vierzon.⁷⁸

From 8th March, 1901, L. G. Mouchel's Head Office was permanently established at, 38, Victoria Street, Westminster,⁷⁹ in a light apartment on the fifth floor.⁸⁰ Here, says Roch, he (Roch) organised the office for efficiency and economy superior to Hennebique's arrangements in Paris, with a project office, execution department, despatch, accounts, reception, typists and Mouchel's and Eliot's office,⁸¹ whilst he (Roch) had no holiday for three years, being indispensable in organising staff and checking all calculations and drawings.⁸² It seems unlikely, in view of what is known of L. G. Mouchel, that he played such a secondary role in this organisation as Roch implies and Roch himself admits that Mouchel worked late at nights in the office, (although possibly expecting the same dedication of his staff!)

Following his induction course in Brussels, Francis Eliot had suggested, towards the end of 1900, he should open an office in Manchester, where, according to C. Roch (1958) he was unsuccessful, quarrelled with Mouchel and returned to France⁸³ - although Francis Eliot was involved in the successful execution of Rose, Downs & Thompson's Old Foundry building (1901) in Hull for example, (where there was no separate agency).⁸⁴ Roch wrote to H. Foort,

76. E.g. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20), p.17: warehouse, Brentford, 1899, (68); warehouse, Royal Albert Docks, Lond., 1900, for G.W.R. Co: see Appendix I.

77. Roch, op.cit. (4), pp.10-11.

78. *Ib.*, p.11.

79. L.G.Mouchel, G.W.R. Buildings, 124, Holborn, E.C., op.cit. (75).

80. Roch, op.cit. (4), p.11.

81. *Ib.* Chronology, op.cit. (37); L.G.Mouchel & Ptrs. stayed 50 years, occupying more floors.

82. Roch, op.cit. (4), p.12.

83. *Ib.*, p.14.

84. Old Foundry, Hull, Fitting Pit, Notes, signed: Francis Eliot, Manchester, 19.2.1901.

F. Hennebique's former Chief Engineer and Roch's superior in Hennebique's office and who had studied English, whom L. G. Mouchel engaged in December, 1901, although Mouchel had first asked Hennebique's opinion;⁸⁵ (Foort, like Roch, was one of Hennebique's "disconsolates", having also left his employment dissatisfied with the arrangements for moving from Brussels to Paris).

By 1902,⁸⁶ L. G. Mouchel had Technical Offices in Westminster, where Mouchel himself, H. Foort and C. Roch⁸⁷ for example, worked, in Manchester and also Southampton, where one of the first British Hennebique jobs had been carried out.⁸⁸ T. O. Dixon, a British engineer, represented L. G. Mouchel here⁸⁹ and applied to Mouchel for projects which he (Dixon) had acquired.⁹⁰ By this date (1902), Mouchel also had licensed contractors in a dozen cities in England and Wales.⁹¹

By November, 1904, further offices were established in Birmingham and Glasgow, and in Newcastle on Tyne,⁹² where T. J. Gueritte became L. G. Mouchel's Northern District Engineer and Manager, with responsibility

85. Roch, op.cit. (4), p.15.

86. Relevé de Travaux Executés, Année 1902, Bétons Armés Système Hennebique, Bureau Technique Central, Paris, p.4. Ferro-Concrete, B.J., vol.15, 30.7.1902, (p.388 ff), p.389.

87. L.G.Mouchel, The Hennebique Ferro-Concrete System, Lond., 2nd edn., 1905, p.167: Foort and Roch at London office, 22. 1. 1902.

88. Retaining Bank, River Itchen, Southampton, for L.S.W.R. Co., 1897: Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20), p.96.

89. Mouchel, op.cit. (87), p.164. T.O. Dixon, Southampton Office, letter to L.G.Mouchel, 24.7.1901.

90. T.O.Dixon to L. G. Mouchel, 16.9.1902.

91. Relevé, op. cit. (86).

92. L.G.Mouchel, 38 Victoria St., Westminster, to Rose, Downs & Thompson, Hull, 1.11.1904.

for North-Eastern England and Eastern Scotland.⁹³ The early buildings in Newcastle were noted (1909) as, "conspicuously satisfactory" (although their design and execution in at least two instances were somewhat protracted).⁹⁴

In May, 1904, J.S.E. de Vesian, who with T.J.Gueritte became L.G.Mouchel's partner in 1907, was engaged as Mouchel's Assistant or Secretary.⁹⁵ De Vesian (brother of Mouchel's solicitor⁹⁶) was English⁹⁷ and a member of the I.C.E.⁹⁸ Further British trainees and engineers, joined L. G. Mouchel, for example, W. R. Howard (1906) who was trained by Gueritte and de Vesian (and became a director of L.G.Mouchel & Partners in 1923⁹⁹), and F.A.MacDonald, by 1907, District Engineer for Hennebique's system in Glasgow, (although there is no evidence that he was involved in the design and construction of the Lion Chambers offices, Glasgow, (1904-7).¹⁰⁰

Shortly before L.G.Mouchel's death in May, 1908, knowing himself ill, Mouchel in 1907 formed a Company - L. G. Mouchel & Partners Ltd., - with himself Senior Partner and T.J.Gueritte and J.S.E. de Vesian as Joint Directors.¹⁰¹ The company's object was described as being to carry

93. T.J.Gueritte, Distr. Mgr., Newcastle on Tyne, Northern District Office, letter re : Ouseburn Valley Works, 27.11.1905.

94. Tests of Ferro-Concrete Construction at the Tynemouth Palace, F.C., vol.1, no.2, Aug., 1909, p.29. S.a. later this chapter.

95. Roch, op.cit. (4), p.16: de Vesian engaged, 2.5.1904. S.a. Discussion on Reinforced Concrete, 5.12.1904, J.R.I.B.A., vol.12, 10.12.1904, p.84.

96. Roch, op.cit. (4), p.16.

97. G.P.Manning, M.Eng., F.I.C.E., personal communication by letter, 9.10.1980; Mr. Manning was employed by L.G.Mouchel & Ptrs., 1913-15.

98. Discussion on Reinforced Concrete, op.cit. (95).

99. W.R.Howard, Notes, n.d., Album, L.G.Mouchel & Ptrs., 38 Victoria St., Westm.

100. Ed's note to: F.A. MacDonald, Standard Fire-Resisting Construction in Relation to the Present Rules of the Fire Offices Committee, C. & C.E., vol.2, no.3, July, 1907, p.219. Lion Chambers is discussed below and the subject of Chapter 11.

101. Obituary. L.G.Mouchel, op.cit. (9). T.J.Gueritte and J.S.E. de Vesian, Obit. letter for L.G.M., op. cit. (26). Obituary, L.G.Mouchel. op.cit. (6). S.a. W.R.Howard, letter to Mr. Crundwell, 6.12.1977.

on the business of,

"specialists in ferro-concrete construction, engineers,
architects, etc." 102

Concrete and Constructional Engineering (1908) apparently did not regard
this as a change of emphasis (to include "architectural" design),
commenting,

"the work undertaken by Mr. Mouchel is frequently quite
as much of an architectural or of an engineering character
as it is commercial ". 103

The company structure did not involve F. Hennebique.¹⁰⁴ T. J.
Gueritte was later head of the firm for nearly 40 years and influential
in introducing prestressed concrete into the U.K.¹⁰⁵

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102. Memoranda, C. & C. E., vol.2, no.6, Jan., 1908, p.491.

103. Editorial Notes, C. & C.E., vol.2, no.6, Jan., 1908, pp.425-6.

104. Memoranda, op.cit. (102).

105. T.J.Gueritte, Album, L.G.Mouchel & Ptrs., 38 Victoria St.,
Westminster.

Mouchel-Hennebique Construction.

In 1900, L. G. Mouchel obtained the first few of a dozen British patents for reinforced concrete design, half of which were for piles, Mouchel had early employed ferro-concrete piles - Hennebique's latest development¹⁰⁶ - in Britain, for a river wall at Southampton (1897).¹⁰⁷ L. G. Mouchel was said (1921) to be the first engineer to make a special study of reinforced concrete as applied to marine works¹⁰⁸ and one of his own patents (1900) was for grouping and protecting ferro-concrete piles for jetties¹⁰⁹ - claimed by C. Roch (1958) as his idea,¹¹⁰ although Ferro-Concrete (1911) for example, credited it to L. G. Mouchel, while (again) emphasising Mouchel's engineering inventiveness.¹¹¹

L. G. Mouchel's patent no. 4548 (1900) for improvements in piles, employed, in hollow piles, diagonal cross ties looped around adjacent vertical bars, "along a spiral line around the pile body".¹¹² L. G. Mouchel (1904) claimed that this patent proved that he, not

106. Hennebique's first patent for piles: 1896: Le Bet. Arme, Sept., 1900, p.5. W.Noble Twelvetrees, Francois Hennebique: A Biographical Memoir, F.C., vol.13, no.5, Nov., 1921, pp.135, 137. Gueritte, op.cit. (2), p.89.

107. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20).

108. Mouchel-Hennebique Ferro-Concrete. A Handbook for Engineers and Architects, Lond., 4th edn., 1921, p.2.

109. Gueritte, op.cit. (2), p.92.

110. Roch, op.cit. (4), p.14. Roch himself obtained a patent with L. G. Mouchel & Ptrs., Ltd., for reinf. in brick walls (no. 7590, 1908-9): Recent Patents, C. & C.E., vol.5, no.1, p.48.

111. Life and Work, op.cit. (2), p.213.

112. Gustave Louis Mouchel, 124, High Holborn, London, Engineer, Improvements in and Relating to Piles, no. 4548, 9.3.1900; Complete Specif., 8.1.1901; Amended 21.8.1907 - amends. indicated; (pp.1-17 and 5 sheets diags.), pp.12,16 and sheet 2, figs. 8, 9; s.a., p.4, (Provis. Specif., 1900).

A. Considère, invented spiral reinforcement,¹¹³ although Mouchel's was not a true nor closely spaced spiral like Considère's, nor did he apply it in columns.

In 1904, L. G. Mouchel corrected Charles Marsh's statement in his book, Reinforced Concrete (1904) that F. Hennebique was constructing hollow piles, the only hollow pile on the market, he said, being his own.¹¹⁴ Mouchel's hollow piles were used, for example, for a ferro-concrete granary (1907) at Dunston on Tyne for the C.W.S.¹¹⁵

However, L. G. Mouchel's original work in reinforced concrete was not confined to underground and underwater construction. For instance, Mouchel's patent no. 15,446 (1900) was for reinforced concrete walls and partitions, either cast in situ, or prefabricated,¹¹⁶ with straight vertical bars, and horizontal curved bars which were convex against lateral pressure for use in silos, warehouses or similar structures.¹¹⁷ L.G.Mouchel also patented steel rod links for columns, instead of Hennebique's "distant pieces" (perforated steel plates)¹¹⁸ which had been

113. L.G. Mouchel, communicated by J.S.E. de Vesian, Discussion on Reinforced Concrete, op.cit. (95), p.84. L.G.Mouchel & Ptrs. later launched: Helical Bar & Engineering Co: Howard, op.cit. (101).
114. Erratum slip inserted in Marsh, op.cit. (66), p.197, saying Marsh informed of this by L.G.Mouchel.
115. Ferro-Concrete Work at Dunston-upon-Tyne, Instit. Min. Engrs., Trans., vol.34, 1907-8, (pp. 61-5), p.64: N.Eng. Instit., Excursion meeting, 29.8.1907. Chapter 10, Appendix I.
116. Gustave Louis Mouchel, Improvements in and Relating to Walls, Partitions, Slabs, Blocks and the Like, U.K. pat. no. 15,446, 1900; Complete Specif., 30.5.1901: Main frame (beams, pillars) in situ: s.a. Chapter 3.
117. Ib., pp. 2 - 5, diags: sheets 1, 2.
118. Hennebique Methods of Calculation, Article VI, F.C., vol. 1, no. 10, April, 1910, p.217.

difficult to surround with concrete.¹¹⁹ Such links were employed, for example, in W. G. Black's Lion Chambers Building in Glasgow (1905).¹²⁰

In 1905, L. G. Mouchel patented stirrups held in place by the use of cotter pins¹²¹ (G.P.Manning, M.Eng., F.I.C.E., (1980) described the use of flat stirrups and their displacement as the, "great weakness of the Hennebique system"¹²²).

In addition, Concrete and Constructional Engineering (1908) referred to L. G. Mouchel's use of the main principles of Hennebique's system to construct arched beams and latticed girders of long span; (the latter were applied, for example, in New Bridge Street Goods Station, Newcastle on Tyne, completed in 1907.) These beams and girders,

"embodying some original features, represent what is termed Mouchel-Hennebique practice ". 123

L. G. Mouchel's usual specification for concrete differed from F. Hennebique's insofar as, for example, Mouchel exclusively specified good Portland cement but Hennebique did not, necessarily.¹²⁴

Thus as well as applying Hennebique's patents, L. G. Mouchel employed his own forms of piles, probably his own design of wall-panels

119. C.A.P.Turner, Concrete-Steel Construction, Minneap., 1909, reprint in: Howard Newlon Jr., ed., A Selection of Historic American Papers on Concrete 1876 - 1926, A.C.I., 1976, p.249.

120. E.g. Building for W.G.Black, Esq., Glasgow.Construction in Hennebique's Patent Ferro-Concrete, Working Plan no.16 (modified), L.G.Mouchel, C.E., 9.12.1905.

121. Gustave Louis Mouchel, Improvements in and Relating to Reinforced Concrete Structures, U.K. pat. no.13,671, 1905.

122. Manning, op.cit. (97). S.a: Chapter 3.

123. Characteristics of the Chief Systems of Reinforced Concrete Applied to Buildings in Great Britain, C. & C.E., vol.2, no.6, Jan., 1908, p.431. S.a. Characteristics of the Chief Systems of Reinforced Concrete Applied to Civil Engineering Works in Great Britain, C. & C.E., vol.3, no.2, May, 1908, p.103. Chapter 3.

124. L.G.Mouchel, Monolithic Constructions in Hennebique's Ferro-Concrete, pr. to R.I.B.A., 21.11.1904, J.R.I.B.A., vol.12, 26.11.1904, (pp.47-61), p.57: severe specif.for cement. New G.P.O.Buildings, C. & C.E., vol.4, no.3, July, 1909, p.162. Memoranda, C. & C.E., vol.4, no.2, May, 1909. Chapters 1, 3.

for silos and similar structures and modified details, for instance, in stirrup design. In at least one building, New Bridge Street Goods Station, Newcastle (and other structures) Mouchel adapted Hennebique's system to girders of novel shape and longer span than Hennebique employed. L. G. Mouchel also had his own ideas about the materials used for ferro-concrete - as well as the skill necessary in its construction.

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"Authorised Hennebique Contractors" in Britain.

Like F. Hennebique, L. G. Mouchel granted licences to building contractors who wished to employ Hennebique's system. The licence, which had reference to, "F. Hennebique or the Licensor", was an agreement to give L. G. Mouchel 12% royalties in return for the provision of working drawings; it also stipulated that the licensees should not use any system except Hennebique's, and in addition that they should inform the licensor of any infringement of Hennebique's patents.¹²⁵ The Licensor reserved the right to grant a specified number of similar licences in a district (for example, 24 in London). L. G. Mouchel licensed building contractors in the U.K. and also in Australia, as a British colony.¹²⁶

Ferro-Concrete (1912) observed that L. G. Mouchel was,

"rigorous on all points connected with the safety, stability and permanence"

of works with which he was associated.¹²⁷ However, it was L. G. Mouchel's opinion (1905) that Hennebique structures could be erected, with carpenters and smiths, by unskilled workers, with a foreman of, "ordinary" ability:

"no skill and no mental effort is required ".- 128

Mouchel (1904) said workmen of average intelligence could be trained,

"in a very few days - I was going to say hours"

125. Licenses of Reinforced Concrete Systems. Mouchel v. William Cubitt & Co., C. & C.E., vol.2, no.1, March, 1907, pp.58-9. S.a. C. & C.E., vol.4, no.4, Sept., 1909, p.234.

126. Memorandum of Agreement. Duplicate or Counterpart. L.G.Mouchel and Colonial Ferro-Concrete Syndicate Ltd., Lond., 19.9.1906. Memoranda, The Will of the Late L. G. Mouchel, C. & C.E., vol.3, no.4, p.341.

127. Life and Work, op.cit. (2), p.213.

128. Mouchel, op.cit. (87), p.20.

and he referred to his own experience of training gangs of workers which he had had to undertake in introducing ferro-concrete.¹²⁹

Building Industries (1907) noted however that the peril of reinforced concrete was its, "supposed simplicity"¹³⁰ and E.C.Hannen (1926) of W. Cubitt & Co., (Hennebique licensees) recalled,

"we proceeded on a system of trial and error and I am afraid the latter was conspicuous by its presence ". 131

F. Hennebique himself, attached more importance both to special training and the use of workmen of proved competence, (Chapter 6).

L. G. Mouchel's contractors' brief training in ferro-concrete construction was sometimes complemented however by the use of specially trained French workers who assisted the construction of other early buildings in the U.K., as well as the first, Weavers' Mill, Swansea (Chapter 6) and possibly at Hennebique's instigation. L. G. Mouchel¹³² or sometimes T.J.Gueritte, for example, representing him,¹³³ also normally supervised buildings personally, together with the non-specialist architect or engineer involved¹³⁴ and contractors' representatives.

Consistently with his views, L. G. Mouchel, unlike Hennebique, did not necessarily limit his licences only to established and tried

129. Mouchel, op.cit. (124), p.50.

130. Reinforced Concrete Construction; Some Points of Risk and Avoidance, Build. Inds., vol.18, 16.8.1907, p.74.

131. E.C.Hannen, (Chairman, Holland & Hannen & Cubitts, Ltd.), Some Notes on Concrete, C. & C.E., vol.21, 1926, p.55.

132. E.g. Marsh, op.cit. (66), p.70: Mouchel generally supervised works.

133. E.g. A Warehouse of Reinforced Concrete in Dundee, op.cit. (66), p.391.

134. E.g., Mouchel, op.cit. (87), pp.174-5; W. Armstrong, Reinforced Concrete on the Great Western Railway, C. & C.E., vol.1, no.2, (pp.108-17), p.111.

contractors, (although he is usually assumed to have done so¹³⁵) and his "Authorised Contractors" had varied backgrounds and experience.

Rose, Downs and Thompson, of Hull, for example, who became licensed contractors for Hennebique's system in 1900, were completely inexperienced builders, being a manufacturing firm for oil mill machinery, who decided to economise on the cost of a four-storeyed extension building to their "Old Foundry" works by using ferro-concrete, (Charles Downs was interested in Hennebique's new ideas) and by building it themselves.¹³⁶ Accordingly, they were granted a licence and work started in the latter part of 1900; drawings for the ferro-concrete construction were underway between April-October.¹³⁷

An unspecified number of specially trained workers and a supervisor who were not local, were also employed for this building, since L. G. Mouchel in 1901, (writing to Brown & Polson, Paisley with reference to their proposed silos and describing Rose, Downs and Thompson as, "our nearest contractors") pointed out that this firm were just finishing their building at Hull and had at their disposal,

"a man whom I think competent to carry out the work; and while that they have (him) as well as trained workmen... would quote you a lower price.....than...after the said staff is dispersed".

(The man may have been Francis Eliot).¹³⁸

135. E.g. Twelvetrees, op.cit. (106), p.131.

136. L.A.Whittle, Leaves from the Rosedowns Story. No. 2. Reinforced Concrete Buildings, Rosedowns News Bulletin, no. 165, 26.10.1957, p.4. L. Whittle, Leaves from the Rosedowns Story. No. 1. New Cleveland Street Bridge, Rosedowns News Bulletin, no. 162, 20.7.1957, p.4.

137. Ib., Leaves from the Rosedowns Story. No. 2, p.4. See Appendix I for drs.

138. L.G.Mouchel, letter to Brown and Polson, Paisley, 11.6.1901. S.a. earlier this chapter; Appendix I.

The Old Foundry workshop, entirely reinforced concrete with 4" exterior walls (reinforced with "fishtail" bars)¹³⁹ was successfully completed on 13th June, 1901,¹⁴⁰ L. G. Mouchel's project no. 125.¹⁴¹

Rose, Downs and Thompson then commenced business as licensees for further ferro-concrete work; indeed, they were seeking their first job in June, 1901, while their own building was finished. This was an unexecuted project for silos for Brown and Polson in Paisley, for which L. G. Mouchel sent drawings to Rose, Downs and Thompson.¹⁴²

Again, on 29th October, 1901, for example,¹⁴³ Rose, Downs and Thompson wrote to L. G. Mouchel mentioning two floors for an oil mill for Edwin Robson.¹⁴⁴ L. G. Mouchel promptly (and personally) replied on the 30th, with sketches and quantities, and did not lose the opportunity to advise Rose, Downs and Thompson,

"Of course you will observe to this gentleman (Edwin Robson) that the building will not be an incombustible one owing to the exposed girders and iron pillars ". 145

This project was also rejected,¹⁴⁶ but Rose, Downs and Thompson built

139. Personal inspection of building. Extension of Workshops, Old Foundry, Hull, Construction in Hennebique's Patent Ferro-Concrete, no.125, Plan no. 6, 27.10.1900. S.a. Appendix I.

140. Leaves from the Rosedowns Story - No. 2, op.cit. (136), p.4. S.a. Mouchel, op.cit. (138).

141. Project Record No. 1, op. cit. (70). Drs: See Appendix I. S.a: Chapter 10.

142. Mouchel, op.cit. (138). Messrs. Brown & Polson, Paisley, Silos. Proposed Construction in Hennebique's Patent Ferro-Concrete, order no. 213, 1st Project, Plan no. 1, Lond., 7.6.1901; 2nd Project, Plan no. 2, 7.6.1901 (blueprints). Not mentioned in: Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20), or elsewhere.

143. Further projects included: silos, Wincolmlee, Hull: L.G.Mouchel, Lond., to Rose, Downs & Thompson, Hull, 26.10.1904; L.G.Mouchel, to Rose, Downs, & Thompson, 1.11.1904; (not executed).

144. L.G.Mouchel, Lond., to Rose, Downs & Thompson, Hull, 30.10.1901.

145. Ib.

146. Not mentioned in: Mouchel-Hennebique Ferro-Concrete. List of Works, op. cit. (20) or elsewhere.

a ferro-concrete bridge for Hull Corporation in 1902 (still in use).¹⁴⁷

On at least one occasion, Rose, Downs and Thompson misinterpreted a plan from L. G. Mouchel,¹⁴⁸ but a National Building Studies Special Report (1956) on the durability of reinforced concrete buildings noted the "excellence" of Rose, Downs and Thompson's early work in reinforced concrete, of which only the foundry building and bridge were known.¹⁴⁹

One of the most prolific licensees, on the other hand, was the Yorkshire Hennebique Contracting Co. Ltd., who constructed many of the early Hennebique buildings and bridges, including one of the most interesting early works, the eight-storeyed entirely ferro-concrete Lion Chambers, Hope Street, Glasgow (still in use and recently renovated).¹⁵⁰

The company originated with an agreement in October, 1898, between L. G. Mouchel and D. Jones, a Leeds contractor, allowing Jones to exploit Hennebique's British patents nos. 30143 and 30144 (1897) in Leeds;¹⁵¹ D. Jones & Co.¹⁵² subsequently became the Yorkshire Hennebique Co. Ltd., Contractors (remaining in business under this name until the 1960s¹⁵³). Although they claimed to be the, "oldest Hennebique contractors in the U.K."¹⁵⁴, the first recorded Hennebique contract,

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147. Contract for Ferro-Concrete Construction - Bridge for New Street, Witham to Cleveland St. Messrs. Rose, Downs & Thompson Ltd. & their Sureties and The Mayor Aldermen and Citizens of....Hull, 21.11.1902. Personal visit to area.
148. Mouchel, 1.11.1904, op.cit. (143).
149. The Durability of Reinforced Concrete in Buildings, D.S.I.R., N.B.S. Spec. Rep. no. 25, Lond., 1956, p.8.
150. Memoranda, C. & C.E., vol.1, no.3, July, 1906, p.214. The Yorkshire Hennebique Contracting Co. Ltd., Leeds, Section A. Buildings, Schools, Offices, Warehouses, Mills, Etc., Brochure, n.d., c.1919. Chapter 11.
151. Memorandum of Agreement between David Jones, 15 Park Place, Leeds and Louis G. Mouchel, 38 Victoria St., Westminster.(28.10.1898), 16.3.1904.
152. Ib. D. Jones "& Co." by 1904.
153. Note added to Memorandum, ib., by L. G. Mouchel & Ptrs.
154. Advert: The Yorkshire Hennebique Contracting Co. Ltd., F.C., vol.2, no. 9, March, 1911, p.318.

Weaver's Provender Mill, Swansea (1897-8), was executed by D. Jenkins & Sons of Swansea.¹⁵⁵

The Cooperative Wholesale Society, which had its own architectural and building departments, by 1902 obtained a Hennebique licence for their own new works in ferro-concrete;¹⁵⁶ their first ferro-concrete commission, the Quayside warehouse, Newcastle (1899-1901) was built by D. N. Brims, a Newcastle contractor.¹⁵⁷

Some of L. G. Mouchel's licensees, like F. Hennebique's, were established and well-known building or engineering contractors. For example, Sir John Aird, whose firm was appointed, "Authorised Hennebique Contractors" in October, 1899, was described by Ferro-Concrete (1911) as, "one of the first large engineering contractors to recognise the merits of ferro-concrete".¹⁵⁸ Aird, (who was associated with his father in the erection of the Great Exhibition Building, 1851¹⁵⁹) had probably observed John Grant's experiments with Portland cement and concrete, in 1865.¹⁶⁰ One of John Aird & Co.'s earliest large ferro-concrete buildings was the Cold Storage warehouse at Southampton (1904),¹⁶¹ in which C. Roch was involved.

L. G. Mouchel achieved another important contract in 1903, (not without difficulty) for five large dock transit sheds entirely in

155. Hennebique's Patent Buildings in Strengthened Concrete. Work Executed in the U.K., n.d.

156. Relevé de Travaux Executés. Année 1902, op.cit. (86): Bureaux Techniques Pour Etudes. Agents et Concessionnaires: Angleterre. S.a. Chapter 9.

157. Obituary. The Late Mr. David Nicholas Brims, op.cit. (63). Chapter 10.

158. Obituary. Sir John Aird, F. C., vol.2, no.8, Feb., 1911, (pp.226-7).

159. Ib.

160. John Aird jun. in discus., I.C.E., 1865: John Grant, Experiments on the Strength of Cement, Lond., 1875, p.68. Chapter 1.

161. Hennebique's Patent Buildings in Strengthened Concrete, op.cit. (155). Mouchel- Hennebique Ferro-Concrete. List of Works, op.cit.(20),p.18.

ferro-concrete for the Manchester Dock and Warehouse Extension Co., in association with the Manchester Ship Canal Co.,¹⁶² (and which was reported in Le Béton Armé¹⁶³).

For this job, begun in July, 1903, a French firm of Hennebique contractors, M. Breuder, was employed, together with a Wolverhampton firm, H. Lovatt & Co; out of 350 - 400 workers for this contract, the foremen, head carpenters and head concreters were French, numbering about 20 special workers altogether.¹⁶⁴ L. G. Mouchel, W. H. Hunter (Chief Engineer to the Manchester Ship Canal Co.) and others directed the work¹⁶⁵ (figure 1), (which was finished six months' ahead of time¹⁶⁶).

Breuder were also involved in ferro-concrete work for an earlier, oil mill in Liverpool (1898) for Simonds, Hunt and Montgomery.¹⁶⁷

W. Cubitt & Co., like John Aird & Co., an example of well-established builders who became Hennebique licensees, also developed a special knowledge of Portland cement and concrete. (B. Hannen (1905) said Cubitt & Co. took up the subject of Portland cement,

"in a more detailed manner than is usual amongst contractors ".¹⁶⁸)

W. Cubitt & Co. obtained a licence in March, 1903, to work Hennebique's British patents nos. 10203, 30143 and 30144 (1897) in London¹⁶⁹ and on

162. Indenture between L.G.Mouchel and Manchester Dock and Warehouse Extension Co. Ltd., for erection 5 transit sheds, Hennebique system, 18.3.1903. See Appendix. S.a. last section of this chapter.

163. Canal Maritime de Manchester, Le Bét. Armé, June, 1903, p.14. Canal Maritime de Manchester. Les Nouveaux Magasins de Transit, Le Bét. Armé, mai, 1904, (pp.173-80), p.180.

164. Le Bét. Armé, mai, 1904, ib., pp.173-80.

165. Ib., p.180.

166. Le IXe Congrès et l'Exposition du Béton Armé, Le Bét. Armé, March, 1905, p. 38.

167. Hennebique's Patent Buildings in Strengthened Concrete, op.cit. (155). S.a. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit.(20), p.31. This building, in Boundary St., Liverpool, apparently demolished: personal search of area, April, 1978.

168. B.Hannen, jun ., Cubitt & Co., Portland Cement for Reinforced Concrete, J.R.I.B.A., vol.12, 20.5.1905, (pp.491-4), p.491. S.a. Chapter 3.

169. Licensees of Reinforced Concrete Systems, op.cit. (125), p.58. Relevé de Travaux Executés Année 1902, op.cit. (86), p.4.

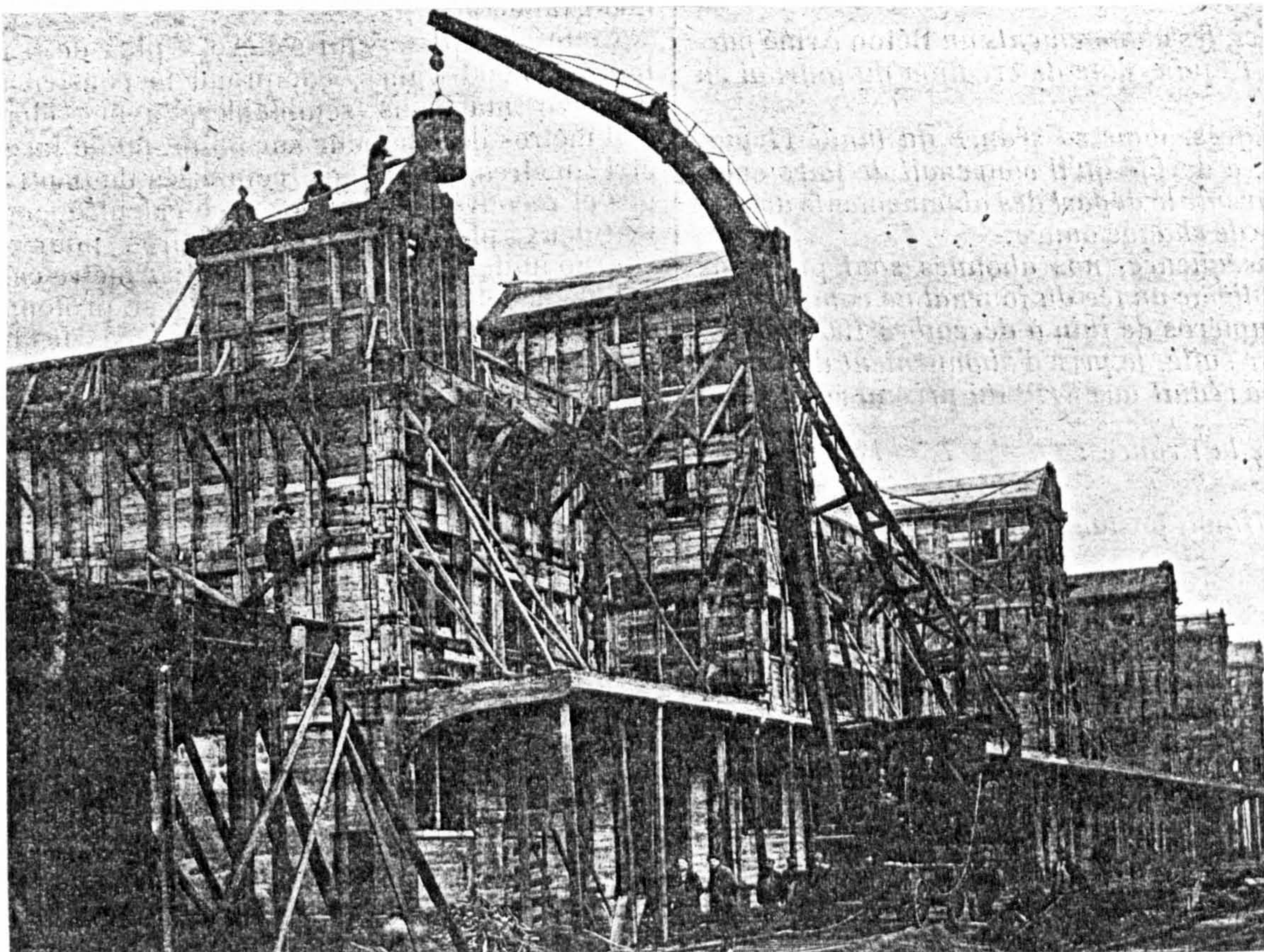


Figure 1: Transit Sheds Manchester: under construction.



Figure 2: Transit Sheds Manchester: almost completed.

adopting reinforced concrete, Cubitts took care to specify their own, "stringent" standard of Portland cement and stressed the importance of using the best concrete.¹⁷⁰

E.C.Hannen (1926) said Cubitt & Co. were among the small band of pioneering enthusiasts who devoted much time and money to experiments with reinforced concrete,¹⁷¹ although B. Hannen (1904) of Cubitt & Co., for instance, said he himself,

"knew nothing about the scientific part of the new material ". 172

W. Cubitt & Co. constructed a column on Considère's system for tests by William Dunn, F.R.I.B.A., in 1903¹⁷³ (who had prompted their original researches in cement¹⁷⁴). In 1905, W. Cubitt & Co. made concrete beams reinforced in various ways, and invited the Science Committee of the R.I.B.A. to witness the construction: these were given to the R.I.B.A. Joint Reinforced Concrete Committee when it was formed.¹⁷⁵

William Cubitt & Co. did both general contracting and ferro-concrete work (as the Cubitt Concrete Construction Co.) and for the Bank of England's new premises, Priory Lane, Roehampton (1908), for example, they had both contracts.¹⁷⁶ One of their most important early reinforced concrete works was a large water tower at Newton-le-Willows (1904), designed by Read and Waring¹⁷⁷ (recently demolished¹⁷⁸). Although B. Hannen (1905) said Cubitts had not experienced any failure with reinforced

170. B. Hannen, op.cit. (168), p.491. Discussion on Reinforced Concrete, op.cit. (95), pp.91-2.
171. Hannen, op.cit. (131). Cubitt & Co., J.R.I.B.A., 19.12.1903, p.114.
172. Hannen, ib., p.91.
173. W.Dunn, Test of an Armoured Concrete Column, J.R.I.B.A., vol.11, 21.11.1903, (pp.48-52), p.48.
174. Hannen, op.cit. (168), p.491. Discussion on Reinforced Concrete, op.cit. (95), p.91.
175. I.C.A. Trans., 1906, R.I.B.A., Lond., 1908, p.155. Chapter 8.
176. Memoranda: Contracts, C.& C.E., vol.3, no.1, March, 1908, p.69. Cubitt Conc. Constrn. Co: C.& C.E., vol.4, no.7, Dec., 1909, p.453.
177. New Works in Concrete, C. & C.E., vol.1, no.3, July, 1906, p.222.
178. See Appendix.

concrete,¹⁷⁹ the water tower did present some minor problems a few years after completion.¹⁸⁰

In order to, "clarify" the meaning of the terms of their licence for the Hennebique system, W. Cubitt & Co. in 1906 used another system than Hennebique's for a small piece of reinforced concrete work at Whitbread's brewery, London.¹⁸¹

L. G. Mouchel prosecuted W. Cubitt & Co. and won the case, brought in February, 1907, thus successfully preventing Cubitts (or other Hennebique licensees) from working with systems in competition with Hennebique's.¹⁸²

However, L. G. Mouchel failed to obtain a legal agreement that the terms of the licence implied a covenant between licensor and licensee involving loyal cooperation in extending and promoting the Hennebique system, and not any other system, in the U.K. or in London.¹⁸³

Cubitt's was not an isolated move against the licensing system or the promotion of particular systems of reinforced concrete in Britain at this time, (see Chapter 8).

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179. Hannen, op.cit. (168).

180. The I.C.E. and Reinforced Concrete, C.& C.E., vol.5, no.11, Nov., 1910, pp.803-4.

181. Licensees of Reinforced Concrete Systems, op.cit. (125), p.59, Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20⁽¹⁸⁾), p.18: Three brewery storehouses for Whitbread & Co. in Chiswell St., E.C.; Tottenham and Willesden; (1903): Cubitt & Co. constructed floor for Mouchel at Tottenham: Mouchel, op.cit. (87), p.145.

182. Licensees of Reinforced Concrete Systems, ib., p.59.

183. Ib.

The Roles of Specialists and Non-Specialists in Design.

The role of architects vis-à-vis specialists in reinforced concrete design was another focus of contemporary moves to undermine the "specialist system" (Chapter 8). Architects, and also engineers, in Britain around 1900 were generally ignorant of reinforced concrete design,¹⁸⁴ which, together with its construction was mostly carried out by specialists' firms (especially L. G. Mouchel's) representing particular systems.¹⁸⁵ However, architects and to a lesser extent, engineers,¹⁸⁶ were also employed, together with structural specialists for buildings. The respective roles of specialists and non-specialists, and the usual sequence of designs, are examined here as relevant to:

- (1) clarifying the specialists' achievements in the early buildings,
- (2) the aesthetic design and character of these buildings and the artistic problems encountered by architects in ferro-concrete design,
- (3) the position of architects and specialists in ferro-concrete design to which some architects and others were opposed, (Chapter 8).

Lucien Serraillier (1909), associated with the Patent Indented Steel Bar Co., noted that the specialist organisation was peculiar to

184. E.g. Ferro-Concrete, B.J., vol.15, 30.7.1902, p.388; Mouchel, op.cit. (124), p.47. Cf: S.B.Hamilton, A Note on the History of Reinforced Concrete in Buildings, N.B.S. Spec. Rep. No.24, Lond., 1956, p.14.

185. W. Dunn, pr. to C.I., C. & C.E., vol.3, no.6, Jan., 1909, p.480. Jones, op.cit. (13), p.270.

186. Out of a total of 72 non-specialist designers for all the reinforced concrete framed buildings estimated as designed on Hennebique's system, 1897 - 1908, 58 were architects, (35, members of R.I.B.A.,) and 14 were engineers, (12, members of I.C.E.): extrapolated: Mouchel-Hennebique Ferro-Concrete, op. cit. (20). (18)

reinforced concrete, although occasionally employed for steelwork.¹⁸⁷ However, Serraillier distinguished two kinds of reinforced concrete specialists, those who exploited a patent system of construction, supplying designs and licensing contractors to construct them, their profit being a percentage of the contract (such as L. G. Mouchel and G.C. Workman (Coignet's system)) and those who sold and designed for a patent reinforcement, their profit deriving from the sale of reinforcement,¹⁸⁸ (such as the Trussed Concrete Steel Co. (Kahn bars)). The main concern here (as in Chapter 8) is with the former, and L. G. Mouchel.

Although reinforced concrete floors, for example, had previously been designed and executed by patentees, specialists might now be involved in the design and construction of entire reinforced concrete frames for buildings, and which were designed and erected as an entity (and not in the manner described of some British steel-work, when architects added individual steel girders as required; however, major steel-work was also being erected in "the American way" in the U.K. in the early 1900s¹⁸⁹).

Maurice Béhar (1911), associated with Coignet's system, said that for, "architectural work including buildings", the specialist worked under the client's architect, who had general control of the work.¹⁹⁰ However, the specialist might similarly work for an engineer.

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187. Lucien Serraillier, The Commercial Aspect of Reinforced Concrete, pr. to C.I., 18.2.1909, C.I. Trans. & Notes, vol.1, pt. 2, Lond., April, 1909, (pp.41-64), p.42. The Patent Indented Steel Bar Co. is mentioned in Chapter 3.
188. Ib. Lucien Serraillier, The Reinforced Concrete Specialist, C.& C.E., vol.7, 1912, (pp.93-7), p.95. There were occasionally unpatented or non-specialist uses of reinforced concrete, e.g. Fred Ballard (1904) designed and built a bungalow reinforcing it with barbed wire: F. Ballard, Concrete, Lond., 3rd edn., 1925, p.71, il. fig.48.
189. E.g. Ritz Hotel, London: Chapter 5. S.a: Chapter 4.
190. Maurice Béhar, Formulae for the Verification of Schemes in Reinforced Concrete, C. & C.E., vol.6, no.10, Oct., 1911, (p.736 ff), p.736.

For example, W. W. Squire, M. Inst. C.E. and A. G. Lyster, M. Inst. C.E., who both early employed Hennebique's system for framed buildings,¹⁹¹ said in evidence to the I.C.E. Committee on Reinforced Concrete (1908 - 10) that they always employed specialists for reinforced concrete work, but J. J. Webster, M. Inst. C.E., (who had made some personal study of concrete in the early 1890s¹⁹²) did so sometimes.¹⁹³ W. W. Squire said he prepared outline drawings and specifications, without restriction as to system, and he checked the patentee's calculations.¹⁹⁴ W. H. Hunter, M. Inst. C.E., Chief Engineer to the Manchester Ship Canal Co.¹⁹⁵ and engineer for their large, early ferro-concrete transit sheds (1903-5) stated that for these, M. Mouchel designed the reinforcement, but he examined the drawings and his staff checked the calculations.¹⁹⁶ Opinions differed about the allocation of final responsibility for the work between engineer and specialist and contractor.¹⁹⁷

William Dunn, F.R.I.B.A., was sure that where architects worked with reinforced concrete specialists, the architect had final responsibility.¹⁹⁸ W. Dunn, who had employed Hennebique's system for example in an Assurance office extension in St. James' Square, London (1903), and Sir Henry Tanner, F.R.I.B.A., who also had experience of working with L. G. Mouchel (1906-7)¹⁹⁹ each explained the respective roles of architects and specialist. The

191. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20): W.W. Squire erected transit sheds and granary for Bristol City Docks Committee (1904-7), and A.G.Lyster, granary, Birkenhead (1899) for Mersey Docks & Harbour Board.

192. T. Potter, Concrete, Vol.2, Lond., n.d., c.1893, pp.178-9.

193. The I.C.E. and Reinforced Concrete, C. & C.E., vol.5, no.10, p.712.

194. Ib.

195. Editorial Notes, C.& C.E., vol.2, no.2, p.90.

196. The I.C.E. and Reinforced Concrete, op.cit. (193), p.712.

197. Ib. p.713.

198. William Dunn, F.R.I.B.A., Reinforced Concrete Floors, letter to Ed., 5.4.1905, J.R.I.B.A., vol.12, 8.4.1905, p.373.

199. See Appendix.

specialist method entailed the architect's initial and overall design for a reinforced concrete building,²⁰⁰ but all calculations for strength were by the specialist, who fixed beam and column sizes, slab thicknesses and reinforcement details.²⁰¹ These might be checked by the architect if competent.

For Sir H. Tanner's G.P.O. buildings in King Edward St., London, E.C., (1905-9)²⁰² and which Ferro-Concrete (1912) considered an important acknowledgement of ferro-concrete,

"and of L. G. Mouchel as engineer", 203

the plans were prepared in Tanner's office in skeleton and L. G. Mouchel adapted his construction accordingly; Sir H. Tanner's instructions to L. G. Mouchel specified that supports should be minimal in area and as few as possible and beams shallow.²⁰⁴

For A.E. Corbett, A.R.I.B.A.'s Y.M.C.A. premises, Manchester, (1908-11)²⁰⁵ on Kahn's system, the architects supplied drawings and specification as a basis for tenders;²⁰⁶ the Trussed Concrete Steel Co., Westminster, who won the contract, designed the reinforcement and supervised the execution,²⁰⁷ but C. F. Marsh, M. Inst. C.E., (like Dunn and Tanner, active in moves to make reinforced concrete design independent of specialist control: Chapter 8) assisted with the development of working

200. Sir H. Tanner, The First Presidential Address to the Members of the C.I., C. & C.E., vol.6, no.12, Dec., 1911, (p.930 ff), p.933.

201. *Ib.*, p.933. Dunn, *op.cit.* (198).

202. Appendix I. S.a. Chapter 5.

203. Life and Work, *op.cit.* (2), p.213.

204. Sir H. Tanner, Visit to the New G.P.O. Buildings, June 10, 1909, C.I. Trans. & Notes, vol.1, pt.3, pub. Sept., 1909, xxxii.

205. E.g. A.E. Corbett, The Y.M.C.A. Building, Manchester, pr. to C.I., 8.6.1911: C. & C.E., vol.6, no.7, July, 1911, (pp.502-9; discus., pp.509-15), p.509; (or see: C.I. Trans. & Notes, vol.3, pub. Nov., 1911, p. 282 ff). S.a. Appendix I.

206. *Ib.*, p.503.

207. Albert Lakeman, The Y.M.C.A. Building, Manchester, C. & C.E., vol.6, no.5, May, 1911, (pp.368-77), p.377.

drawings in accordance with the R.I.B.A. Report (1907), his fee being paid by the specialists, "an important concession".²⁰⁸ The architects themselves checked the original tenders from specialists.²⁰⁹

The design of at least two early Hennebique buildings in Britain appears to have been somewhat protracted and difficult: New Bridge Street, and Forth Banks, Goods Stations, Newcastle on Tyne, again on Hennebique's system and entirely ferro-concrete, except for the roof of the latter, which was steel-framed. Both buildings involved the North Eastern Railway Company's Architect, William Bell, F.R.I.B.A. and L. G. Mouchel's Northern Agent, T.J.Gueritte, superintending the work.²¹⁰

New Bridge Street Goods Station and Warehouse was completed in 1907.²¹¹ However, drawings for it, from L. G. Mouchel's office, date from October, 1901²¹² (perhaps preceded by architects' drawings): these are entitled "Trafalgar Goods Warehouse", the name of the earlier building of 1850, which New Bridge Street Station replaced.²¹³ At first steel columns were included, while further drawings in October, 1903, were again for part ferro-concrete construction, excluding the columns and roof.²¹⁴ Subsequently, two series of architect's contract drawings referred to tenders of 17.11.1903, then of 31.10.1905, about two years later;

208. Corbett, op.cit. (205), p.504.

209. Ib.

210. E.g. T.J.Gueritte, Forth Banks Warehouse, letter, 15.5.1907, referring to Mr. Bell's (architect's) plans; New Bridge Street Goods Station. Wm. Bell, Esq., Architect, Working Plan no. 27, 2.6.1904, "referred to in M. Gueritte's letter dated 6.6.1904".

211. William Weaver Tomlinson, The North Eastern Railway, Newcastle and Lond., n.d., Preface, Nov., 1914, p.763.

212. N.E.R. Trafalgar Goods Warehouse, Newcastle. Proposed Construction in Hennebique's Patent Ferro-Concrete - General Agent, L.G.Mouchel, Order no. 226, Plan no. 1, 12.10.1901; see following note re. title.

213. Tomlinson, op.cit. (211), pp.763, 507: Trafalgar Goods Station, Newcastle, opened, 1850 and closed, 2.1.1907, when New Bridge Street Station opened.

214. N.E.R. Trafalgar Goods Warehouse, op.cit. (212): steel cols. N.E.R. Trafalgar Goods Warehouse, Newcastle. Construction in Hennebique's Patent Ferro-Concrete, 13.10.1903.

(the first series was signed by William Bell, the next by A. Pollard, for Bell²¹⁵).

Possibly the time involved in designing New Bridge Street Station resulted from a slow decision to use reinforced concrete for the entire structure. It was also a difficult building technically, with the special girders employed by L. G. Mouchel. W. Bell,²¹⁶ or A. Pollard representing him, supervised the construction.²¹⁷

Before this station was finished, another ferro-concrete framed warehouse/goods station at Forth Banks, Newcastle was begun, also for the N.E.R. Co; a note of 31.5.1906 refers to bars from stock of another piling job available from M. Gueritte to enable a speedy start.²¹⁸ However, on 20.11.1906, a note from T.J.Gueritte (undirected, in English and perhaps to the contractors), advises that,

"this work was so often altered, the calculations extended over such a long period, and were utilized at the best for the final design, that it is not surprising that you will find discrepancies. The best is therefore, to follow them when possible and not to follow them when impossible ". 219

On 15. 5. 1907, another note from T. J. Gueritte (also undirected and perhaps to someone in Mouchel's office), complains that,

"I have today discovered that you had never yet altered the plan..... in accordance with the Architect's plan dated 11.4.07..... I have withdrawn all the incorrect plans from the Contractors hands so as to avoid mistakes.... and it would be well for you to put these plans in order at your earliest convenience ". 220.

215. Appendix I. S.a: Mouchel, op.cit. (87), p.174.

216. New Works in Concrete, C. & C.E., vol.1, no.4, Sept., 1906, p.306.

217. Mouchel, op.cit. (87), p.174: Pollard represented Bell at tests, March, 1905.

218. Hennebique's Patent Concrete Buildings: Cellar Accommodation, Forth Banks, Newcastle, N.E.R., Lond. Office, no. 407, Lond., 31.5.1906, quantities, 7 sheets.

219. Gueritte, Forth Banks Warehouse, note, undirected, 20.11.1906. Cf: Forth Banks Warehouse Cellar Accommodation, no.1054, 27.7.1906: unsigned, undirected, note in French saying preliminary drawings and calculations differ and asking: "which should be followed?"

220. Gueritte, Forth Banks Warehouse, letter, 15.5.1907, (undirected).

Possibly with this building, T.J. Gueritte and W. Bell experienced problems of "dual control", (referred to in Chapter 8), but in 1911, Bell was inviting tenders, "on the Hennebique system" for the N.E.R. Co.'s new Central Stores at York.²²¹

L. G. Mouchel's office designed the ferro-concrete construction for Lion Chambers, Glasgow (Chapter 11) as evidenced by the drawings (1905) for it from Mouchel's office, and there are constant references to the architects' plans for dimensions and shapes. A set of architects' plans, by Salmon, Son & Gillespie, Glasgow, were drawn between 12.4.1904 and 19.4.1905 but show changes within the group and none were as built. The proposed construction was registered with the Local Authority in June, 1905.²²² Mouchel's Working Plans were done in 1905-6²²³ and also show unexecuted details, indicating that, as the building was completed before 11.4.1907,²²⁴ there were modifications in progress.

Thus, in general, non-specialist architects, or engineers, who had overall responsibility for jobs, initially designed buildings, for which specialists then calculated the ferro-concrete construction, which might be checked by the architect or engineer if competent. The designs of at least two, early, Hennebique buildings, both for the N.E.R. Co., apparently caused difficulty and of one, extended over several years, although there may have been additional reasons for this, unconnected with the use of ferro-concrete.

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221. Memoranda, C. & C.E., vol.6, no.11, Nov., 1911, p.885.

222. Dean of Guild, Glasgow, Register of Plans, 2nd Series, 1904-10: 172, Hope Street: Date of Decree, 1.6.1905.

223. See Appendix.

224. Register of Plans, op.cit. (222): 172, Hope Street: reported completed: 11.4.1907.

Projects and Contracts.

According to L. G. Mouchel and Partners' company record of projects and completed works, the first executed Hennebique work in Britain was Weaver & Co.'s Provender Mill, Swansea which was Project No. 5. Nothing is recorded as Project No. 1, perhaps to avoid admitting experimental status to potential clients, but No. 2 was an unexecuted project for a Public Hall at Briton Ferry - where L. G. Mouchel had his office - dated 18.6.1897. Although Nos. 3 and 4 are again blank,²²⁵ a project drawing for some silos at Birkenhead for W. Vernon & Sons executed in Hennebique's Technical Office in Nantes, in January, 1898, is numbered 3 in the U.K. series.²²⁶

Since projects are listed from the start with "London numbers" (which were given to all works, together with a local agency number (for example, for Newcastle) if relevant),²²⁷ it is possible the record was begun systematically after L.G.Mouchel's move to London (that is, after March, 1900), or even later, when L. G. Mouchel & Partners was formed. It is also probable that L. G.Mouchel's ferro-concrete works as client, before he became Hennebique's Agent, would not be included.

Out of the first hundred projects recorded by L. G.Mouchel (& Partners), covering the period, June, 1897 - December, 1899, and including all potential jobs, that is, entire buildings, parts of buildings, bridges, wharves and other structures, twenty-four were executed. Of the next hundred (which are recorded as between May - June, 1901, but must

225. Project Record No.1, op.cit. (70).

226. Silos à Birkenhead, Projet de Construction en Béton de Ciment Armé, Système Hennebique: Série de l'Angleterre Commande N^o.3, Nantes, 13.1.1898.

227. Project Record No. 1, op.cit. (70).

include projects acquired between January, 1900 - April, 1901, during L. G. Mouchel's moves to his London offices), twenty-three were carried out, and over the following year, June, 1901 - May, 1902, Projects Nos. 201 - 300 include twenty-six built.²²⁸ Thus between June, 1897 and May, 1902, the numbers of projects acquired increased after the first two or three years and about a quarter were executed. Taking a later sample, Projects Nos. 2,243 - 2,343, recorded between 2.1.1908 and 4.2.1908, twenty-seven were built.²²⁹

Between 1897 - 9, there were about seven Hennebique framed buildings commissioned in Britain, but by 1908, nearly forty new buildings in this year alone were commissioned or under construction; (this number dropped, following L. G. Mouchel's death, to about sixteen for 1909, increasing again in 1910). Between 1897 - 1908, there were altogether over 130 reinforced concrete framed buildings on Hennebique's system in Britain,²³⁰ and roughly the same number again of contracts for parts of buildings (such as floors)²³¹; there were 89 bridges²³² and a similar number of reservoirs and tanks and of marine and river structures and some colliery works.²³³

228. *Ib.*, (extrapolated).

229. *Ib.*

230. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. ⁽¹²⁾~~(9)~~ and individual studies of many buildings: see Appendix. Possibly not all those counted, complete framed buildings ("extensions" might be insignificant, or independent, multi-storeyed structures) whilst some contracts included more than one building.

231. Mouchel-Hennebique Ferro-Concrete. List of Works, *ib.*, extrapolated, based on estimated framed buildings and studies of individual buildings compared with contracts for parts only of buildings for 2 sections of the List, viz: 1) Offices, Stores and Warehouses; 2) Factories, Workshops and Powerhouses, for the years 1897-1908.

232. *Ib.*: Bridges executed, 1897 - 1908.

233. *Ib.*: extrapolated; based on numbers, compared to bridges (1897-1919) stated in Preface, 1920.

As with F. Hennebique, examples were important in advertising the system; for example, groups of architects, engineers, and journalists²³⁴ observed tests of works and favourable reports on the performance of completed structures were published, which were elicited from clients, sometimes after several years' trial.²³⁵ Books and brochures illustrated works under construction and completed²³⁶ and lists of all works were also published.²³⁷ L. G. Mouchel,²³⁸ J.S.E. de Vesian²³⁹ and T. J. Gueritte²⁴⁰ also gave lectures on Hennebique's system to professional bodies (as did Moritz Kahn, on the Kahn system²⁴¹ for example); a number of these were to architects' societies. By 1909, of over 1,000 reinforced concrete works in the U.K., 700 were on Hennebique's system.²⁴²

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234. Mouchel, op.cit. (87), p.145.

235. Ib., p.161.

236. Ib; L.G.Mouchel, Hennebique Ferro-Concrete Bridges, Lond., 1907.

237. Catalogue and Pamphlets, F.C., vol.1, no.6, Dec., 1909, p.134.

238. E.g. Mouchel, op.cit. (124).

239. E.g. J.S.E. de Vesian, prs. to Civil & Mech. Engrs. Soc., Lond., e.g. C. & C.E. vol.2, no.6, Jan., 1908, pp.490 - 1.

240. T.J. Gueritte, Ferro-Concrete Construction, 13.12.1905, Edin. Arch. Assoc. Trans., vol.5, 1910.

241. E.g. M. Kahn, Reinforced Concrete and its Practical Application, 12.2.1908, Edin. Arch. Assoc. Trans., vol.6, 1910.

242. British Engineers and Ferro-Concrete, F.C., vol.1, no.4, Oct., 1909, p.65.

L. G. Mouchel's Rivals?

Frequent bulletins in Ferro-Concrete (1909-10) about failures of steel structures (for example, "How Steel Frames Perish"²⁴³; "Collapse of a Steel Bridge"²⁴⁴), less reference to timber and masonry failures, and little to other reinforced concrete systems, suggests that L. G. Mouchel & Partners may then have regarded steel as their main competition. However, L. G. Mouchel himself did not easily accept the introduction of systems competing with Hennebique's; for example, he (and Hennebique) initiated and pursued a long legal dispute with E. Coignet's representatives in Britain, and Mouchel spoke disparagingly of A. Considère's methods.²⁴⁵

In L. G. Mouchel's lifetime, the comparative quantity, of buildings, at least, on Coignet's, or on other, systems does not appear to have been large; the exact number is not known. On the other hand, several early Coignet buildings were notably large contracts, including that which provoked L., G. Mouchel's court proceedings.²⁴⁶

E. Coignet's system, like Hennebique's, was well-established in France when introduced in Britain (in 1904)²⁴⁷ where it was generally known as armoured concrete;²⁴⁸ the commercial and technical arrangements were similar to Hennebique's, and Coignet's General Agent in Britain, G.C.Workman,²⁴⁹ licensed contractors for Coignet's system, in various parts of the U.K., for example, W. Cowlin of Bristol, a "well-known firm

243. A Building Danger: How Steel Frames Perish, F.C., vol.1, 1910, p.182.
S.a. Dangerous Buildings, F.C., vol.1, p.161.

244. Collapse of a Steel Bridge During Construction, F.C., vol.1, p.86,
(American example).

245. See later this section of Chapter 7.

246. Mentioned shortly.

247. G.C.Workman, The Future of Reinforced Concrete, C. & C.E., vol.21,
1926, pp.102-3. Chapter 3.

248. E.g. Memoranda, C. & C.E., vol.2, no.1, March, 1907, p.71.

249. C. & C.E., vol.1, no.4, Sept., 1906, p.283.

of builders and contractors",²⁵⁰ Watt Bros. of West Hartlepool²⁵¹
 and Peacock Bros. of Brixton.²⁵² Specialists, including some
 French-trained engineers, such as Maurice Béhar,²⁵³ again designed
 the armoured concrete construction whilst clients employed additional
 engineers or architects for the general design.

Documented examples of reinforced concrete framed buildings
 using Coignet's system before 1908 amount to about a dozen. There
 was a very small decrease in the approximate number of Mouchel's
 contracts for framed buildings in 1905 after the introduction of
 Coignet's system.²⁵⁴

S. B. Hamilton (1956) mentions some "Coignet" warehouses for
 Messrs. Field in Rainham, Essex, erected in 1905,²⁵⁵ which may have
 been the earliest reinforced concrete framed buildings in Britain
 in another system than Hennebique's. Coignet's large reinforced
 concrete framed tobacco warehouse at Bristol was built a little later
 than Hamilton states, however, (1906-8, not 1904).²⁵⁶ Further
 Coignet buildings included some shop/office premises (1906-7) in West

250. Mr. Wm. Henry Cowlin obit., B.N., vol.70, 6.3.1896, p.364.

251. B.J., C. & S. suppl., 27.3.1907, p.33.

252. B.J., C. & S. suppl., 27.2.1907, p.23.

253. Maurice Béhar, Engineer of Ecole Nationale des Ponts et Chaussées,
 C. & C.E., vol.6, no.1, Jan., 1911, (pp.29-31), p.29.

254. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. ⁽¹⁸⁾
~~(20)~~:
 extrapolated.

255. Hamilton, op.cit. (184), p.11. S.a. Memoranda, C. & C.E., vol.2,
 no. 4, Sept., 1907, p.320: Three Coignet warehouses in hand for
 J.C.& J. Field, Ltd., of Rainham. S.a. New Works in Concrete:
 Reinforced Concrete Buildings at Rainham, Essex, C. & C.E., vol. 3,
 no. 1, pp.82-3.

256. Hamilton, ib. C. & C.E. vol.1, no.4, Sept., 1906, p.280. C. & C.E.,
 vol.2, no.4, Sept., 1907, p.320. G.C.Workman, C. & C.E., vol.21,
 1926, pp.99, 103. S.a. B.J., vol.27, pp.368-70 for reference to
 earlier tobacco warehouse, not reinforced concrete.

Hartlepool and an eight-storeyed perfume warehouse (1907) for J. Grossmith, Son & Co., in Newgate Street, London, E.C., built by Peacock Bros. and in the space of six months, with brick exterior walls, perhaps to comply with London building regulations.²⁵⁷

In 1907, G.C.Workman moved to "extensive" new offices at 20, Victoria Street, Westminster,²⁵⁸ not far from L. G. Mouchel's offices at no. 38.

E. Coignet Ltd. was subsequently registered, like L. G. Mouchel & Partners, in June, 1908, with E. Coignet, G.C.Workman and A. Lazard as Directors, its objects to develop the Coignet system, the business of builders, contractors and makers of cement, concrete, etc.,²⁵⁹ thus differing from the objects of L. G. Mouchel & Partners and being the original patentee's as well as the agent's company.

In 1906, L. G. Mouchel prosecuted E. Coignet, G. C. Workman and W. Cowlin (licensee) for allegedly infringing Hennebique's patent (no. 10203, 1897) in constructing reinforced concrete piles in Bristol, although Coignet's piles, employing spiral binding, differed from Hennebique's.²⁶⁰ C. Roch (1958) maintained that L. G. Mouchel anticipated a lawsuit occupying several years, during which time, his piles would enjoy a profitable monopoly and until the patent expired.²⁶¹

L.G.Mouchel won the case, but the legal dispute between Mouchel and Hennebique and Coignet continued from the appeal court (where Coignet won)²⁶² to Hennebique's appeal in the House of Lords, which he lost, with a cost

257. B.J., vol. 25, C. & S. suppl., 27.2.1907, p.23: contract obtained. New Works in Concrete, C. & C.E., vol.2, no.4, Sept., 1907, p.323, pls: pp.323-4: just been erected. S.a. Chapters 3, 5, 11.

258. B.J., C. & S. suppl., 27.3.07, p.33.

259. Memoranda, C. & C.E., vol.3, no.4, pp.342-3.

260. British Patent Rights in Reinforced Concrete Piles, C.& C.E., vol.1, no.4, Sept., 1906, (pp.280-5), pp.280, 285.

261. Roch, op.cit. (4), p.17.

262. British Patent Rights in Reinforced Concrete Piles, C. & C.E., vol.2, no. 2, May, 1907, (pp.139-48).

of £6,000 to Hennebique and the London office; L. G. Mouchel died in the interval.²⁶³

Many of the advantages advertised for Kahn's system in Britain (from 1906) were directly opposed to features of Hennebique's system (Chapter 3) and furthermore, C.A.P. Turner (1909) claimed that the Trussed Concrete Steel Co., who introduced the system widely,²⁶⁴ did so by means of misleading advertisement and, "exceptional push";²⁶⁵ however there is no evidence of counter-action by L. G. Mouchel.

Before Kahn's system arrived in Britain from the U.S., W. Dunn, F.R.I.B.A. (1904) for example, had already referred to favourable tests with it²⁶⁶ and no doubt approved the fact that the Trussed Concrete Steel Co. advertised that they did not take royalties from contractors,²⁶⁷ unlike L. G. Mouchel and G. C. Workman. 120 orders, but mostly small, were taken in the first year, including a number of buildings,²⁶⁸ but to what extent Kahn bars were used in each is not clear.²⁶⁹ Friar's House, Broad Street, London, E.C., designed by Arthur Blomfield, F.R.I.B.A. (1908) had a "Kahn" reinforced concrete frame (and Portland stone front).²⁷⁰

263. Editorial Notes, C. & C.E., vol.4, no.1, March, 1909, p.4.

264. Reinforced Concrete Systems - XII. The Kahn Trussed Bar, B.J., C. & S. suppl., 27.3.1907, (pp.38-40), p.38.

265. Turner, op.cit. (119), pp.253, 258. Reinforced Concrete Systems - XII, op.cit. (264), p.38.

266. W. Dunn, Construction and Strength of Reinforced Concrete Columns, J.R.I.B.A., vol.12, (pp.21-46), pp.45-6.

267. Kahn System, Advertiser, Build. Inds., vol.17, no.194, 16.5.1906, xiii. Chapter 8.

268. Reinforced Concrete Systems - XII, op.cit. (264), p.40.

269. The Progress of Reinforced Concrete in Great Britain, C. & C.E., vol.2, no. 1, March, 1907, p.6: first build., workshop, Carlisle, - 1906: Kahn system for roof.

270. A Reinforced Concrete Office Building in London: Friars House, C. & C.E., vol.3, no.2, May, 1908, p.113; s.a. Chapter 2 for reference to A. Blomfield, F.R.I.B.A.

Although A. Considère was not L. G. Mouchel's direct competitor, since the first use of his system in Britain was probably in 1908²⁷¹ and the first building in 1909 (an Institute and Hall in Ogmore Vale, South Wales²⁷²), his system, like Kahn's, was being favourably discussed in the U.K. earlier. W. Dunn's reports to the R.I.B.A. of tests of a Considère column,²⁷³ for example, provoked a surprisingly dismissive reaction from L. G. Mouchel (1904), in a statement read to the R.I.B.A. on his behalf by J.S.E. de Vesian (and which shows L. G. Mouchel to be less diplomatic perhaps than F. Hennebique).

L. G. Mouchel first claimed to have invented and patented spiral reinforcement himself, in March, 1900,²⁷⁴

"which, I believe gave M. Considère the idea of studying that form of reinforcement." 275

However, L. G. Mouchel goes on to describe Considère's pillar as,

"an interesting toy....the construction of which would be an impossibility in actual practice....No builder would consent to trust to such an arrangement for the support of a building",

concluding that such an arrangement would,

"compel us to rob...the spring mattress industry of its skilled hands ". 276

271. E.g: Reference List of Works Carried out to Considère Designs, (1908 - 23), n.d., first works (1908): bridge, Angel Rd., Tottenham and wharves, Aberdeen Harbour. S.a. Edward A. Wilson, Reinforced Concrete on the G.E.R., C. & C.E., vol.3, no.3, July, 1908, p.196; Introducing Considère & Partners, Boot World, Henry Boot Constrn. Ltd., Spring, 1977, p.12.

272. Reference List of Works Carried out to Considere Designs, ib.

273. Dunn, op.cit. (173); Dunn, op. cit (266), pp.43-5.

274. Mentioned earlier, under: "Mouchel-Hennebique Construction".

275. L.G.Mouchel, Discussion on Reinforced Concrete, op.cit. (95), p.84.

276. Ib.

Charles Marsh, Assoc. M. Inst.C.E. commented,

"I was surprised to hear M. Mouchel refer to M. Considère
in a somewhat slighting manner ". 277

Except for L. G. Mouchel's allusion to plagiarism, the reason for his attitude is not clear. Certainly Mouchel's general philosophy: his scepticism about "theories" and dislike of regulations²⁷⁸ differed from A. Considère's, known as the "theorist" of reinforced concrete and influential in the French Commission for Regulations for Reinforced Concrete.²⁷⁹ L. G. Mouchel had no doubt met A. Considère in London, in January, 1902, if he had not done so before, when Considère, as Chief Engineer to the Department of Ponts et Chaussées, was sent to London by the French Government to test some Hennebique floors at the French Embassy.²⁸⁰

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277. Charles F. Marsh, Discussion on Reinforced Concrete, op.cit. (95), p.87.

278. L.G.Mouchel, ib., p.85. Chapter 5; s.a: Chapter 8.

279. E.g. Tech . et Arch., vol.9, 1949, p.49.

280. Mouchel, op.cit. (87), p.167.

A Manchester Failure and Others.

In 1909, Ferro-Concrete claimed that the U.K. was the only country where failures with reinforced concrete were unknown.²⁸¹ If this was a slight exaggeration, there do not seem to have been any serious failures of framed buildings there,²⁸² (most of which, as noted, were L. G. Mouchel's). By comparison, a number of fatal accidents occurred before 1909 in the U.S.,²⁸³ for example, which J. Kahn (1904) attributed to "incompetence" although some of those subsequently were on Kahn's system.²⁸⁴

There were failures in Britain in this period however, but without serious consequences, for instance, a pile failed under test at Purfleet (1903)²⁸⁵ because the, "stirrups or iron bands were not....efficiently connected".²⁸⁶ It seems that in some other cases, reinforcement was inadequately covered, resulting in some areas becoming exposed.²⁸⁷

The architect for some business premises in Queen Street, Cardiff (1906), partly constructed on Hennebique's system, Edwin Seward²⁸⁸ (1906) described a "happy failure" where the reinforced concrete construction was finished short of the stone front of the building to which it was to

281. Editor's note, F.C., vol.1, no.3, Sept., 1909, p.49. Cf: Editorial Notes, C. & C.E., vol.3, no.3, July, 1908, p.175.
282. Cf: Dr. Fritz von Emperger, The Prevention of Failures in Reinforced Concrete Structures, C. & C.E., vol.4, no.5, Oct., 1909, p.313: no completed building handed over for service, failed anywhere.
283. Editorial Notes, C.& C.E., vol.2, no.1, March, 1907, pp.2-3.
284. J. Kahn, A Plea for Reenforced Concrete, Amer. Archt., vol.83, 30.1.1904, Chapter 3.
285. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. ⁽¹⁸⁾~~(20)~~, p.87: Purfleet Jetty and bowstring girder bridge, 1903; engineers: P.W. & C.S. Meik, M M.Inst. C.E.
286. C.S.Meik, Notes.Ferro-Concrete Structure, 1903, p.2.
287. Own inspections and photographs: Appendix I. S.a: Chapter 9: "Fire-Proof" Buildings.
288. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. ⁽¹⁸⁾~~(20)~~.

be anchored, but the floors were loaded and some front struts removed, when the whole mass leaned to join prepared cavities in the wall,

"and so quite accidentally they got a united building ". 289

A few years after L. G. Mouchel's death however, a completed six-storeyed Hennebique building in Bradford, did collapse. This was an office and warehouse for J. Dawson Ltd., built entirely in ferro-concrete in 1914; the cause is not known but the failure occurred when the roof reservoir was being filled for the first time and gave way.²⁹⁰ The collapse resulted in a curious, illustrated, brochure issued in several languages by the owners for their clientele, partly to reassure them of "business as usual" but also reaffirming their confidence in ferro-concrete.²⁹¹ (The company had two other ferro-concrete warehouses²⁹² nearby; furthermore, the architect, J. Dawson, may have been closely connected with the firm.)

In 1902, pending an important contract for L. G. Mouchel, with the Manchester Ship Canal Co., the failure of a test floor in Manchester provoked a long and interesting letter from Mouchel, addressed to the client's Chief Engineer, W. H. Hunter.²⁹³ The contract, which L. G. Mouchel retained, was agreed on 18.3.1903, between Mouchel and the

289. Edward Seward, I.C.A., Lond., 1906, Trans., R.I.B.A., Lond., 1908, pp.250-1.

290. Joseph Dawson, Introduction, Ecrroulement Singulier de ma Manufacture Nouvellement Construite en Ciment Armé, Joseph Dawson, Cashmere Works, Bradford, England, n.d., but Feb. 12, 1914, inserted in pencil.

291. Ib.

292. Mouchel-Hennebique Ferro-Concrete. List of Works, op.cit. (20), pp.24-5, 27: warehouses in 1911 and 1912, Archt: J. Dawson; offices for mill, 1914, Archt: J. Dawson.

293. L.G.Mouchel, 38 Victoria Street, Westminster, S.W., letter to: W. Henry Hunter, Manchester, 5.9.1902, (pp.1 - 12).

Manchester Dock & Warehouse Extension Co. Ltd., for the erection of five transit sheds, worth £130,000, (completed in 1905: figure 2).²⁹⁴

A photograph of a collapsed test floor (figure 3), which is held by both the Manchester Ship Canal Co. and L. G. Mouchel & Partners in Manchester, may very possibly refer to this failure,²⁹⁵ rather than to an unspecified Hennebique failure in London, as C.C. Stanley (1977) concluded.²⁹⁶ A top-hatted gentleman posing unhappily in front of the wreckage, may be François Hennebique, who might therefore have been a witness to the test result, if not its execution, and if so, this is another indication of its importance. (Hennebique again perhaps is shown in attendance at a successful test (March, 1904) of one of the sheds under construction: figure 4).

L. G. Mouchel's private and handwritten letter of twelve pages, in September, 1902,²⁹⁷ pleads for the retention of the contract, following justificatory arguments why the failure should have occurred in the circumstances, and making the outcome a condition of whether all his past efforts to introduce ferro-concrete in Britain would be vitiated. Although the contract was retained, W. H. Hunter and his staff had already invested nearly a year's time and effort in the decision to use the Hennebique system,²⁹⁸ which no doubt weighed the balance.

L. G. Mouchel's letter demonstrates his personal commitment to introducing ferro-concrete in Britain and his confidence in its proper design and fabrication. It also indicates Mouchel's and his foreman's, part in

294. Indenture, op.cit. (162). Roch, op.cit. (4), p.16. S.a. Appendix I.

295. Photograph of collapsed test floor, held by L.G.M. & Ptrs., Manchester, and Manch.Ship Canal Co., untitled, n.d., but from clothes worn, early 1900s.

296. C.C.Stanley, Cem. & Conc. Assoc., lect. to Conc. Soc., Edin., 2.11.1977. C.C.Stanley, personal communication by letter, Nov., 1977.

297. Mouchel, op.cit. (293).

298. Canal Maritime de Manchester, op.cit. (163), p.14.



Figure 3: Collapsed test floor.

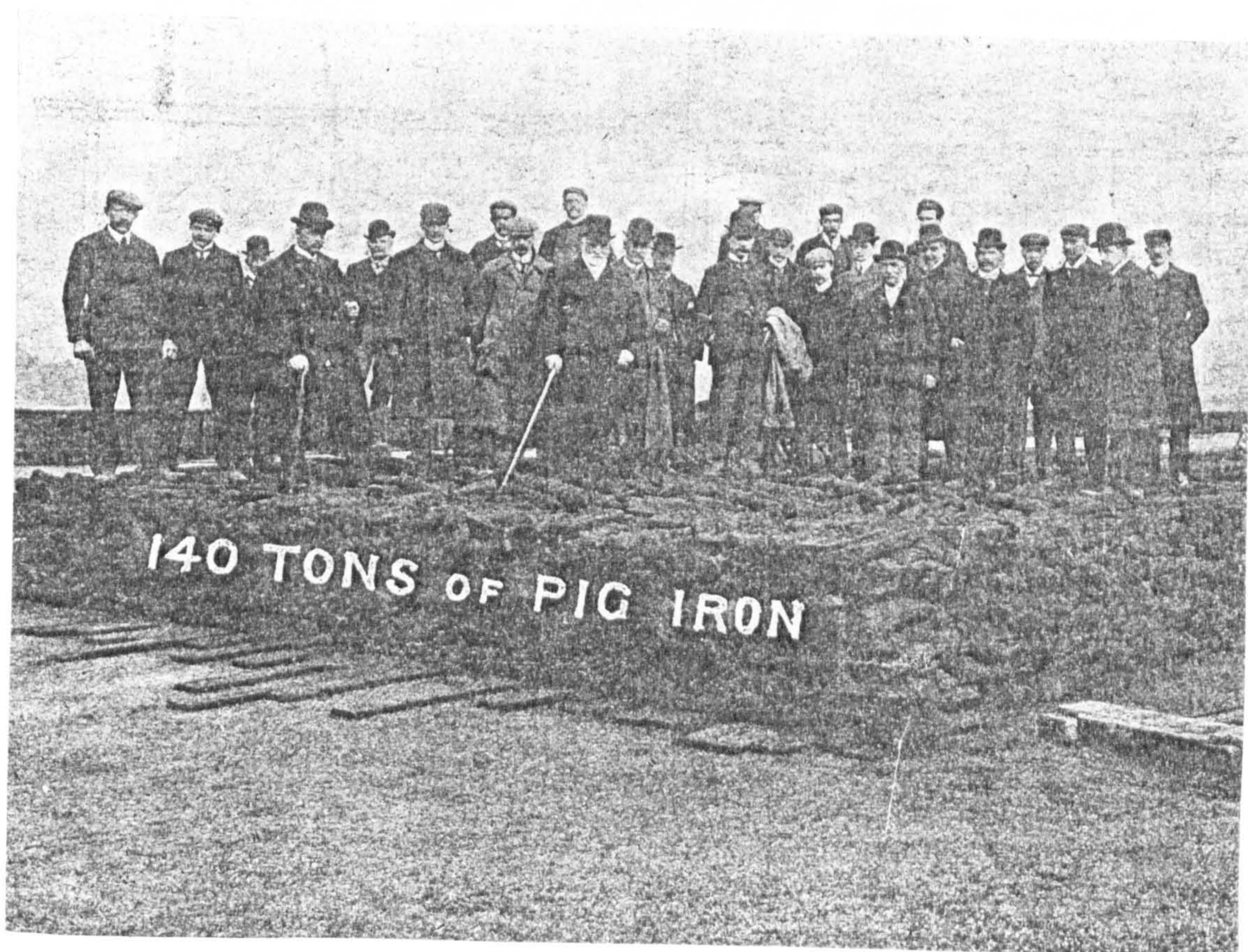


Figure 4: Transit Sheds Manchester: successful test of second floor column, (1904).

arranging such tests of ferro-concrete structures, and, according to L.G.Mouchel's assessment of the reasons for failure, the necessity for the engineer (Hunter) to take the specialist's (Mouchel's) advice, for example in composing the concrete and for the specialist to be present at the testing. The letter also shows incidentally L. G. Mouchel's fluent command of English, which was sometimes disputed by critics of, "foreign specialists" (Chapter 8), as well as his oratorical or persuasive skill.

L. G. Mouchel appeals to W. H. Hunter personally as,

"an upright man as well as a competent technical man ", 299

going on to criticise him for not following his advice regarding cement, mistaking the nature of the ground and using dirty gravel - which Mouchel observed being washed by primitive means but assumed that it would be done again, according to his specification ,

"You will say that my foreman should have seen to this. But my foreman was sent merely to construct the floor. He had my instructions to employ, as per plans, the materials handed to him: He knew that we never allow him to judge of materials this being the work of the engineer or contractor: At any rate this is our practice." 300

The test at which L.G.Mouchel and, perhaps, F. Hennebique³⁰¹ anticipated being present was begun 24 hours sooner than agreed, said Mouchel, and access to the floor was blocked with timber,³⁰²

"I bitterly regret now that the testing should have been so completely taken out of our hands; because at the first inkling of mischief we could have consulted together and found means to avoid the wreck." 303

299. Mouchel, op.cit. (293), p.1.

300. Mouchel, ib., p.7.

301. Ib., p.8: L.G.Mouchel refers to "we", arriving for test and Hennebique perhaps present for photograph of collapse, although he may have come later.

302. Ib.

303. Ib.. p.9.

L.G.Mouchel concluded,

"of one thing I am quite sure; and it is this: the design of the floor is all that can be wished....." 304

asking further,

"why should we make bad concrete at Manchester when all over England we make it perfect?" 305

and Mouchel added, cannily,

"I quite understand that to laymen the sight of the wreck of our small floor may appear dreadful. But it cannot be the same with you who know the causes of same ", 306

also pointing to the non-experimental status of the ferro-concrete buildings Hunter had seen in use and "their committee" (presumably Hunter and other representatives of the Manchester Ship Canal Co.) had seen both in Britain and abroad,

"You know and they know that they are perfectly sound." 307

Having thus vindicated himself, and his system, L. G. Mouchel concludes

304. Ib.

305. Ib., pp.9 - 10. See Chapter 3.

306. Ib., p.10.

307. Ib., p.11.

his letter with an appeal revealing why he had written to W. H. Hunter at such, "unusual length" ³⁰⁸:

"if on account of that wretched incomplete test they throw us overboard, I would consider it an iniquity. Because it would be doing us, without justification, the maximum of injury possible. and destroying at one stroke the result of my five years of anxious and arduous work in this country. just at the moment when having succeeded in bearing down all difficulties I see things taking a change for the best.

"And I appeal to you to prevent that such a grievous injustice should be done to me." 309

L. G. Mouchel thus plainly conveyed to W. H. Hunter ("an upright man") that retaining the contract was not only a business matter, but a question of personal and professional justice.

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308. *Ib.*, p.12.

309. *Ib.*, p.11; the eccentric punctuation is Mouchel's own.

Conclusion.

In 1901, The Building News considered that "armoured concrete" was little used in England except in,

"fireproof flooring, (small) arches for culverts, sewers and small subterranean footways", 310

although L. G. Mouchel had by then completed or started a dozen or more reinforced concrete framed buildings, in England and South Wales. However, by 1903, The Building News said reinforced concrete was "largely" used in Britain;³¹¹ L. G. Mouchel himself evidently considered 1902 a turning point in the establishment of ferro-concrete in Britain;³¹² (and by May that year, over 70 Hennebique jobs had been accepted³¹³).

Between 1905-8, there was a general awareness of a rapid development in the use of reinforced concrete in Britain,³¹⁴ although Building Industries (1906) characterised attitudes to reinforced concrete as,

"uncertainty and perplexity, not to say doubt". 315

In 1907, Concrete and Constructional Engineering noted an, "extraordinary increase" of interest in reinforced concrete, perhaps partly due to the publication of the R.I.B.A. Joint Committee's Report.³¹⁶ By 1908,

310. T.C., Armoured Concrete in Fortifications, B.N., vol.81, 30.8.1901, p.273.

311. Steel-Concrete, B.N., vol.85, 2.10.1903, p.436.

312. Mouchel, op.cit. (293), p.11.

313. Project Record No.1, op.cit. (70): extrapolated: see: Projects and Contracts.

314. E.g: Philip H. Palmer, Armoured or Reinforced Concrete, Incomp. Assoc. Munic. & County Engrs., vol.31, 1905, p.355. See following references for later examples: (316,317).

315. The British Attitude to Ferro-Concrete Construction, Build. Inds., vol.17, 15.6.1906, p.34.

316. Editorial Notes, C. & C.E., vol.2, no.3, July, 1907, p.171. Chapter 8.

E.R. Matthews, M.Inst. C.E., for example, anticipated that reinforced concrete would soon be,

"the chief material used in all engineering and architectural constructions"

in Britain as well as the U.S.³¹⁷

The establishment of reinforced concrete in Britain and in particular its use for framed building construction, by about 1902-3, (as well as its increasing use from this time), was largely L. G. Mouchel's achievement³¹⁸ and preceded the commercial introduction of other major framing systems, as well as the initiation of various "non-specialist" institutions for reinforced concrete in Britain, such as the R.I.B.A. Joint Committee (1905). By 1909, Hennebique works formed the great majority of reinforced concrete structures in Britain, (and many of the early buildings are still used, or were, until recently demolished: Appendix I).

Architects or engineers in Britain designed reinforced concrete framed buildings in outline, for which reinforced concrete specialists then designed the structure, although the former had overall responsibility for the work. The first British contracts for reinforced concrete framed buildings (Weaver's Mill, Swansea and the Quayside warehouse, Newcastle) were obtained by F. Hennebique and his agents, in France and Hennebique or his engineers (in France) also designed the ferro-concrete construction for the early British jobs, including Weaver's Mill and possibly the Quayside warehouse.

317. E.R. Matthews, The Use of Reinforced Concrete in Engineering and Architectural Construction in America, pr. to R.S.A., 11.3.1908, B.J., vol.27, p.363.

318. Cf: Obituary, L. G. Mouchel, op.cit. (6).

Meanwhile, L. G. Mouchel, in liaison with F. Hennebique, established regional technical offices in Britain, secured contractors, and further clients, and from about 1899, ferro-concrete work was designed in Britain by engineers trained by Hennebique (such as C. Roch) or L. G. Mouchel himself, also trained by Hennebique, and who subsequently worked out his own modifications to Hennebique's system.

The success of the early buildings was not adversely affected by L. G. Mouchel's somewhat liberal selection of licensees, (compared to F. Hennebique), although supplementary special workers were employed for some buildings, and L.G.Mouchel personally trained and supervised workmen.

L. G. Mouchel's energy, industry, organisational skill and singlemindedness have been referred to as significant in his establishment of ferro-concrete. L. G. Mouchel also, evidently, had an expressive and forceful personality, indicated by references to his "great personal charm" and "magnetic" influence as well as, for example, by the language and tone of his letter (5.9.1902) to W. H. Hunter; these attributes worked both to Mouchel's advantage and disadvantage, either compelling confidence in himself (and ferro-concrete)³¹⁹ or taken for arrogance: (see Chapter 8).

Ferro-Concrete (1912) believed that L. G. Mouchel,

"literally forced ferro-concrete construction upon the reluctant engineering and architectural professions of the U.K.", 320

although T. J. Gueritte (1926) referred to the, "openmindedness" of some architects and engineers, such as F.E.L. Harris, F.R.I.B.A., William Bell, F.R.I.B.A., and W. H. Hunter, M. Inst. C. E. (and the part of clients was

319. "Ability to inspire confidence": Editorial Notes. The Late Mr.L. G. Mouchel, op.cit. (7).

320. Editorial Notes, F.C., vol.3, no.7, Jan., 1912, p.205.

also important).³²¹ Nonetheless, L. G. Mouchel himself (1902) said that he had had, "five years of anxious and arduous work"³²² to establish ferro-concrete in Britain.

Perhaps L. G. Mouchel's confirmed opinion that Hennebique's system was superior to any other,³²³ his public attitude (1904) to A. Considère's methods (criticised for example by C. F. Marsh, M. Inst. C.E.³²⁴), the licensing practice which limited contractors to the Hennebique system and required them to inform L. G. Mouchel of patent infringements, and his prosecution of G. C. Workman and W. Cowlin (1906) for alleged infringements, all contributed to an impression that L. G. Mouchel was attempting to monopolise reinforced concrete in Britain, which in 1905-6, encouraged W. Dunn, C. F. Marsh and others interested in reinforced concrete, to propose and initiate a R.I.B.A. Joint Committee as an independent authority to study and report on reinforced concrete in Britain and without any formal reference to established specialists, notably L. G. Mouchel. The R.I.B.A. Report (1907) was also intended to change the role of architects in reinforced concrete design and their dependence on L. G. Mouchel, or other specialists.³²⁵

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321. Gueritte, op.cit. (2), p.92: S.a: Chapter 9.

322. Mouchel, op.cit. (293), p.11: previously cited: (309).
Cf: Mouchel, op.cit. (124), p.47.

323. E.g. L. G. Mouchel, Discussion on Reinforced Concrete, op.cit. (95), pp.84-5.

324. Charles F. Marsh, ib., p.87. Cf: William Dunn, F.R.I.B.A., Reinforced Concrete, Notes, Queries and Replies, J.R.I.B.A., vol.12, 24.12.1904, p.141.

325. See the following chapter.

CHAPTER 8: ARCHITECT AND SPECIALIST.

Introduction.

The Question of Monopoly.

One Job, One System.

Specialists' Grievances.

Architects' Responsibilities.

Constructive Architects.

William Dunn and the R.I.B.A. Joint Committee on Reinforced Concrete.

The R.I.B.A. Report.

Edwin Sachs and "Concrete and Constructional Engineering".

The Concrete Institute.

The I.C.E. Report.

Conclusion.

Introduction.

Chapter 8 considers:

- (1) Contemporary criticisms of L. G. Mouchel's (and similar) specialist organisations, with special systems, in Britain (described in Chapter 7) and the case for "non-specialist" or "independent" design in reinforced concrete, which had particular reference to architects.

- (2) The efforts of several, influential architects and engineers to break L. G. Mouchel's "monopoly" of reinforced concrete in Britain and promote greater knowledge and use of the material, especially among architects, with the establishment of the R.I.B.A. Joint Committee on Reinforced Concrete (1905 - 6), a new journal, Concrete and Constructional Engineering (1906) and The Concrete Institute (1908).

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The Question of Monopoly.

Sir Henry Tanner, F.R.I.B.A. (1908) observed that the general adoption of reinforced concrete in Britain was hindered partly because reinforced concrete was practically controlled by specialists and patentees.¹ William Dunn, F.R.I.B.A. (1908) also maintained that other designers and builders were discouraged from adopting, "ordinary combinations of steel and concrete" for fear of legal disputes.² Indeed, Concrete and Constructional Engineering (1907) referred to a belief among, "certain well-known architects " that L. G. Mouchel was trying to monopolise reinforced concrete construction in the U.K.³ and even referred (1908) vaguely to his, "intelligence" department.⁴

There is no doubt that L. G. Mouchel, like F. Hennebique, regarded ferro-concrete as superior to other systems, and an article in Ferro-Concrete (1912) for example, affirmed that Mouchel and Hennebique were,

"actuated and sustained by a firm belief in the intrinsic merits of the system" 5

- or that L. G. Mouchel was not vigilant to suspected patent infringements or to, "disloyal" contractors who employed other systems, (Chapter 7) - but apart from C. Roch's (1958) claim that L. G. Mouchel's legal proceedings against E. Coignet's representatives (1906) were tactical as much as genuine (Chapter 7), there is no evidence of deliberate monopoly.

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1. Sir H. Tanner, pr. to Roy. Sanit. Instit., Cardiff, C. & C. E., vol.3, no. 4, Sept., 1908, pp.263 - 4.
 2. William Dunn, pr. to C. I., 1908, C. & C.E., vol.3, no.6, Jan., 1909, p. 480.
 3. Report of The Committee on Reinforced Concrete, C. & C.E., vol.2, no.3, July, 1907, p.176; S.a. Wm. Dunn and the R.I.B.A. Joint Committee on Reinforced Concrete, this chapter.
 4. Editorial Notes: The Late Mr. L. G. Mouchel, C. & C.E., vol.3, no.3, July, 1908, p.180.
 5. Walter Young Armstrong: A Biographical Sketch, F.C., vol.3, no.9, March, 1912, p.273.

However, specialist firms in general endeavoured to guard their design methods from potential rivals and to this end, some firms objected to showing their drawings⁶ and,

"even the architect, or engineer, himself may be in the dark"
(1906).⁷

Reinforced concrete specialists were therefore criticised by architects and engineers for their, "trade secrecy" which not only ensured that reinforced concrete design remained in specialist hands but might leave a supervising architect or engineer in ignorance.

This secrecy was also a feature of specialist organisations elsewhere, but it is unlikely that F. Hennebique himself withheld information from an architect or engineer involved in one of his buildings, although he did guard his methods from engineers and the press.⁸ For example, an article by Paul Christophe reprinted by Le Béton Armé (1900), F. Hennebique's company journal, asserted that the engineer in charge should know exactly what was happening, and it was wrong of some constructors to endeavour to keep the proceedings secret, only guaranteeing the result.⁹

There is no evidence that L. G. Mouchel, either, discouraged architects and engineers from seeing working drawings or calculations and indeed evidence to the contrary, since they checked such work, if competent, (Chapter 7).

6. Chronicle, J.R.I.B.A., vol.13, 28.4.1906, (pp.338-40), p.339.

7. The British Attitude to Ferro-Concrete Construction, Build. Inds., vol.17, 15.6.1906, p.34.

8. F. Hennebique, Note sur les Brevets et Travaux de la Maison Hennebique, Le Bét. Armé, Sept., 1900, p.4: Hennebique said he had kept calculations from press or enquiring engineers, except under pledge of secrecy.

9. Paul Christophe, Le Béton Armé et Ses Applications, extract from Annales des Travaux Publics de Belgique, Aug., 1899, Le Bét. Armé, April, 1900, p.1.

However, G. P. Manning, M. Eng., F.I.C.E. (1980), who worked for L. G. Mouchel & Partners between 1913 - 15, states that at that time, employees had to sign an agreement, (not enforceable in law) not to work for another firm of reinforced concrete specialists within five years of leaving Mouchels' to preserve the secrecy of their methods.¹⁰

William Dunn, F.R.I.B.A. (1905), who wrote part of the R.I.B.A. Report on Reinforced Concrete and who had used Hennebique's system in London in 1903 - 4, further cast doubts on the character of the expertise which was guarded,

"In this country....the (reinforced concrete) experts, generally speaking, have very little scientific knowledge or training, andfew experiments are made or published here ". 11

No doubt L. G. Mouchel's expressed scepticism about laboratory tests and "theories" and his tendency to insist instead on the axiomatic successes of Hennebique's system,¹² assisted Dunn's impression, although Mouchel's recognised ability as a civil engineer was noted in Chapter 7.

Concrete and Constructional Engineering (1906) further commented, not unfairly perhaps, that licensees were frequently ignorant about reinforced concrete or its constituents,¹³ but does not mention the additional use of experienced contractors in some cases.

In 1907, Concrete and Constructional Engineering claimed that the,

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10. G.P.Manning, M.Eng., F.I.C.E., Lond., personal communication by letter, 9.10.1980. G.P.Manning, A Hennebique Bridge, letter to Ed., Concrete, vol.11, no.10, Oct., 1977, p.20.
11. William Dunn, F.R.I.B.A., Reinforced Concrete Floors, letter to Ed., 5.4.1905, J.R.I.B.A., vol.12, 8.4.1905, p.373. S.a: Chapter 3. W. Dunn and his use of Hennebique system and the R.I.B.A. Report are both discussed later this chapter.
12. L.G.Mouchel, in communication read by J.S.E. de Vesian, Discussion on Reinforced Concrete, 5.12.1904, J.R.I.B.A., vol.12, 10.12.1904, p.85. S.a: Chapter 7.
13. Editor's note, C. & C.E., vol.1, no.4, Sept., 1906, p.275. S.a.Chapter 3: builders' ignorance about reinforced concrete. S.a. Chapter 7: L.G.Mouchel's Licensees.

" 'infallibility' of a certain class of specialist" was now doubted.¹⁴
 For example, James Sheppard (1907) questioned the validity of fire tests reported by specialists - until recently relied upon, which he claimed were now found to be based on trivial or non-existent fires.¹⁵

Concrete and Constructional Engineering (1907) again, attacked,

"self-opinionated specialists whose obstinacy prevents their realising some of the early faults of this method of construction" 16

and referred to resentment of criticism among specialists.¹⁷ A tendency to reject criticism was possibly true of L. G. Mouchel, judging, for instance, by his response to some demonstrated advantages of Considère's system, or by his, perhaps justified, denial of all blame for a failure of his own system (see Chapter 7).¹⁸

Concrete and Constructional Engineering (1906) warned, vaguely,

"to the specialist in 'systems' we would remind him that Great Britain only stands humbug and bluff to a point" 19

- a patently unfair view of the specialist's, such as L. G. Mouchel's integrity, as well as of his intentions with regard to, "British interests": (see Chapter 7).

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14. C. & C.E., vol.2, no.1, March, 1907, p.11.
15. James Sheppard, The Application of Reinforced Concrete for the Construction of Fire-Resisting Buildings, C. & C.E., vol.2, no.1, March, 1907, (p.13ff.), p.18.
16. The Progress of Reinforced Concrete in Great Britain During 1906, C. & C.E., vol.2, no.1, March, 1907, (pp.5 - 12), p.8.
17. Editorial Notes, C. & C.E., vol.2, no.1, March, 1907, p.1.
18. See: A Manchester Failure and Others, Chapter 7.
19. The Progress of Reinforced Concrete in Great Britain During 1906, op.cit. (16), p.12.

One Job, One System.

The specialists' basis in the use of special systems was open to criticism, and C. F. Marsh (who in 1904 had advised employing specialist firms²⁰) in 1908 anticipated a need for specialists in a, "broader sense" than at present, that is, not employing "systems".²¹ C. Marsh (1908) observed before the newly formed Concrete Institute,

"It could not reasonably be expected that reinforced concrete would remain as a multitude of various more or less rational systems, relying on more or less valid patents." 22

Concrete and Constructional Engineering (1907), likewise maintained that,

"Dependency on any one so-called system or commodity is radically wrong ",

but noted an,

"unfortunate feeling.....that a reinforced concrete structure should be entirely on one system " . 23

Some patented features were better adapted to particular structural elements: for example, Concrete and Constructional Engineering's (1907) ideal building would include: Considère and Indented Bar columns, Kahn beams and Hennebique piles.²⁴

This notion still acknowledged special systems however, like the new Patents Act (1908), which allowed the owner of a system to prevent a licensee from using unpatented systems but not another patented system.²⁵ Until this date however, patentees usually limited contractors to one system which further complicated the possibility of designing a job for several.

20. Charles F. Marsh, Reinforced Concrete, London, 1904, pp.26-7.

21. Charles F. Marsh, to C.I., C. & C.E., vol.3, no.6, Jan., 1909, p.474.

22. Ib.

23. Editorial Notes, op.cit. (17), p.4.

24. Ib.

25. Douglas Leechman, The New Patents Act, C. & C.E., vol.3, no.2, May, 1908, p.141.

Some reinforced concrete systems which were not organised on the basis of royalties from contractors (Chapter 7), such as Kahn's and Indented Bars, were employed together in Britain in single structures (1907).²⁶

Although Hennebique's system was not used by L. G. Mouchel in Britain in combination with others in the same structure, it was elsewhere; the use of Hennebique's and Coignet's systems for the French Civil Engineers' building, rue Blanche, Paris (1896) was mentioned in Chapter 2; in 1905, Hennebique's system was used for all parts of a building in Brünn, Austria, except the columns, which were by Considère.²⁷

Tony Garnier's project in France for an industrial city in reinforced concrete (1904 - 17)²⁸ combined systems, including Hennebique's and Cottancin's,²⁹ for their visual effect.

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26. E.g., New Works in Concrete: Downside Abbey Reservoir, C. & C.E., vol.2, no. 4, Sept., 1907, p.324.
27. L. Hess, The Historical Evolution of Reinforced Concrete in Austria, C. & C.E., vol.2, no.4, (p.265,ff.), p.270: Rohrer Printing Works, Brunn.
28. Dora Wiebenson, Utopian Aspects of Tony Garnier's Cité Industrielle, J.S.A.H., vol.19, no.1, March, 1960, (pp.16-24), p.16.
29. *Ib.*, p:21; (de Baudot employed Cottancin's system).

Specialists' Grievances.

William Dunn (1908) criticised specialists' drawings submitted with tenders as, "meagre",³⁰ but specialists also had grievances about the conditions of reinforced concrete design. G. C. Workman (1909) said specialists were given inadequate data for their designs,³¹ and these were required too quickly.³² There was uneconomical duplication of designs between competing specialist firms³³ and the lowest tender rather than the best contractor or the most economical design, was often accepted.³⁴

Thus there were commercial incentives to skimp the design or materials; for the Y.M.C.A. headquarters, Manchester, for example, G. C. Workman attributed his loss of the contract for Coignet's system to adding the expense of distributing rods³⁵ (and at the International Congress of Architects (1906), J. Bassegoda (Spain) referred to an exaggerated lightness of construction which resulted from competition to reduce dimensions and thereby estimates.³⁶)

Finally, specialists were financially responsible for the accuracy of their quantities and the stability of the structure³⁷ -

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30. W. Dunn, to C.I., C. & C.E., vol.3, no.6, Jan., 1909, p.480.
31. G.C.Workman, discus. at C.I., C. & C.E., vol.4, no.1, March, 1909, p.55.
32. Lucien Serrailier, The Reinforced Concrete Specialist, C. & C.E., vol.7, 1912, (pp.93-7), p.96.
33. R.W.Vawdrey, The Dissociation of Competitive Designs and Tenders, pr. to C.I., 2.2.1911, C. I. Trans & Notes, vol.3, Nov., 1911, (pp.93 - 126), p.98.
34. Lucien Serrailier, Some Commercial Aspects of Reinforced Concrete, C. & C.E., vol.4, no.1, March, 1909, p.53; Serrailier, op.cit. (32).
35. G.C.Workman, at C.I., C. & C.E., vol.6, no.7, July, 1911, p.511.
36. J.Bassegoda, Les Constructions en Acier et en Ciment Armé, I.C.A., 1906, Trans., R.I.B.A., 1908, p.236.
37. Vawdrey, op.cit. (33), pp.98, 100.

although R. W. Vawdrey (1911) pointed out that,

"to invite tenders for the construction of a building which has not yet been designed, is absolutely unheard of, when any material other than reinforced concrete is being considered ". 38

Lucien Serraillier (1912) commented that because of this liability, specialists had been justified in limiting contracting, for which they were criticised.³⁹

These difficulties thus undermined the quality of specialists' work, as well as damaging relations between specialists and others involved in a job; an example of misinterpretation between specialist (L. G. Mouchel) and contractor (Rose, Downs and Thompson) was mentioned in Chapter 7 and Lucien Serraillier (1912) said the speed work was required led to mistakes, and friction between client, specialist and contractor.⁴⁰

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38. *Ib.*, p.99.

39. Serraillier, *op.cit.* (32), p.94.

40. *Ib.*, p.96.

Architects' Responsibilities.

Mr. Wentworth Shields, M. Inst. C.E. (1909) regarded the, "designer-specialist" as obsolescent because of the difficulties of, "dual control" between architect or engineer and specialist⁴¹ (although Lucien Serrailier, on behalf of specialists, replied that they did not intend to disappear!⁴²)

Although architects' professional status was undefined in law (Chapter 4), their responsibilities and liabilities for buildings were considerable⁴³ but not always clearly defined; for example, architects undertook to supervise their buildings, but the law was unclear about the meaning of supervision.⁴⁴

An agreement between the R.I.B.A. and the Institute of Builders (1903) intended to define the relative responsibilities of architect, client and contractor, recognised the architect's,

"absolute authority.....over....workmanship and materials" 45

but did not refer to the introduction or role of reinforced concrete specialists.

W. Dunn (1905) observed that while specialists carried out reinforced concrete work, the final responsibility for failure, despite the specialist's guarantees, lay with the architect;⁴⁶ therefore, as

41. Mr. Wentworth Shields, M. Inst. C.E., discus. at C.I., C. & C.E., vol. 4, no.1, March, 1909, p.53.

42. L. Serrailier, ib., p.58.

43. E.g., D. Wood, letter, 30.9.1911, J.R.I.B.A., vol.18, p.736.

44. Edwin T. Hall, discus., J.R.I.B.A., vol.17, 19.3.1910, p.403.

45. A. Webb, Open. Address, 2.11.1903, J.R.I.B.A., vol.11, 7.11.1903, (pp.1 - 11), p.3.

46. Dunn, op. cit. (11).

matters stood, specialists calculated work - under the difficulties outlined - which the architect or engineer was unqualified to check, although liable for its safety.

R. T. Surtees (1907), for example, said it was, "repugnant" to many to have to entrust work to patentees without being able to have it checked by an independent authority.⁴⁷

No doubt the combined offices of designer and contractor which specialist firms effectively represented (forbidden to R.I.B.A. members as a matter of professional etiquette) was also repugnant to some architects. The execution of reinforced concrete work by special, not general, contractors, also tended to give architects and engineers less need or opportunity to study it,⁴⁸ despite their responsibility for supervision.

Architects were reluctant to give up their overall responsibility for design and supervision⁴⁹ however, therefore they must either design in reinforced concrete themselves or be able to check the specialist's work⁵⁰ and supervise its construction. Sir Henry Tanner, F.R.I.B.A. (who chaired the R.I.B.A.'s Committee on Reinforced Concrete) wished to see architects accepting responsibility for reinforced concrete which was nominally theirs anyway.⁵¹

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47. R.T.Surtees, Water Engineer, Newton-le-Willows, A Few Experiments and Tests with Reinforced Concrete, C. & C.E., vol.2, no.1, March, 1907, p.43. Cf: Everyday Uses of Portland Cement, Assoc. P.C.Manufrs. (1900) Ltd., 2nd edn., 1912, p.120.
48. E.g., P. Waterhouse, Reviews, J.R.I.B.A., vol.1, 21.12.1893, p.120.
49. E.g., A.H.Alban Scott, M.S.A., discus., C.I., C. & C.E., vol.4, no.1, March, 1909, p.54.
50. Dunn, op.cit. (11).
51. Sir H. Tanner, Discussion on the Report of the Joint Reinforced Concrete Committee, J.R.I.B.A., vol.14, 1.6.1907, (pp.497-505), p.503.

Constructive Architects.

There was undoubtedly interest in reinforced concrete among architects, perhaps more than among engineers, around 1900 in Britain. For example, the Northern Architectural Association had demonstrated an early interest in Expanded Metal (Chapter 2); two papers on reinforced concrete to the R.I.B.A. in 1904, by William Dunn, and L. G. Mouchel, respectively, attracted a "record audience",⁵² although it was augmented by a certain number of guest-engineers and Portland cement manufacturers.⁵³ At tests (1905) of the North Eastern Railway Company's New Bridge Street Goods Station, Newcastle on Tyne (architect, William Bell, F.R.I.B.A: Chapters 7, 10; Appendix I), eleven visiting architects were present, compared with seven civil engineers, excluding N. E. R. and Local Government officials.⁵⁴

T. J. Gueritte (1926) included William Bell, F.R.I.B.A. (the N.E.R. Company's Architect from 1877⁵⁵), among the eminent British architects and engineers who, "by their openmindedness"⁵⁶ contributed towards the spread of reinforced concrete in Britain in the first decade, as well as F.E.L. Harris, the Cooperative Wholesale Society's Architect, and W. H. Hunter, Chief Engineer to the Manchester Ship Canal Company.⁵⁷

52. Harold H. D. Anderson, Discussion on Reinforced Concrete, op.cit. (12), p.90. S.a: Chronicle, J.R.I.B.A., vol.12, 26.11.1904, p.62.

53. Discussion on Reinforced Concrete, ib., (pp.87 - 94). Chronicle, ib.

54. L.G.Mouchel, The Hennebique Ferro-Concrete System, London, 2nd edn., 1905, p.174. James Salmon, F.R.I.B.A., (1908) advised architects to witness reinforced concrete tests: referred to shortly.

55. E.g., William Weaver Tomlinson, The North Eastern Railway, Newcastle and London, n.d., Preface, 1914, p.773.

56. T.J.Gueritte, The First Decade of Reinforced Concrete in the U.K. (1897 - 1906), C. & C.E., vol.21, 1926, p.92.

57. See Chapter 7.

F.E.L. Harris was indeed, "probably the first English architect to adopt reinforced concrete construction on an extensive scale" (1914).⁵⁸ Harris was responsible for "numerous" works in general;⁵⁹ he was articted to W. H. Cowlin of Bristol,⁶⁰ probably the same, well-known firm of builders who became contractors for E. Coignet's system (Chapter 7).

At the International Congress of Architects in London (1906), organised by the R.I.B.A., Building Industries observed a particular interest in reinforced concrete, but also a characteristic bewilderment and vagueness of attitude with respect to it.⁶¹

However, Mr. Berlage (Amsterdam) in a paper on "armoured concrete" to the I.C.A. (1904), regarded it as determining architecture in the future and urged architects to study artistic forms in their present use of reinforced concrete, if they wished, "to remain masters of their art".⁶²

Contemporary views that architects, for aesthetic reasons should be able to design in reinforced concrete, having either a general, or a detailed, knowledge of the subject were mentioned in Chapter 4. Sir Henry Tanner, addressing the Architectural Association in 1909, warned that architects would have to take up reinforced concrete, or be relegated to interior decoration and external design by the reinforced concrete specialists⁶³ - or, indeed, by the civil engineer: C. A. Harrison, M. Inst. C.E. (1907) for example, regarded the architect's function in reinforced concrete design as embellishing the exterior or interior of buildings, while the engineer designed the framework: such construction,

58. Who's Who in Architecture, Technical Journals Ltd., Westminster, 1914, p.102.

59. *Ib.*, p.101.

60. *Ib.*

61. Architects and Reinforced Concrete Construction, Build. Inds., vol.17, 16.8.1906, pp.65-6.

62. The Sixth I.C.A. Congress, 1904, Madrid, J.R.I.B.A., vol.11, 23.4.1904, (pp.343-6), p.345.

63. Sir H. Tanner to A.A., C. & C.E., vol.4, no.6, Nov. 1909, pp.377 - 8.

(said Harrison), "will necessarily add to the work of the engineer".⁶⁴

An article in Concrete and Constructional Engineering (1907) also perceived reinforced concrete buildings as a future addition to engineers' practice, taken from the architectural profession, whose fields of activity were being reduced almost daily, and in such buildings,

"it will really only remain for the architect....to occasionally clothe the exterior of the engineer's design with a suitable decorative garb and perhaps to also ornament some of the interior".⁶⁵

Although as noted in Chapter 4, architects were often employed for reinforced concrete buildings, such views may have helped provoke architects' concern about the issue of reinforced concrete design.

L. G. Mouchel and T. J. Gueritte both attached importance to the architectural use of reinforced concrete (Chapter 10), and no doubt welcomed the employment of architects to give their material an artistic advantage;⁶⁶ indeed the practice of L. G. Mouchel & Partners from 1907 included architecture.⁶⁷ The fact that most reinforced concrete buildings were industrial or commercial types would not debar them from artistic expression in L. G. Mouchel's view or that of many architects (see Chapter 4).

However, in practice, in the design of reinforced concrete buildings, as illustrated in Chapter 7, the specialist was consulted following an initial design by the architect (usually fairly detailed⁶⁸), but who was usually ignorant of reinforced concrete; architects thus customarily designed, according to their training, as if for traditional materials and

64. C.A.Harrison, Reinforced Concrete Railway Structures, C. & C.E., vol.2, no.3, July, 1907, p.233.

65. The Progress of Reinforced Concrete in Great Britain, op.cit. (16), p.6.

66. E.g., L.G.Mouchel, lecturing to R.I.B.A., anticipated the artistic adaptation of ferro-concrete by architects: L.G.Mouchel, Monolithic Constructions in Hennebique's Ferro-Concrete, pr. to R.I.B.A., 21.11.1904, J.R.I.B.A., vol.12, 26.11.1904, (pp.47-61), p.57.

67. Memoranda, C. & C.E., vol.2, no.6, Jan., 1908, p.491; Chapter 7.

68. See Chapters 7, 11.

without any prior influence from the specialist's design⁶⁹ (and because of "trade secrecy", drawings for reinforced concrete construction were unlikely to be freely available to architects): hence, according to Ferro-Concrete (1910), the usual imitation of stone buildings.⁷⁰ However, certain aesthetic preferences may also have been operative in such design: (Chapters 4 and 10).

Ferro-Concrete (1910) proposed that architects should instead make skeleton drawings, followed by structural drawings by the specialist, then given expression and decoration by the architect.⁷¹ This suggestion again (like extant architects' drawings for reinforced concrete buildings: see Appendix I) indicates that architects' initial designs were generally more than outlines, and the architect was not, in fact, responsible for just, "ornamenting the engineer's structure". Rather, the specialist adapted reinforced concrete to the architect's design.

The architects for two of the most original early buildings did probably have some technical understanding of reinforced concrete, as well as an interest in its "appropriate" expression. James Salmon, jun ., joint architect (with J. Gaff Gillespie) for Lion Chambers, Glasgow (1904 - 7: Chapter 11 and Appendix I) at some time made a special study of reinforced concrete.⁷² Salmon had worked for W. J. Anderson,⁷³ who attempted to use an unpatented method of reinforced concrete in 1889, but which failed (Chapter 2).

69. Ferro-Concrete in Architecture, F.C., vol.2, no. 1, July, 1910, (pp.2-7), p. 2.

70. *Ib.*

71. *Ib.*, p.2, cont. on: p.5.

72. *Obit.*, James Salmon, F.R.I.B.A., J.R.I.B.A., vol.31, 7.6.1924, p.513.

73. A. Gomme and D. Walker, Architecture of Glasgow, London, 1968, p.264.

James Salmon jun. (1908) regarded a good knowledge of reinforced concrete as essential to design in it,

"Just as I consider that....no one can design woodwork until he... (has) familiarised himself with it in every way; so I consider that a close study should be made of reinforced concrete, and especially should one take many opportunities of witnessing tests to destruction of reinforced concrete beams, slabs and pillars!"

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Salmon also believed architects should concern themselves with all details of design,

"from the front gate to the salt cellars " . 75

(Both the appropriate use of materials in design, and the "wholeness" of a design were views typical of the "Arts and Crafts Movement" .)

The architects' designs for Lion Chambers were probably modified, however, in the course of translation to ferro-concrete construction (Chapters 7 and 11).

A. E. Corbett, F.R.I.B.A., whose Y.M.C.A. premises in Manchester, on Kahn's system, was his main work,⁷⁶ believed an,

"entire building must grow in the designer's mind as a whole"

(with special attention to the roof)⁷⁷ and that for reinforced concrete design, a man trained as architect and engineer was required.⁷⁸

74. James Salmon, F.R.I.B.A., The Decoration of Steel and Reinforced Concrete Structures, pr. to Glasgow Instit. Archts., 11.3.1908, B.J., vol. 27, 25.3.1908, (pp.269 - 73), p.271.

75. A Glasgow Architect. Death of Mr. James Salmon, Glasgow Herald, 28.4.1924.

76. Who's Who in Architecture, op.cit. (58), p.56: only work specifically mentioned.

77. A.E.Corbett, Modern Domestic Architecture, pr. to Manchester Soc. Archts., 12.11.1903, J.R.I.B.A., vol.11, 9.1.1904, (pp.117 - 25), p.125.

78. A.E.Corbett, discus. at C.I., C. & C.E., vol.6, no.7, July, 1911, p.499.

A. E. Corbett, himself, it seems was such a man since he was educated at the Royal Academy and Architectural Association Schools and the Engineering Department of Manchester School of Technology;⁷⁹ he also attended the L.C.C. School of Arts and Crafts.⁸⁰

The Builders' Journal (1908 -9) on the other hand, for example, believed reinforced concrete design must remain with specialists, not architects or civil engineers, whose function was more general.⁸¹

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79. Who's Who in Architecture, op.cit. (58), p.56.

80. Obituary. A. E. Corbett, J.R.I.B.A., vol.23, 29.7.1916, p.290.

81. B.J., vol.30, 13.10.1909, p.292. S.a: The Architect's Relation to Reinforced Concrete, B.J., vol.28, C. & S. suppl., 2.12.1908, p.427.

William Dunn and the R.I.B.A. Joint Committee on Reinforced Concrete.

William Dunn, F.R.I.B.A., who by 1910 had become Consulting Architect to H. M. Office of Works to advise on designs tendered by reinforced concrete firms,⁸² did not apparently discuss the aesthetic aspects of reinforced concrete design in his many lectures on the material; the only indication of his views in this direction is that he was probably not interested in the immediate question of an original style,⁸³ whether or not associated with the new material.

However, W. Dunn believed architects should themselves design in reinforced concrete and he was the main instigator of a Report on Reinforced Concrete by the R.I.B.A. and other bodies, for architects' use, and which was intended to make architects (or engineers) less dependent on specialists or on patent systems.

Concrete and Constructional Engineering (1907) said the origin of the Joint R.I.B.A. Committee on Reinforced Concrete (1905-6) was generally considered to be mainly due to:

- (1) The influence of Charles F. Marsh, M. Inst. C.E., who wanted an independent ruling in Britain for reinforced concrete.
- (2) "The desire of certain well-known architects (notably, William Dunn: see below) to thwart what they thought - rightly or wrongly - to be an effort on Mr. Mouchel's part to make a monopoly of his system of design", (by issuing independent guidance for architects and engineers).⁸⁴

82. Civil Engineer: Correspondence, C. & C.E., vol.5, no.5, May, 1910, p.372.

83. William Dunn, F.R.I.B.A., Robert Watson, 1865-1916, J.R.I.B.A., vol.23, 19.2.1916, (pp.142-4), p.143: Dunn said this of Watson, who, "shared his views on important subjects".

84. Report of the Committee on Reinforced Concrete, C. & C.E., vol.2, no.3, July, 1907, (p.175, ff.), p.176. S.a: Characteristics of the Chief Systems of Reinforced Concrete Applied to Buildings in Great Britain, C. & C.E., vol.2, no.6, Jan., 1908, (pp.427-44), p.429: as systems of reinforced concrete increase, engineers will lose the suspicion that, "playing into hands of monopolists"; The R.I.B.A. and Reinforced Concrete, B.J., vol.25, 8.5.1907, p.225: Committee appointed because of the increasing adoption of reinforced concrete in buildings.

E. O. Sachs (1909) said it was an,

"open secret that Mr. Dunn was one of the primary movers....
in obtaining for the architectural profession the
Reinforced Concrete Committee which was formed by the R.I.B.A..." 85

In 1905, William Dunn, F.R.I.B.A., proposed a Committee of the R.I.B.A., possibly with the I.C.E., to prepare a standard specification for reinforced concrete.⁸⁶ W. Dunn's object was to improve architects' position in reinforced concrete design vis-à-vis specialists, and whose competence he doubted.⁸⁷ Such a Committee was recommended by the R.I.B.A. Science Standing Committee (of which William Dunn was a member⁸⁸) and the recommendation adopted by the R.I.B.A. Council in October, 1905.⁸⁹

William Dunn, F.R.I.B.A. was regarded as a,

"leading exponent on all questions relating to reinforced concrete ". 90

The Building News (1897) also described William Dunn and his partner, Robert Watson, F.R.I.B.A., as among the, "leading English architects "⁹¹. W. Dunn was also, by 1910, an Associate member of the I.C.E.,⁹² (and R. Watson, "had originally intended to train as an engineer but entered Mr. Paterson's office in Edinburgh"⁹³). W. Dunn endeavoured to educate architects in modern construction and inculcate, for example, that, "strength

85. E.O.Sachs, at C.I., C. & C.E., vol.3, no.6, Jan., 1909, p.479.

86. Dunn, op. cit. (11).

87. Dunn, op.cit. (51), p.502; see earlier this chapter for Dunn's remarks on competence.

88. E.g. Chronicle: The Annual Elections, J.R.I.B.A., vol.12, 10.6.1905, p.516.

89. Sir H. Tanner, Prefatory Remarks, Report of the Joint Committee on Reinforced Concrete, J.R.I.B.A., vol.14, 15.6.1907, (p.513, ff.), p.513.

90. Edwin O. Sachs at C.I., C. & C.E., vol.3, no.6, Jan., 1909, p.479.

91. B.N., vol.73, 24.9.1897, p.436.

92. J.Gibson Fleming, Review of Lectures on Reinforced Concrete to I.C.E., Nov., 1910, by Wm. Dunn, F.R.I.B.A., Assoc. Inst. C.E., J.R.I.B.A., vol.18, 30.6.1911, pp.588-9.

93. Dunn, op.cit. (83), p.142.

to the eye" was an inappropriate criterion⁹⁴ (see Chapter 10). Dunn studied and advocated reinforced concrete, of which he had a technical knowledge⁹⁵ and lectured on the subject to the R.I.B.A. (1904),⁹⁶ the I.C.E. (1910)⁹⁷ and other bodies.⁹⁸ W. Dunn also had some technical understanding of steel-framing and discussed the subject, for example, in 1896-7, "for the assistance of architects".⁹⁹

William Dunn collaborated with Charles F. Marsh, Assoc. M. Inst. C.E. for a new edition of Marsh's Reinforced Concrete of 1904 (which ran into many more editions¹⁰⁰); he was a member of the Concrete Institute at its formation¹⁰¹ and Chairman of its Science Standing Committee.¹⁰²

W. Dunn and R. Watson, F.R.I.B.A., had employed Hennebique's system in 1903-4, in an extension¹⁰³ to the premises of the Clerical, Medical and General Life Assurance Society, St. James' Square, London.¹⁰⁴ W. Dunn (1905) said that he used reinforced concrete frequently,¹⁰⁵ but no framed buildings of Dunn's and Watson's are known; W. Dunn and R. Watson employed reinforced concrete for floors, for instance, in St. John's

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94. William Dunn, The Principles of Dome Construction - I, A.R., vol.23, 1908, (pp.63-73), p.73.
95. E.g. W. Dunn, The Bending Stresses in Flat Rectangular Concrete Floors, J.R.I.B.A., vol.7, (pp.369-73).
96. E.g. W. Dunn, Construction and Strength of Reinforced Concrete Columns, pr. to R.I.B.A., 21.11.1904, J.R.I.B.A., vol.12, (pp.21-46).
97. New Books: Lectures on Reinforced Concrete delivered at I.C.E. Nov., 1910, C. & C.E., vol.6, no.9, Sept., 1911, pp.716-7.
98. University of London: Mr. Wm. Dunn's Lectures, J.R.I.B.A., vol.17, 22.10.1910, p.798.
99. William Dunn, The Strength of Beams and Pillars: with Diagrams for the Assistance of Architects, A.R., vol.1, 1896-7, p.212.
100. E.g. Charles F. Marsh, M. Inst. C.E., etc., and William Dunn, F.R.I.B.A., Assoc. Inst. C.E., Manual of Reinforced Concrete, London, 4th edn., 1922.
101. Chronicle, J.R.I.B.A., vol.15, 9.5.1908, p.412.
102. Sachs, op.cit. (90).
103. Mouchel-Hennebique Ferro-Concrete. List of Works, 1920. W. Dunn and R. Watson, letter to A.D. Besant, 4.9.1903.
104. In a visit to the Society's buildings at St. James' Square, there was little evidence of reinforced concrete, which may have been used in some floors and roofing, (July, 1977).
105. Dunn, op.cit. (11).

Institute, Larcom Street, Walworth, London, S.E.¹⁰⁶

Robert Watson had assisted in the offices of (Sir) Rowand Anderson,¹⁰⁷ who also employed Hennebique's system, in 1910, for a chapel dome at Dunblane.¹⁰⁸

However, William Dunn (1904) described A. Considère's spiral reinforcement for columns as, "more scientific"¹⁰⁹ than types such as Hennebique's. L. G. Mouchel's somewhat unreasonable attitude towards Considère's system and, indeed, Mouchel's dismissal of a test of a spirally reinforced column arranged and reported by W. Dunn, in 1903 and 1904 (Chapter 7) therefore may perhaps have provoked Dunn's concern to promote disinterested study of reinforced concrete in Britain.

The Chairman of the R.I.B.A. Joint Committee was Sir Henry Tanner, F.R.I.B.A., at this time (and until 1913) the principal Architect and Surveyor at H.M. Office of Works.¹¹⁰ Sir H. Tanner was especially interested in fireproof construction¹¹¹ and (in 1906) he personally recommended Hennebique's ferro-concrete for a large G.P.O. extension at St. Martins-le-Grand, London;¹¹² (the significance of this decision in the context of discussion about building regulations for reinforced concrete in London was noted in Chapter 5). Sir H. Tanner (1907) said he had started, "about three" works with reinforced concrete, so he had some faith in it.¹¹³

106. Current Architecture, A.R., vol.18, July-Dec., 1905, pp.184-5: built, 1901.

107. Dunn, op. cit. (83), p. 142.

108. See: Appendix I.

109. Dunn, op. cit. (96), p.44.

110. Who's Who in Architecture, op.cit. (58), p.217. S.a. Chronicle, J.R.I.B.A., vol.11, 25.6.1904, p.459.

111. Sir H. Tanner, Even. Standard, 25.2.1914, cited in: Mouchel-Hennebique Ferro-Concrete, London, 4th edn., 1921, p.88.

112. Editorial Notes, C. & C.E., vol.1, no.6, Jan., 1907, p.403. Sir H. Tanner, 1914, ib. Cf: The Durability of Reinforced Concrete in Buildings, N.B.S. Spec. Report, no.25, London, H.M.S.O., 1956, p.3. See: Appendix I.

113. Sir H. Tanner, Discussion on the Report of the Joint Committee, op.cit. (51), p.502.

William Woodward (1911) commented that he had known Sir Henry Tanner for 30 - 40 years and,

"no more careful man than he existed in the profession of architect".¹¹⁴

Before adopting ferro-concrete, Sir H. Tanner had used coke breeze for floors for many years.¹¹⁵

The R.I.B.A. President, when the Joint Committee was formed (1906) and its Report adopted (May, 1907), Thomas E. Collcutt,¹¹⁶ also had some prior interest in concrete and reinforced concrete. T. E. Collcutt had made a personal discovery of the use of concrete blocks for an old aqueduct near Algeciras, Spain.¹¹⁷ In 1904, T. E. Collcutt had observed tests of a Hennebique building in Tottenham, London (a brewery storehouse for Whitbreads'¹¹⁸).

Collcutt's view, like Salmon's and Corbett's, was again that,

"no student (was) equipped....unless a builder as well as a designer of architecture",¹¹⁹

and that an architect should know the principles of modern construction,¹²⁰ although he himself was technically ignorant of reinforced concrete.¹²¹

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114. William Woodward, C.& C.E., vol.6, no.4, April, 1911, p.304.
115. Thomas Potter, letter to editor, C. & C.E., vol.6, no.5, May, 1911, p.399.
116. Minutes XV, J.R.I.B.A., vol.13, 16.6.1906, p.435: President: 1906-7.
117. T.E.Collcutt, President, R.I.B.A., Discus., W.J. Dibdin, The Composition and Strength of Mortar, J.R.I.B.A., vol.14, 22.12.1906, p.120.
118. B. Hannen, Discussion on Reinforced Concrete, op.cit. (12), p.91. Mouchel-Hennebique Ferro-Concrete. List of Works, 1897- 1919, London, 1920.
119. T.E.Collcutt, J.R.I.B.A., vol.9, 1901-2, p.415.
120. T.E.Collcutt, President's Address to Students, 4.2.1907, J.R.I.B.A., vol.14, 9.2.1907, (pp.213-7), pp.216-7.
121. T.E.Collcutt, Discussion on the Report of the Joint Reinforced Concrete Committee, op.cit. (51), p.503.

During the discussion of the R.I.B.A. Report, J. J. Burnet's nervousness about adopting it as a, "R.I.B.A. textbook",¹²² for instance, could possibly have afforded a lead not to do so, had not the President moved its adoption, especially as the discussion revealed some doubts about the practicability of reinforced concrete.¹²³

The R.I.B.A. Science Standing Committee again had previously shown an interest in concrete; in its Annual Report for 1901-2, the Committee said it was considering,

"the subject of cement-concrete in flats and floors and are awaiting the result of some further experiments to.... report on the behaviour of concrete ". 124

By March, 1906, this committee had instigated - and provided a basis for - a Joint Committee of R.I.B.A. members and other interested bodies to draw up rules for architects' guidance in the use of reinforced concrete.¹²⁵ The Committee included representatives from the District Surveyors' Association, the Institute of Builders, the Incorporated Association of Municipal & County Engineers, the War Office, the Admiralty, and three individual members, Charles F. Marsh, Professor W. C. Unwin and Colonel F. Winn.¹²⁶

A leading article in The Builders' Journal (1907) commented that the Committee members lacked a thorough practical knowledge of reinforced concrete, unlike the members of the French Government's Commission on

122. J. J. Burnet, A.R.S.A., ib., p.502.

123. E.g. F.T.Reade, ib., p.503: Reade questioned the sanity of any engineer using reinforced concrete for girders or columns because of the heterogeneity of concrete and steel.

124. Report of the Council, J.R.I.B.A., vol.9, 10.5.1902, p.335.

125. Chronicle, J.R.I.B.A., vol.13, 24.3.1906, p.271.

126. Ib. Report of the Joint Committee on Reinforced Concrete, op. cit. (89), p. 513: Admiralty and Col. Winn, R.E. were later additions.

Reinforced Concrete (who included François Hennebique).¹²⁷ There was no official representation of - nor consultation with - specialist designers, although they were consulted unofficially by some Committee members.¹²⁸ However, the view held of their expertise, apart from William Dunn's own, is perhaps indicated by a comment in the R.I.B.A. journal (1906) with regard to the proposed Report, that so far, no responsible body in Britain,

"no one man even whose name carries great weight"

had advocated reinforced concrete¹²⁹ - thus ignoring L. G. Mouchel's work in Britain and his advocacy of Hennebique's system, for example, in a lecture to the R.I.B.A. (1904).¹³⁰

The I.C.E., invited to join the Committee, refused.¹³¹ Concrete and Constructional Engineering (1910) observed that for many years, the I.C.E. had treated reinforced concrete with, "indifference or hostility"¹³² and only later was it persuaded to take up the subject.¹³³

127. The R.I.B.A. and Reinforced Concrete, op.cit. (84). W. Noble Twelvetrees, Francois Hennebique: A Biographical Memoir, F.C., vol.13, no.5, Nov., 1921, (p.119,ff.), p.140.

128. The R.I.B.A. and Reinforced Concrete, ib.

129. Chronicle, op.cit. (6), p.338.

130. Mouchel, op.cit. (66).

131. William Dunn, American Committee's Report on Reinforced Concrete, J.R.I.B.A., vol.17, 20.11.1909, p.87.

132. Editorial Notes, C. & C.E., vol.5, no.10, Oct., 1910, (pp.703-4), p.703.

133. Ib. Cf: The Inst. C.E. Report on Reinforced Concrete, F.C., vol.2, no.5, Nov., 1910, p.136.

If the I.C.E. Council was intransigent at this time with regard to the study of reinforced concrete, there was some interest in the subject earlier among individual engineers, apart from C. F. Marsh. For example, A. T. Walmisley, M. Inst. C.E. (1900) claimed that tensile reinforcement in concrete was engaging engineers' attention.¹³⁴ W. Armstrong, M. Inst. C.E. adopted Hennebique's system for various buildings for the Great Western Railway Co., from the late 1890s (see Appendix I). However, H. E. Steinberg (1956), who joined Considère's company in Britain, in 1909, recalled antagonism towards reinforced concrete among consulting engineers.¹³⁵ Engineers' lack of initiative in reinforced concrete in the U.K. was untypical of other countries.¹³⁶

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134. The Use of Expanded Metal in Concrete, Bldr., vol.79, 15.9.1900, (pp.231-4), p.231.

135. H.E.Steinberg, C. & C.E., vol.51, no.1, Jan., 1956, p.31.

136. Dunn, op.cit. (131): American Committee initiated, 1903, by American Soc. C.E.s. S.a: Professor Schule, cited in: Editorial Notes, C. & C.E., vol.3, no.5, Nov., 1908, p.349.

The R.I.B.A. Report.

The R.I.B.A. Report was specifically intended to provide rules for reinforced concrete for architects' guidance.¹³⁷ Major E. M. Paul, a Committee member, thought the Report enabled the design of reinforced concrete structures without recourse to patent systems¹³⁸ (and by implication, to specialists). The Joint Committee (1906) assumed that,

"the engineer or architect must be in command, and must know, not only what is proposed to be done, but how it should be done" 139

(thus perhaps furthering the cause of architecture as a, "technical profession" : see Chapter 4), although the involvement of experts was also envisaged.

The Report was intended to provide an independent and unbiased working guide to the use of reinforced concrete;¹⁴⁰ as such, the Committee did not include any representatives of commercial systems, thus disregarding their experience of reinforced concrete (although some unofficial consultation took place, as noted) and the proposals avoided any preference for "patent" features.¹⁴¹ Efforts to be unbiased were regarded as precluding from consideration all, "special forms of bar", only referring to plain, round bars.¹⁴²

137. Report of the Joint Committee on Reinforced Concrete, op.cit. (89), p.513.

138. Major E.M.Paul, R.E., Discussion on the Report, op.cit. (51), p.500.

139. Chronicle, op.cit. (6), p.339.

140. Report of the Joint Committee, op. cit. (89), p.514.

141. Tanner, ib., p.514.

142. Ib.

At the Joint Committee's first meeting, (April, 1906), the proposed scope of the Report included, as well as technical questions (such as fire-resistance and the question of rust), how far building regulations should be altered to permit reinforced concrete walls (Chapter 5), contracting and carrying out of reinforced concrete work and the architect's or engineer's responsibilities, vis-à-vis the specialist firms.¹⁴³

By December, 1906, three sub-committees were appointed for fire-resistance, materials and formulae,¹⁴⁴ and Materials and Methods of Calculation were the chief headings of the Report.¹⁴⁵

Although notes upon fire-resistance and on the need for altering bylaws to accommodate reinforced concrete were included, the respective roles and responsibilities of architects and specialists in reinforced concrete design were not, and a possible limitation of scope may have resulted from the work involved in translating and studying,

"the great mass of literature and records of tests upon reinforced concrete"

and the Committee's intention to produce a report by the following Spring,¹⁴⁶ which it accomplished; the Report was issued on 27th May, 1907.¹⁴⁷ An American Committee on Reinforced Concrete, initiated by the American Society of Civil Engineers in 1903, reported two years after the British Committee, and with, "similar findings".¹⁴⁸

143. Chronicle, op.cit. (6).

144. Chronicle, J.R.I.B.A., vol.14, 8.12.1906, pp.96-7.

145. Report of the Joint Committee, op. cit. (89).

146. Chronicle, op.cit. (144), p.97. S.a: Chapter 3 on quantity of literature.

147. Dunn, op.cit. (131), p.87. Report of the Joint Committee, op.cit. (89), p.513.

148. Dunn, ib., pp.86-7.

The R.I.B.A. Committee decided to collate information about reinforced concrete instead of carrying out additional testing, relying largely on foreign reports and experiments¹⁴⁹ and a few tests on beams given to the Committee by Cubitt & Co.¹⁵⁰ (W.B.Wilkinson's work was acknowledged¹⁵¹). William Dunn, who contributed three of the five Technical Appendices to the Report¹⁵² was also something of a linguist, which enabled him to translate foreign regulations¹⁵³ for the Joint Committee.

The R.I.B.A. Report was the first "official" pronouncement upon reinforced concrete in Britain,¹⁵⁴ preceding the first I.C.E. Report on Reinforced Concrete (1910) for example, by several years. The Report considered various technical and practical aspects of reinforced concrete construction, often without conclusions, because of the difficulty of prescribing general rules, (or the absence of general rules).¹⁵⁵ The need for skilled workmanship is emphasised, in contradistinction perhaps to L. G. Mouchel's expressed views: (Chapter 7).

There is no aesthetic comment, which was never part of the Committee's "brief", whose object was to provide technical guidance for architects.

149. Tanner, op.cit. (89), p.514.

150. Ib.

151. Ib.

152. Ib., (p.513,ff.).

153. E.g. J.R.I.B.A., vol.13, 25.11.1905, p.50 ff: Dunn transl. Prussian Regulations on Reinforced Concrete in Buildings (1905) for architects' and engineers' benefit;
W. Dunn, Notes on the Stresses in Framed Spires and Domes, J.R.I.B.A., vol.11, 21.5.1904, p.412: Dunn cites from French text.

154. Tanner, Prefatory remarks, Report of the Joint Committee, op.cit. (89), p.513: first "authoritative" report.

155. E.g. Report of the Joint Committee, ib., p.518.

Lt.-Col. J. Winn (1908) said the Report was deliberately simple, without advanced mathematics;¹⁵⁶ advance copies were sent in April, 1907 to all R.I.B.A. members.¹⁵⁷ Major E.M. Paul (1907) stated,

"anyone with this Report in his hands would be able to strike out confidently in the design of reinforced structures without having recourse to any particular patent system " . 158

Concrete and Constructional Engineering (1911) called it a, "momentous statement"¹⁵⁹ which sanctioned a novel method of construction.¹⁶⁰

The Report was said (1909) to be widely used,¹⁶¹ but doubts were expressed whether it achieved its objects, because it was at once insufficient,¹⁶² and abstruse for architects.¹⁶³ Ferro-Concrete (1910) warned that such rules could be superficially complied with.¹⁶⁴ Building Industries (1907) thought it contained safe commonplaces together with abstruse matter timorously advanced and represented a, "darkening of counsel",¹⁶⁵ but Concrete and Constructional Engineering (1908) concluded it was the best available guide¹⁶⁶ (and Charles Marsh's comparison with provisions abroad was discussed in Chapter 5).

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156. Lt.Col. J. Winn, The "Advance" in the Concrete Age, C. & C.E., vol.3, no.1, March, 1908, (pp.5-10), p.6.
157. Discussion on the Report, op.cit. (51), p.497.
158. Maj. E.M.Paul, R.E., ib., p.500.
159. Editorial Notes, C. & C.E., vol.6, no.8, Aug., 1911, p.563.
160. S.a: Editorial Notes, C. & C.E., vol.6, no.9, Sept., 1911, p.645.
Cf: The R.I.B.A. and Reinforced Concrete, B.J., vol.25, 29.5.1907, p.259.
161. Dunn, op.cit. (131), p.86. F.C., vol.1, no.2, Aug., 1909, p.28.
162. The R.I.B.A. and Reinforced Concrete, op.cit. (160).
163. John Slater, F.R.I.B.A., Discussion on the Report, op.cit. (51), p.498.
164. Comparison of Reinforced Concrete Designs and Tenders, F.C., vol.1, no.7, Jan., 1910, p.143.
165. Joint Committee on Reinforced Concrete, Build. Inds., vol.18, 15.6.1907, pp.33-4.
166. Editor's note, C. & C.E., vol.3, no.3, July, 1908, p.181.

Edwin Sachs and "Concrete and Constructional Engineering".

While the R.I.B.A.'s Joint Committee was being constituted, Edwin O. Sachs started a new journal, Concrete and Constructional Engineering (March, 1906), which he founded, managed and edited, with financial help from sympathisers as the journal could not pay its way on the basis of the popularity of the subject.¹⁶⁷

Edwin O. Sachs, F.R.S. Ed., F.R.G.S., born in 1870, was educated in London and at the University of Berlin and travelled extensively before commencing practice as an architect in London, in 1892; (he was architect to the Royal Opera House, Covent Garden, reconstructed, 1898-1903).¹⁶⁸

E.O.Sachs had a particular interest in fire-prevention (especially in theatres) and founded and chaired the British Fire Prevention Committee in 1897 (aged 27),¹⁶⁹ with a broad-based membership, including many eminent architects;¹⁷⁰ this had undertaken a vigorous programme of tests of materials, including reinforced concrete:¹⁷¹ (see Chapters 2 and 9). (Testing stations were established abroad, for instance in St. Petersburg, on the London model¹⁷²). Sachs published

167. C. & C.E., vol.51, no.1, Jan., 1956, p.1. Bldr., and B.J., had already taken up the subject, e.g. The Student's Column. Concrete-Steel, Bldr., vol.85, 4.7.1903, p.19 - 26.12.1903, p.669. B.J., vol.23, Jan. - June, 1906: Concrete and Steel suppl.

168. Who's Who in Architecture, op.cit. (58), p.193. S.a: Max Clarke, J.R.I.B.A., vol.4, 26.8.1897, p.444; C. & C.E., vol.51, no.1, Jan., 1956, p.2: Sachs died (only 49) in 1919.

169. C. & C.E., vol.51, no.1, Jan., 1956, p.3. Cf: S.B.Hamilton, A Short History of the Structural Fire Protection of Buildings Particularly in England, N.B.S. Spec. Report no. 27, London, 1958, p.31.

170. B.J., vol.7, Feb. - Aug., 1898, p.272.

171. E.g. Expanded Metal: Chapter 2.

172. E.g. B.N., 1.9.1899, p.284.

numerous papers and books on the subject of fire-prevention, especially in public buildings.¹⁷³

E.O.Sachs' interest in reinforced concrete no doubt resulted from and was certainly associated with this interest; for example, a resolution proposed by Sachs at the International Congress of Architects (1906), drew attention to conditions for the fire-resistance of reinforced concrete.¹⁷⁴

E.O.Sachs (1906) said that, as an architect, he was, "astounded at the ugliness" of examples of reinforced concrete buildings (not necessarily British).¹⁷⁵ Sachs (1906) believed that the design of reinforced concrete buildings should be kept in architects' hands,¹⁷⁶ (although Sachs also considered that, "concrete engineering works" had been aesthetically successful, so that in 1911, he stated, in apparent contradiction, that,

"Concrete architecture was likely to find its salvation in the hands of the civil engineer".¹⁷⁷)

E. O. Sachs (1908) described the current organisation of reinforced concrete work in Britain as a, "harmful" situation of, "laissez-faire"¹⁷⁸ (although L. G. Mouchel's safety record for buildings, for example, was good: Chapter 7). From its foundation in 1906, Concrete and Constructional Engineering maintained an editorial line opposing the commercial-specialist, "monopoly" of design and execution, which was largely L. G. Mouchel's. Concrete and Constructional Engineering had clear

173. Who's Who in Architecture, op.cit. (58), p.193: details of publications.
174. J.R.I.B.A., vol.13, Congress No., Summary of Proceedings, xxxii.
175. E.O.Sachs, meeting of A.A. and Jun. Instit. Engrs., April, 1906, Build. Inds., vol.17, 16.5.1906, p.17.
176. Reinforced Concrete at the I.C.A., C. & C.E., vol.1, no.4, Sept., 1906, p.291, and, Mr. Sachs, I.C.A., 1906, Trans., London, R.I.B.A., 1908, p.246.
177. Edwin O. Sachs, discus., C.I., C. & C.E., vol.6, no.7, July, 1911, p.498.
178. Edwin O. Sachs, at C.I., cited in: Editorial Notes, C. & C.E., vol.3, no.4, Sept., 1908, p.262.

objectives, evident in its editorials (1906-8):

- (1) Independent propagation of reinforced concrete, with unbiased reports.¹⁷⁹
- (2) Independent design by engineers or architects, selecting from systems as required.¹⁸⁰
- (3) Amendment of building laws to encourage reinforced concrete construction, especially extended periods for Local Government Board loans (see Chapter 5), perhaps of particular interest to Sachs, because such loans influenced the use of reinforced concrete for public buildings.

In accordance with the first objective, it was Concrete and Constructional Engineering's policy not to gloss over failures of reinforced concrete and to urge independent investigation.¹⁸¹ Its coverage of,

"interesting failures in reinforced concrete construction whilst strongly advocating that method"

received more comment than any other point in the journal and the policy was generally approved, except by,

"a few all too optimistic....engineers and....representatives of the 'specialist systems' ". 182

179. E.g. Characteristics of the Chief Systems of Reinforced Concrete Applied to Buildings in Great Britain, C. & C.E., vol.2, no.6, Jan., 1908, p.428.

180. Editorial Notes, C. & C.E., vol.2, no.1, March, 1907, pp.3-4.

181. Mr. Sachs, Reinforced Concrete at the I.C.A., op.cit. (176), pp.293-4: on importance of independent inquiries and publishing of reinforced concrete failures.

182. Editorial Notes, op.cit. (180), p.1.

Concrete and Constructional Engineering (1907) dismissed "ferro-concrete", "armoured concrete" and "concrete-steel" as, "fancy descriptions"¹⁸³ and favoured instead, "reinforced concrete",¹⁸⁴ apparently not associated with a particular system.

Advertisements in Concrete and Constructional Engineering promoted only, "independent" contractors, such as D. G. Somerville & Co., who expressed their willingness to construct in any system¹⁸⁵ (and used Kahn's, for instance, which did not require a licence).

Concrete and Constructional Engineering (1907) commented,

"the most difficult problem....has been to retain absolute independence in respect to the conflicting interests of the various 'specialist' concrete systems, contractors and traders ". 186

However, Concrete and Constructional Engineering perhaps gave less attention to the Hennebique system than its extent of use justified, and to favour for example, the Patent Indented Steel Bar Co.¹⁸⁷

Concrete and Constructional Engineering combined an internationalism of content and comment with a somewhat jingoistic attitude to foreign specialists in Britain such as L.G.Mouchel.¹⁸⁸ For example, (unsigned)

183. Editorial Notes, C. & C.E., vol.2, no.5, Nov., 1907, p.344.

184. E.g. Memoranda, C. & C.E., vol.2, no.4, Sept., 1907, p.320.

185. Advert., D.G.Somerville & Co., C. & C.E., vol.2, no.6, Jan., 1908, p.510.
Advert., D.G.Somerville & Co., C. & C.E., vol.3, no.4, Sept., 1908, p.344.

186. Editorial Notes, op.cit. (180), p.1.

187. E.g. Memoranda, C. & C.E., vol.1, no.3, July, 1906, p.214: "quite extraordinary excellence and utility" of this company's catalogue. C. & C.E. provided M.T.Cantell with illustrations of Coignet works for his book, Reinforced Concrete Construction, London, 1912, (which does not refer to Hennebique or to L.G.Mouchel & Partners): Cantell, ib., Preface, xvi.

188. Hence, perhaps, P. Collins' reference to L.G.Mouchel and others representing a, "foreign invasion" : P.Collins, Concrete, London, 1959, p.77.

articles referred (1907) to,

"pretentious foreigners (who) attempted to monopolise reinforced concrete", 189

and asserted, vaguely, that the ways of foreigners working,

"so-called systems...are anything but in accordance with British traditions" 190

- perhaps a reference to the method of licensing contractors instead of allowing, "free competition"; (for example, Lucien Serraillier (1912) said that specialists were criticised for confining permission to construct on their designs to a limited number of contractors, restricting competition¹⁹¹), although in 1907, Concrete and Constructional Engineering stated, again without elucidation,

"we....do not always agree with Mr. Mouchel's methods of propagation".¹⁹²

The journal's claims (1908) that L. G. Mouchel had had, "linguistic difficulties" and that,

"he only took up civil engineering at a somewhat late period of his life" 193

appear to be unjustified, (see Chapter 7). Concrete and Constructional Engineering (1907) welcomed the R.I.B.A. Report as representing,

"independent data compiled by British colleagues". 194

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189. The Progress of Reinforced Concrete in Great Britain, op.cit. (16), p.11.

190. Ib.

191. Serraillier, op.cit. (32), p.94.

192. Report of the Committee on Reinforced Concrete, op.cit. (84), p.176.

193. Editorial Notes, op.cit. (4).

194. Report of the Committee on Reinforced Concrete, op.cit. (84), p.175.

The Concrete Institute.

The Concrete Institute was again largely E.O.Sachs' creation. According to S.B.Hamilton (1956) the Concrete Institute was formed, in 1907-8, to pre-empt a combination of specialists proposed in a circular from a specialist firm to others in 1907,¹⁹⁵ and provide instead a more broadly-based permanent association. Thus like the R.I.B.A. Committee on Reinforced Concrete, the Concrete Institute was to some extent a "defensive" response to specialist initiative; it was also instigated in default of interest in reinforced concrete by the major engineers' institutions,¹⁹⁶ although The Builders' Journal (1908) maintained the call for a Concrete Institute (to parallel The Iron and Steel Institute) was, "pressing and widespread".¹⁹⁷

The Concrete Institute was being formed in January, 1908,¹⁹⁸ and by February had its 100 founders.¹⁹⁹ Edwin O. Sachs was again a key figure in both its foundation and management,²⁰⁰ as of Concrete and Constructional Engineering. At a lunch held by E.O. Sachs at the Ritz Hotel, in July, 1908, prepared regulations were agreed to and the Earl of Plymouth elected first President,²⁰¹ a titular head to give a small, new society prestige.²⁰²

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195. S.B.Hamilton, A Note on the History of Reinforced Concrete in Buildings, N.B.S.Spec. Report No.24, London, 1956, p.15.
196. Editorial Notes, C. & C.E., vol.3, no.3, July, 1908, pp.177-8.
197. The Concrete Institute, B.J., vol.27, C. & S. suppl., 20.5.1908, p.436. Cf: Chronicle, J.R.I.B.A., vol.15, 9.5.1908, p.412.
198. A Concrete Institute, B.J., vol.27, C. & S. suppl., 29.1.1908, p.95.
199. The Concrete Institute, B.J., vol.27, 26.2.1908, p.197.
200. Editorial Notes, C. & C.E., vol.6, no.7, July, 1911, p.487.
201. Sir H. Tanner, C. & C.E., vol.6, no.12, Dec., 1911, p.930.
202. E.O.Sachs, at C.I., C. & C.E., vol.6, no.7, p.494.

The objects of The Concrete Institute²⁰³ were twofold:

- (1) To advance the knowledge of concrete and reinforced concrete (and, like Concrete and Constructional Engineering, to refrain from indulging in, "unnecessary laudation"²⁰⁴).
- (2) To provide a means of communication between the different professions and trades involved in reinforced concrete.

From the beginning, a beneficial meeting of different interests was anticipated²⁰⁵ and a better cooperation was hoped to result.²⁰⁶ The Concrete Institute is interesting as including a mixed membership²⁰⁷ with diverse interests in reinforced concrete (and it was not only a civil engineers' institution, as sometimes implied²⁰⁸). However, Concrete and Constructional Engineering (1911) claimed that only civil engineers were specifically invited to join, originally.²⁰⁹

The British Fire Prevention Committee, of which E.O.Sachs was also Chairman (and some of whose work the Concrete Institute anticipated taking over²¹⁰), itself comprised a broad, professional membership.²¹¹ Institute members could be:

- (1) Persons professionally or practically engaged in the application of concrete/reinforced concrete or the production of their constituents.

203. Objects of the Institute, C.I. Trans.& Notes, vol.1, pt.2, April, 1909.

204. C. & C.E., vol.3, no.6, Jan., 1909, p.471.

205. A Concrete Institute, op.cit. (198), p.95.

206. Editorial Notes, C. & C.E., vol.3, no.1, March, 1908, pp. 1 - 2.

207. Cf: Hamilton, op.cit. (195), p.16.

208. E.g: M.Bowley, Innovations in Building Materials, London, 1960, pp.88-9; Collins, op.cit. (188), p.134: B. Pite (1911) at C.I., "lecturing to engineers".

209. Editorial Notes, C. & C.E., vol.6, no.12, Dec., 1911, p.890.

210. Chronicle, J.R.I.B.A., vol.16, 23.1.1909, (pp.216-8), p.218.

211. Miscellaneous: The British Fire Prevention Committee, Bldr., vol.80, 16.2.1901, p.169.

(2) Persons of relevant scientific, technical or literary attainments.

(3) "Special subscribers" such as public authorities.²¹²

Unlike the R.I.B.A. Committee, the Concrete Institute was not intended to exclude specialists or commercial interests. E.O.Sachs, Chairman of the Executive, viewed the Institute as combining different, often divergent, interests: engineers, architects, government officials, manufacturers and (despite Concrete and Constructional Engineering's publication of references to, "pretentious foreigners") also specialist firms.²¹³

The Vice-Presidents represented: architecture (Sir Henry Tanner, F.R.I.B.A.), civil engineering (Sir William Preece, F.R.S.) and industrial interests (Sir William Mather, LL.D., M.Inst. C.E.).²¹⁴

Only British subjects could be council members²¹⁵ (which would have debarred L. G. Mouchel, who remained a French citizen,²¹⁶ had he lived). Council members (1908), numbering about twenty, included the architects and engineer most active in the R.I.B.A. Joint Committee, notably William Dunn, F.R.I.B.A., and Charles Marsh, M. Inst. C.E. Professor W. R. Lethaby was also a Council member. The Council included, in addition, W.H.Hunter, M. Inst. C.E. (see Chapter 7), Benjamin Hannen of Cubitt & Co. (Chapter 7) and E. P. Wells (Chapter 3) and a number of

212. The Concrete Institute, Engr., vol.105, 8.5.1908, p.490.

213. Edwin O. Sachs, at C.I., Editorial Notes, C. & C.E., vol.3, no.4, p.262.

214. Editorial Notes, C. & C.E., vol.3, no.2, May, 1908, pp.89-90.
Sir H. Tanner subsequently became President: Editorial Notes, C. & C.E., vol.6, no.7, p.487.

215. Editorial Notes, C. & C.E., vol.3, no.2, p.89.

216. Memoranda, C. & C.E., vol.3, no.4, Sept., 1908, p.341.

heads of specialist firms: J.S.E. de Vesian, M. Inst. C.E. for L. G. Mouchel & Partners, G.C. Workman of E. Coignet Ltd., and L. Serrailier, Manager of the Patent Indented Steel Bar Co. The Trussed Concrete Steel Co., Stuart's Granolithic Co. and The New Expanded Metal Co. (Chapter 2) were also represented.²¹⁷

Ordinary architect-members of the Institute included A. E. Corbett, F.R.I.B.A.²¹⁸ and F.E.L. Harris, F.R.I.B.A.²¹⁹, (Chapter 10). The first President, the Earl of Plymouth, urged members to consider the aesthetic - as well as practical - aspects of reinforced concrete²²⁰ and Charles Marsh (1908) for instance, also suggested the Institute would have a role in finding architectural uses for reinforced concrete.²²¹ Beresford Pite, F.R.I.B.A. (1908) proposed an Art Committee of the Concrete Institute.²²²

Three other main sections of membership, apart from architects, were identified (1909): engineers, specialists and cement manufacturers,²²³ but engineers and architects were in the majority.²²⁴ E.O. Sachs (1908) said that at the first meeting of 300 members, over 100 were I.C.E. members,²²⁵ (although the number of non-I.C.E. members who were engineers is not stated). In 1911, with membership weighted towards London, there were: 582 engineers, 91 architects and surveyors, 31 specialists, 45 chemists and cement manufacturers and 28 contractors,²²⁶ a considerably increased proportion of engineers, perhaps due to the technical bias of papers.

217. Council, C.I. Trans. & Notes, vol.1, pt.2, April, 1909; Editorial Notes, C. & C.E., vol.3, no.2, May, 1908, p.90.

218. Who's Who in Architecture, op.cit. (58), p.56.

219. *Ib.*, p.101.

220. The Earl of Plymouth, at C.I., cited in: Editorial Notes, C. & C.E., vol.3, no.4, pp.262-3.

221. C.F. Marsh, at C.I., C. & C.E., vol.3, no.6, Jan., 1909, p.474.

222. B. Pite, at C.I., *ib.*, p.482.

223. F.A. White, C. & C.E., vol.4, no.4, Sept., 1909, p.290.

224. Editorial Notes, C. & C.E., vol.6, no.7, pp.483-4; Chronicle, J.R.I.B.A., vol.16, 8.5.1909, p.483.

225. Edwin O. Sachs at C.I., C. & C.E., vol.3, no.6, p.472.

226. Sir H. Tanner, President's Address to C.I., 9.11.1911: B.J., vol.34, 22.11.1911, p.548.

Concrete and Constructional Engineering (1911) commented that with the somewhat diverse membership, "esprit de corps (was) sadly lacking" and meetings were not well-attended;²²⁷ membership declined²²⁸ and Sir H. Tanner (1911, now President) proposed a, "broader" scope as an Institution of Structural Engineers.²²⁹ (Concrete and Constructional Engineering (1911) considered such a title would entail loss of prestige, since "structural engineer" was not a professional term, being applied to steel contractors or to failed civil engineers²³⁰).

Perhaps E. O. Sachs' personal influence was significant in the momentum of the Concrete Institute; he had ceased to manage its affairs in 1909,²³¹ but he was also absent altogether subsequently for a long period through illness;²³² perhaps concrete and reinforced concrete had less need of a forum, partly because the Institute's educational function was being provided for by new classes in reinforced concrete (Chapter 3; Sir H. Tanner (1911) said the Institute was unable to compete with the L.C.C. Schools or London or other universities, in such courses²³³). The diversity of its members and interests was evidently a problem rather than a bonus. Finally, the I.C.E. by now had,

"a little concrete institute of its own".

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227. Editorial Notes, C. & C.E., vol.6, no.7, July, 1911, pp.483, 485.
228. E.g: H. Tanner, addrs. to C.I., C. & C.E., vol.6, no.12, p.930.
S.a: C.I., Trans. & Notes, vol.3, 1.8.1911, Nov., 1911; C.I., Trans. & Notes, vol.4, pt. 2, 30.6.1912, July, 1912.
229. Tanner, ib., pp.930-1, 935. Instit. Struct. Engrs. formed, 1922: Hamilton, op.cit. (195), p.22.
230. Editorial Notes, C. & C.E., vol.6, no.12, pp.892-3.
231. E.O.Sachs, at C.I., C. & C.E., vol.6, no.12, p.936.
232. E.O.Sachs, at C.I., 6.10.1910, C.I. Trans. & Notes, vol.3, Nov., 1911, p.3.
233. Tanner, op.cit. (228), p.933.
234. Alexander Siemens, Presid. I.C.E., at C.I., C. & C.E., vol.6, no.7, p.492.

The I.C.E. Report.

No doubt prompted by the formation of the Concrete Institute, which had so far drawn about 200 of its members,²³⁵ the I.C.E. appointed a committee to study reinforced concrete, in December, 1908,²³⁶ none of whose members belonged to the Concrete Institute, and only one (Professor W. C. Unwin) was a member of the R.I.B.A.'s Joint Committee.²³⁷ The I.C.E. thus began work on reinforced concrete, but, "in 'splendid' isolation"²³⁸ and Concrete and Constructional Engineering (1909) pointed to their Committee's inexperience of reinforced concrete practice;²³⁹ (Sir Henry Tanner, later, became a member²⁴⁰).

Unlike the R.I.B.A. Report, which avoided mentioning special systems, the I.C.E. Report (1910) catalogued them, (but with significant omissions²⁴¹). It referred to the experiences of a small sample of engineers with reinforced concrete, including their relation to specialists, and to examples of work (without giving reinforcement details).²⁴²

Ferro-Concrete (1910) noted that the Committee recognised L.G.Mouchel's important role in introducing reinforced concrete in the U.K.,²⁴³ but it did not refer to the work of the British Fire Prevention Committee²⁴⁴ nor to that

235. Editorial Notes, C. & C.E., vol.4, no.1, March, 1909, p.2. S.a: E.O.Sachs, at C.I., C. & C.E., vol.6, no.7, p.494.

236. The I.C.E. and Reinforced Concrete, C. & C.E., vol.5, no.10, Oct., 1910, (pp.707-19), p.707.

237. Editorial Notes, op.cit. (235).

238. Editorial Notes, C. & C.E., vol.4, no.2, May, 1909, p.78.

239. Editorial Notes, op.cit. (235).

240. Edwin O. Sachs at C.I., C. & C.E., vol.6, no.12, p.935.

241. The I.C.E. and Reinforced Concrete, op.cit. (236), p.711.

242. Ib., pp.712-3, 715. S.a: Chapter 7.

243. The Inst.C.E. Report on Reinforced Concrete - II, F.C., vol.2, no.6, Dec., 1910, p.162.

244. The I.C.E. and Reinforced Concrete, op.cit. (236), pp.711-2.

of the R.I.B.A. Joint Committee,²⁴⁵ and Ferro-Concrete (1910) also described part of the Report as out-of-date.²⁴⁶

Unlike the R.I.B.A. Report - whose purpose to provide a practical guide for architects was clear, if not wholly achieved, the I.C.E.'s preliminary Report does not appear to have had a defined object beyond an outline survey of current systems and contracting procedures.

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245. B.J., vol.32, C. & S. suppl., 9.11.1910, p.487.

246. The Inst. C.E. Report on Reinforced Concrete - II, op.cit. (243), p.163.
Cf: The I.C.E. and Reinforced Concrete, op.cit. (236), p.711;
 B.J., vol.32, C. & S. suppl., 9.11.1910, p.487.

Conclusion.

Although, by means of his "specialist organisation", L. G. Mouchel successfully established reinforced concrete construction in Britain (Chapter 7), some architects and engineers, from about 1904-5, were dissatisfied with the conditions of reinforced concrete practice. Although architects or engineers had overall responsibility for reinforced concrete buildings, they relied upon specialists for their structural designs, whose methods were guarded from public knowledge, and on the specialist's contractor for the construction; this arrangement also entailed the use of special "systems", one of which was normally adopted for an entire job. There was also an impression that L. G. Mouchel was attempting to monopolise reinforced concrete construction in Britain.

There was therefore felt to be a need to encourage "independent" design by architects and engineers, drawing on different systems as required and with reference to some objective standard or rules for reinforced concrete, and with contractors free from obligations to particular specialists.

Furthermore, some architects believed that for aesthetic reasons, architects themselves should be able to design reinforced concrete buildings. James Salmon, jun., F.R.I.B.A. and Alfred E. Corbett, F.R.I.B.A., the architects for two of the most interesting early buildings, employing Hennebique's and Kahn's systems respectively (Chapters 10, 11) were of this opinion, and both probably had some technical understanding of reinforced concrete, although the structural designs for their buildings were executed by specialists: (Chapter 7).

This situation resulted in the formation of three organisations in Britain directed towards objective studies of reinforced concrete and educating architects and engineers in reinforced concrete design: the R.I.B.A. Joint Committee on Reinforced Concrete (1905), Concrete and Constructional Engineering (1906) and The Concrete Institute (1908). These organisations were largely responses to specialist initiative, and to some extent in default of interest in reinforced concrete by the major engineers' societies. They are all interesting examples of

"institutions" (which, effectively, endured) created by a very small number of active and influential individuals, the most prominent of whom were three architects: William Dunn, F.R.I.B.A., Edwin O. Sachs, F.R.S.Ed., and Sir Henry Tanner, F.R.I.B.A., and an engineer, Charles F. Marsh, As. M. Inst. C.E.

Although the arguments for "independent" instead of "specialist" design applied to engineers, equally with architects, the initial impetus towards this end was mainly provided by architects, with the R.I.B.A., who also wished to retain responsibility for designing reinforced concrete buildings.

While the R.I.B.A. Joint Committee maintained independence from specialists, and Concrete and Constructional Engineering opposed, not only the specialist system, but, "pretentious foreigners" notably L. G. Mouchel, the Concrete Institute, on the other hand, encouraged a broad membership, including architects, engineers and reinforced concrete specialists, "to resolve differences"; by the time this was being constituted, L. G. Mouchel himself (who died in May, 1908) was no longer a dominant influence or supposed threat to British reinforced concrete practice.

The achievement of the R.I.B.A. Report (1907) or the Concrete Institute, in themselves, in educating architects or engineers in reinforced concrete design, may not have been significant: the usefulness of the R.I.B.A. Report for architects in this respect was questioned, and Sir H. Tanner in his first Presidential address to the Concrete Institute, commented that the Institute was not equipped to compete with other educational institutions for lack of finance; however, both, with Concrete and Constructional Engineering, and other journals, no doubt encouraged such bodies to include the subject in their syllabuses for both architects and engineers,²⁴⁷ (and William Dunn, F.R.I.B.A. was one of the

247. See: Chapter 3: first detailed course on reinforced concrete, in 1911 at the L.C.C. School of Building, Brixton: Editorial Notes, C. & C.E., vol.6, no.9, Sept., 1911, p.651.

first lecturers on reinforced concrete at the University of London²⁴⁸).
At the end of the first decade, however, the, "specialist system"
was yet well-established in Britain,²⁴⁹ (and also in France²⁵⁰).

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248. University of London: Mr. William Dunn's lectures, op.cit. (98).

249. E.g: A Correspondent, The Choice of Reinforcement, C. & C.E.,
vol.5, no.8, Aug., 1910, p.552. Contrast: Collins, op.cit.(188),p.81.

250. Cent Ans de Béton Armé, Paris, 1949, p.114.

CHAPTER 9: CLIENTS AND MOTIVES.

Introduction.

The Advantages of Reinforced Concrete: Economy.

"Fire-Proof" Buildings.

"Indestructibility".

Further Advantages and Disadvantages.

Enterprising Clients.

Conclusion.

Introduction.

Chapter 9 considers why certain companies and individual clients decided to employ reinforced concrete for framing, and especially for the entire construction of their buildings, in this early period of its use, in particular:

- (1) The chief advantages attributed to reinforced concrete by specialists and others.
- (2) The special requirements of clients and their (or their architect's or engineer's) reasons for selecting reinforced concrete in particular buildings.
- (3) Whether, in addition to practical requirements, other special characteristics of clients undertaking reinforced concrete construction at this time might be apparent, for example, marked innovative tendencies.

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The Advantages of Reinforced Concrete: Economy.

Many advantages were claimed for reinforced concrete by its advocates, compared to other kinds of construction, including steel-framing, and the most salient varied, to some extent, according to opinion and use.

E. Coignet's Agent, G.C.Workman (1908) drew attention especially to the fire-resistance and strength of reinforced concrete.¹ L. G. Mouchel (1905) cited as its particular advantages, its,

"imperishable and fire-resisting qualities"

and combined with,

"lightness in construction (and) graceful lines in design".²

However, the latter attribute was rarely, if ever, contemplated by the clients, architects or engineers who adopted reinforced concrete.³

W. Armstrong, M.Inst. C.E., (1906), for example, from his, "personal observation" accounted fire-resistance (and absence of vibration) as, "additional" advantages to: rapidity of execution, adaptability to bad ground, and economy of cost and space.⁴

Perhaps economy in the cost of reinforced concrete construction was the advantage most often cited⁵ as well as a frequent motive for use,

1. G.C.Workman, B.J., vol.27, 1.1.1908, p.23.
2. L.G.Mouchel, The Hennebique Ferro-Concrete System, Lond., 2nd edn., 1905, Introduction, p.1. S.a. L.G.Mouchel, Monolithic Constructions in Hennebique's Ferro-Concrete, pr. to R.I.B.A., 21.11.1904, J.R.I.B.A., vol. 12, 26.11.1904, (pp.47-61), pp. 51-2, 55, 57-9. Cf: E. Leduc, Chaux et Ciments, Paris, 1902, pp. 480-2.
3. S.a. Chapter 10.
4. W. Armstrong, Reinforced Concrete on the Great Western Railway, C. & C.E., vol.1, no.2, (pp.108-17), pp.109-10.
5. E.g. Charles F. Marsh, Reinforced Concrete, Lond., 1904, Introduction; s.a. p. 24.

especially if associated attributes are considered, such as the little maintenance required, rapidity of execution - although this was debatable⁶ - and economy of space, even compared with steel-framing, enabled by its peculiar structural adaptability and the thin reinforced concrete walls sometimes employed with reinforced concrete frames. L. G. Mouchel added to its economies by employing unskilled labour.⁷

F. von Emperger (1908) maintained that the superior economy of reinforced concrete was the leading motive of its introduction and the main cause of its success.⁸

However, reinforced concrete was not economical for "smaller buildings",⁹ such as cheap cottages¹⁰ and it was most economical for large, plain, buildings, carrying heavy loads.¹¹ L. G. Mouchel (1904) said that the motive of economy was the principal cause of the lack of architectural detail of reinforced concrete buildings.¹²

Rose, Downs & Thompson, of Hull, for example, used ferro-concrete entirely for their new machinery workshop,¹³ because it was cheaper than the usual construction.¹⁴ Sir Henry Tanner's ferro-concrete work for H. M. Office of Works' G.P.O. extensions in King Edward Street, London, E.C., saved

6. E.g: Chapter 7: The Role of Specialists and Non-Specialists in Design.

7. See Chapter 7: "Authorised Hennebique Contractors" in Britain.

8. F. von Emperger, Review of the Present Position of Reinforced Concrete Generally, pr. to I.C.A., 1908, C. & C.E., vol.3, no.3, p.212.

9. E.g: M. Kahn, C. & C.E., vol.4, no.4, p.276.

10. H. Kempton Dyson, Cheap Cottages and the Exhibition at Letchworth - II, A.R., vol.18, pp.162-3.

11. A Reinforced Concrete Boot Factory, C. & C.E., vol.2, no.4, (pp.308-14), p.308. F.E.L. Harris, Notes, Queries and Replies, J.R.I.B.A., vol.12, 24.12.1904, p.142. Characteristics of the Chief Systems of Reinforced Concrete Applied to Buildings in Great Britain, C. & C.E., vol.2, no.6, Jan., 1908, p.429.

12. Mouchel, op.cit. (2), 1904, p.57.

13. See Appendix.

14. See Chapter 7: "Authorised Hennebique Contractors" in Britain.

a well-publicised (nearly) 20% of the cost of alternative construction.¹⁵

However, F. E. Wentworth Shields, M.Inst. C.E. (1907) claimed there was now a tendency to reject "steel-concrete" for walls, because of their expense.¹⁶

F.E.L. Harris, A.R.I.B.A. observed that ferro-concrete work (for large, plain, structures) could be,

"proceeded with rapidly, and be practically finished as it progresses",

there being no, "vexatious delays" on account of non-delivery of steel members.¹⁷

However, Singer & Co.'s large, steel-framed, factory (1905-6) in Glasgow, for example, (not reinforced concrete framed, as N. Pevsner (1942) stated¹⁸) was erected in only six months,¹⁹ and rapidity of erection, although often included among the advantages of reinforced concrete,²⁰ was probably not a prime motive for its use.

Several early buildings were designed for restricted sites, for example, L.G.Ekins, F.R.I.B.A.'s soap factory (1907) at Dunston on Tyne, which the Cooperative Wholesale Society originally planned to build at Pelaw,

15. E.g: W.H.Seth-Smith and Monro, letter to Times, Chronicle, J.R.I.B.A., vol.15, 9.5.1908, p.412. S.a: Sir Henry Tanner, The New General Post Office, London, pr. to R.I.B.A., 2.1.1911, J.R.I.B.A., vol.18, 7.1.1911, (p.149, ff), p. 150.
16. F.E.W.Shields, at I.C.E. Confer., 19.6.1907, B.J., 17.7.1907, p.7.
17. Harris, op. cit. (11).
18. Nikolaus Pevsner, Nine Swallows - No Summer, A.R., May, 1942, (pp.109-12), p.110: example of "concrete" factory building.
19. J.Roxburgh Sharman, A.M. Inst. C.E., Recent Examples of Steel and Concrete Buildings in Scotland, C. & C.E., vol.1, no.3, (pp.199-205), p. 203; illust., p.204.
20. E.g: Marsh, op.cit. (5), p.23. S.a: F.C., vol.1, no.5, p.94, re: Royal Liver Building, Liverpool.

"Fire-Proof" Buildings.

The fire-resistance of reinforced concrete was perhaps the chief advantage claimed by its originators, such as François Hennebique and by L. G. Mouchel, (who advertised "fireproof" construction³⁰) as well as by some of the architects and others who advocated its use, for example, Sir Henry Tanner, F.R.I.B.A., and Edwin O. Sachs,³¹ and it was also more economical than most alternative fire-resistant constructions.³²

Concrete and Constructional Engineering (1906) observed that fire service questions were becoming increasingly a matter of fire prevention, to be met by building designers,³³ and William Woodward, F.R.I.B.A., commented that reinforced concrete represented a revolution in fire-resisting construction, because it was not confined to floors.³⁴ Professor Kerr (1899) had pointed out that fire-resistance was usually considered only with regard to large buildings,³⁵ for which, as noted, reinforced concrete was also most economical.

The British Fire Prevention Committee, comprising (1901) about 500 architects, engineers, municipal officers and others,³⁶ (with Edwin O. Sachs as Chairman), from 1897-8, investigated the fire-resistance of concrete and reinforced concrete;³⁷ (their first test was for the Expanded

30. Chapter 7: The Establishment of Technical Offices.

31. Chapters 7, 8. S.a: Mouchel, op.cit. (2), (pp.47-61).
Cf: Cent Ans de Béton Armé, Paris, 1949, p.64.

32. E.g: A. Johnston, M.Inst.C.E., B.N., vol.81, 1901, p.313. Sir H. Tanner, Editorial Notes, C. & C.E., vol.3, no.4, pp.263-4.

33. Editorial Notes, C. & C.E., vol.1, no.1, p.4. Cf: Fires and Fire Prevention (Editorial), Brit. Archt., vol.57, 25.4.1902, p.287.

34. William Woodward, F.R.I.B.A., at Surveyors' Institution, The Evolution of Fire-Resisting Construction, C. & C.E., vol.6, no.4, (pp.299-304), p.302.

35. Professor Kerr, Notes, Queries and Replies, J.R.I.B.A., vol.7, 13.1.1900, p.98. Cf: Fires and Fire Prevention, op.cit. (33).

36. British Fire Prevention Committee, Bldr., 16.2.1901, p.169.
B.J., vol.7, p.272.

37. Editorial Notes, C. & C.E., vol.1, no.1, p.5.

Metal Co.³⁸) and Concrete and Constructional Engineering (1909) commented that,

"it has been mainly due to the research work, of that Committee.... that reinforced concrete was accorded full confidence as a fire-resisting material in our public buildings ". 39

Fire Supplements to The Builders' Journal (which were edited by E.O.Sachs) also gave good coverage to reinforced concrete.

However, The British Fire Prevention Committee tested proprietary reinforced concrete systems only to the order and at the expense of their inventors.⁴⁰ Concrete and Constructional Engineering (1906) observed that the use of suitable aggregate and adequate protection of the steel was not appreciated by the, "vast majority" of those employing reinforced concrete⁴¹ and that "Thames ballast", for instance, (employed by L. G. Mouchel⁴²) was unsuitable in fire.⁴³ There was also said (1909) to be, "resentment" in the, "reinforced concrete industry" at being required by "many authorities" to take such precautions.⁴⁴ J. Sheppard (1904) referred to an unsuccessful fire test with Hennebique's system, carried out by W. Cubitt & Co. to L. G. Mouchel's instructions.⁴⁵

Nonetheless, fires involving buildings on Hennebique's system in various countries, including Britain, appeared to prove its resistance and a favourable Report (1899) on tests of Hennebique's system by

38. Arch . & C.R., vol.60, p.227. S.a: S.B.Hamilton, A Short History of the Structural Fire Protection of Buildings Particularly in England, National Building Studies Special Report No. 27, Lond., 1958, p.27.

39. Editorial Notes, C. & C.E., vol.4, no.3, July, 1909, p.157.

40. B.N., vol.76, 10.2.1899, p.192. Cf: Hamilton, op.cit. (38), p.26.

41. C. & C.E., vol.1, p.288.

42. Chapter 3.

43. Editorial Notes, C. & C.E., vol.1, no.1, p.5.

44. Memoranda, C. & C.E., vol.3, no.6, Jan., 1909, p.509.

45. Discussion on Reinforced Concrete, J.R.I.B.A., vol.12, 10.12.1904, p.97.

Commander Welsch of the Ghent Fire Brigade, was cited in the U.K. for example, by Charles F. Marsh, As. M. Inst. C.E. as well as L. G. Mouchel.⁴⁶

In particular, a large and severe fire in Baltimore, U.S., in February, 1904,⁴⁷ where some buildings were partly on Hennebique's system, demonstrated the superiority of ferro-concrete to other constructions and this was reported, for instance, in The Architectural Record⁴⁸ (U.S.), Hennebique's journal, Le Béton Armé,⁴⁹ and by William Dunn, F.R.I.B.A., for example, in the R.I.B.A. Journal in Britain.⁵⁰ A fire (1906) at the Quayside warehouse, Newcastle on Tyne, was said (by Ferro-Concrete) to be prevented from spreading by the construction.⁵¹

In 1903, The British Fire Prevention Committee convened an International Fire Prevention Congress in London, timed to coincide with the International Fire Exhibition at Earls' Court⁵² and where L. G. Mouchel exhibited views of ferro-concrete work, including grain silos at Dunston on Tyne.⁵³ At this congress, the use of the description, "fireproof" applied to buildings was condemned and "fire-resisting" recommended instead.⁵⁴

46. E.g: Marsh, op.cit. (5), pp.8-9. Mouchel, op.cit. (2), p.10.
Reinforced Concrete Systems II - The Hennebique System, B.J., vol. 23, C. & S. suppl., 20.6.1906, p.31. But, s.a: C. & C.E., vol.2, no.1, p.18: few serious fires in reinforced concrete buildings to judge by; Chapter 7.
47. E.g: Sheppard, op.cit. (45), p.96.
48. A. Elzner, The First Concrete Skyscraper, Arch. Rec., vol.15, June, 1904, (pp.531-44), p.531.
49. Le Bét. Armé, April, 1904, Planches I - III.
50. W.Dunn, Construction and Strength of Reinforced Concrete Columns, pr. to R.I.B.A., 21.11.1904, J.R.I.B.A., vol.12, 26.11.1904, (pp.21-46), p.46.
51. F.C., vol.3, no.2, p.72.
52. Hamilton, op.cit. (38), p.29.
53. Further Notes at the International Fire Exhibition, Bldr., vol.85, 12.9.1903, (pp.274-5), p.274. See: Chapter 10; Appendix: for silos, Dunston.
54. Hamilton, op.cit. (38), p.29.

This was about the time when interest in Britain in reinforced concrete buildings began to grow.⁵⁵

In 1905, The Fire Offices Committee (U.K.) included provision for reinforced concrete in their Rules for Standard Fire-Resisting Buildings (preceding provisions in building regulations).⁵⁶

Reinforced concrete was often used for the entire construction of buildings, including external walls, for fire-resistance, even though brick infill walls might be cheaper, especially by companies with a particular interest in fire-prevention, such as grain merchants.

Warehouses belonging to the Jarrow and Hebburn Co-operative Society Ltd., for example, were destroyed by fire in 1902,⁵⁷ before being rebuilt entirely in ferro-concrete.⁵⁸

Although ferro-concrete was employed entirely for Lion Chambers in Glasgow (1904-7),⁵⁹ partly to enable a gain in space with thin walls,⁶⁰ the chief practical motive was probably fire-resistance, although the client and architects in this example, may not have experimented with reinforced concrete solely for practical reasons.⁶¹ Glasgow was, "notorious for fires" (1898)⁶²: furthermore, Lion Chambers had eight storeys, which fire appliances could not cover.⁶³ With plans of the proposed building (19.4.1905), it was

55. Chapters 5, 7, 8.

56. Chronicle, J.R.I.B.A., vol.12, 26.8.1905, pp. 607-8. S.a: Chapter 5.

57. Cueillettes. Terrible Incendie à Jarrow (Newcastle on Tyne), Le Bét. Armé, Nov., 1902, p. 106.

58. Chapter 10 and Appendix I.

59. Ib.

60. David M. Walker, Salmon, Son, Grandson and Gillespie, Scot. Art Review, vol.10, no.3, 1963-6, (p. 17 ff), p.21. Cf: Les "Lion Chambers" à Glasgow, Le Bét. Armé, Oct., 1906, pp.140-1.

61. See later this chapter and Chapter 11.

62. Arch. & C.R., vol.60, p.97. Cf: F.C., vol.3, no.6, pp.179, 182: Greenlees' factory, ferro-concrete because of many fires, Glasgow.

63. B.N., 5.8.1898, p.196.

especially noted that,

"this building is entirely fireproof, and inflammable materials are reduced to a minimum"

(although the interior was wood-panelled).⁶⁴

Despite the great saving made in using reinforced concrete for Sir Henry Tanner's G.P.O. extensions in King Edward Street, London, the main motive for its use was fire-resistance.⁶⁵

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64. Plans of Proposed Building, 172, Hope St., For Wm. Geo. Black, Esq., Messrs. Salmon & Son & Gillespie, Architects, 53 Bothwell Street, Glasgow, April 19th, 1905.

65. Chapter 8: William Dunn and the R.I.B.A. Joint Committee on Reinforced Concrete.

"Indestructibility".

L. G. Mouchel's letter-heads described ferro-concrete as, "indestructible" as well as fireproof:⁶⁶ this referred not only to fire-resistance but the durability and resistance of ferro-concrete in various conditions (and M. Dumesnil, in France, said of Hennebique's system that it was,

"unassailable and imperishable".⁶⁷)

Ferro-Concrete (1911) claimed Hennebique's system would,

"endure for thousands of years", 68

although Charles Marsh (1909) said that no definite opinion about the durability of reinforced concrete under various conditions was possible for some time to come.⁶⁹

However, F. E. Wentworth Shields, M. Inst. C.E. (1907), for example, believed that reinforced concrete, well-designed, was,

"one of the most durable building materials - if not the most durable - found ". 70

The R.I.B.A. Council (1907) also favourably compared the durability of reinforced concrete, with that of brick or stone, buildings.⁷¹

66. Chapter 7: The Establishment of Technical Offices.

67. M. Dumesnil, Le Bét. Armé, Sept., 1900, p.2.

68. Ancient Concrete, F. C., vol.2, no.11, May, 1911, p.394.

69. Charles F. Marsh, A Concise Treatise on Reinforced Concrete, Lond., 1909, p.9.

70. F.E.W. Shields, The Durability of Reinforced Concrete Structures, pr. to Engineering Conference, Lond., Jun, 1907, C. & C.E., vol.2, no.3, (pp.230-3) p.231.

71. Chronicle : H.M. Office of Works and Reinforced Concrete, J.R.I.B.A., vol.15, 21.12.1907, (pp.137-9).

If durability was not usually a prime motive in the use of reinforced concrete, it was a consideration and especially relevant to architectural discussion about reinforced concrete perhaps, insofar as the idea of "permanent" architecture was pervasive.⁷²

The resistance to decay of ferro-concrete also gave it a capacity to take earth and vegetation, demonstrated, for instance, by François Hennebique in the roof gardens of his villa at Bourg-la-Reine (1902),⁷³ but also in the nineteenth century and earlier, in Britain and elsewhere by advocates of concrete roofs.⁷⁴

The facility of reinforced concrete for heavy loading, was mentioned in relation to economy,⁷⁵ and its monolithic character also reduced the effects of vibration, as from machinery; this encouraged its use, not only for warehouses, but factories and goods stations. The monolithicism of reinforced concrete also made it especially capable of taking eccentric and suddenly varying loads, as in silo buildings,⁷⁶ or caused a structure to withstand shocks, or partial demolition;⁷⁷ (the advantage of stability when partially demolished, was also claimed for cast-iron framed buildings, in the 1850s.⁷⁸).

72. Chapters 4, 10.

73. Chapter 10.

74. Chapter 2.

75. See earlier this chapter. S.a: C. & C.E., vol.1, no.5, p.382: Rowntree & Co.'s factory (1906) - for very heavy loads.

76. L.G.Mouchel, Discussion on Reinforced Concrete, op.cit. (45), p.85.

77. E.g., Mouchel, op.cit. (2), 1904, p.53.

78. Cast Iron Buildings - Their Construction and Advantages, N.Y., 1856, written on behalf of James Bogardus, reprint. in: The Origins of Cast Iron Architecture in America, N.Y., 1970.

Both the monolithicism and resistance to decay of reinforced concrete made it useful for buildings with foundations in bad ground, which was an important consideration in its use, for example, for the Quayside warehouse (1899) in Newcastle on Tyne⁷⁹ and in Northwich, for an entirely ferro-concrete Co-operative stores, where there was possible subsidence.⁸⁰

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79. Marsh, op.cit. (5), p.424. Cf: F.E.L.Harris, (architect for Quayside warehouse), J.R.I.B.A., vol.12, 24.12.1904, p.142.
80. Co-operative Stores, Northwich, F.C., vol.2, no.4, (pp.114-6), p.114.

Further Advantages and Disadvantages.

The structural adaptability of reinforced concrete was noted with respect to its economical use for awkward sites. J. Ernest Franck, A.R.I.B.A. (1907) employed reinforced concrete (Kahn's system) for a roof to Hammersmith Public Baths and Washhouses, because of its constructive flexibility over steel to meet his plans, and also as more, "structurally truthful" than encased steelwork.⁸¹ Watson's whisky warehouse in Dundee, included eleven sizes of beams in the first floor and some, "unusual" beams because of troughs in the floor.⁸²

Ferro-concrete was used for a frame and thin, hollow (sound-proof) walls, of a small Organ Chamber (1909) in Alltwen, Pontardawe, South Wales, for the special purpose of its bearing over the graveyard, on ferro-concrete columns, without imposing too much weight.⁸³

E.B. l'Anson (1911) referred to the "tremendous" unsupported spans available with reinforced concrete,⁸⁴ a motive not to the fore, however, in the early buildings.⁸⁵ Victor D. Horsburgh (1907) pointed out how the strength of, "steel and concrete" floors enabled subdivision irrespective of the floor beneath, again not an advantage much taken in the early buildings in Britain, which tended to have simple, repetitive, plans.⁸⁶

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81. J.Ernest Franck, A.R.I.B.A., Test of Reinforced Concrete Roof, J.R.I.B.A., vol.14, 19.10.1907, (pp.702-4), pp.702-3.
82. C. & C.E., vol. 2, no.5, p.388.
83. Current Practice: Organ Chamber, Pontardawe, F.C., vol.1, no.4, Oct., 1909, p.84. S.a: Chapter 10 and Appendix I.
84. E.B.l'Anson, discus. at Surveyors' Institution, C. & C.E., vol.6, no.4, April, 1911, p.303.
85. Rowland Plumbe (1909) used ferro-concrete to cover gymnasium, Y.M.C.A. building, London, where steel would have been impracticable: The Y.M.C.A. Building, London, F.C., vol.3, no.3, Sept., 1911, (pp.82-95), p.91. E. B. l'Anson, discussion at Surveyors' Institution, ib., p.303, refers to use in G.P.O. (where Sir H. Tanner had requested a minimal number of supports from L.G.Mouchel: Chapter 7).
86. Victor D. Horsburgh, On the Influence of the Use of Iron and Steel on Modern Architectural Design, J.R.I.B.A., vol.14, 19.10.1907, (pp.689-701), p.692. Personal studies of individual buildings, e.g. Appendix I.

The ability of a ferro-concrete (or steel) frame to provide a "daylight factory" (with heavy loading capacity) was early taken advantage of⁸⁷ but was not usually a primary motive for its use, for environmental,⁸⁸ (or architectural⁸⁹), reasons, before 1910.⁹⁰

L. G. Mouchel (1905) said that the hygienic characteristics of ferro-concrete (for example, no shelter for rodents) were appreciated in flour mills and other buildings.⁹¹ John Buchanan & Bros. Ltd., for instance, also employed ferro-concrete for three large buildings (1907-12) for their confectionery works in Glasgow⁹² (and in a position where building space was also valuable⁹³).

J. A. Brodie (City Engineer, Liverpool) counted this advantage in his choice of reinforced concrete for tenements (1905) in Liverpool,⁹⁴ but reinforced concrete also had sanitary disadvantages for domestic use.⁹⁵ Sound penetration was also a problem, if single, reinforced concrete panel walls were used, but the organist at Alltwen, D. J. Rees, in his new ferro-concrete Organ Chamber (1909) for example, was delighted with the resonance achieved.⁹⁶

87. Chapter 10 and Appendix I for examples.

88. That is, beneficial to workers.

89. Chapters 4 and 10.

90. E.g: one explicit motive for Greenlees & Co.'s factory, Glasgow, 1910: James B. Wyllie, Ferro-Concrete Warehouse, F.C., vol.3, no.6, Dec., 1911, (pp.179-83). S.a: F.C., vol.2, 1911, p.389.

91. Mouchel, op.cit. (2), 1905, pp.19-20. Cf: E.W.Hudson, J.R.I.B.A., vol.12, 24.12.1904, p.143.

92. See later this chapter, Chapter 10 and Appendix I.

93. William S. Murphy, Captains of Industry, Glasgow, 1901, p.200.

94. Eng. Rec., 28.10.1905, p.486.

95. Kempton Dyson, op.cit. (10), p.162.

96. D.J.Rees, Organist, Alltwen Congregational Church, letter to L.G. Mouchel & Partners, 30.9.1913.

One of the chief disadvantages of reinforced concrete, resulting from its hardness and monolithicism, was the difficulty of alteration and making holes, for example, for pipes and wires, "a great nuisance" in reinforced concrete buildings⁹⁷ - although services were simply strung across the structure in many of the early buildings.⁹⁸

However, perhaps this difficulty encouraged the use of reinforced concrete for such buildings as warehouses, for which the planning requirements were comparatively simple.

Finally, the material presented artistic problems, but these simply had to be resolved by the architects.⁹⁹

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97. W.G.Perkins, D.S., Holborn, discussion at C.I., C. & C.E., vol.6, no. 7, p.509.

98. Photographs of original interiors: See Appendix I for sources.

99. Chapter 10.

Enterprising Clients.

The major clients for reinforced concrete framed buildings in the U.K. (1897-1908) may be roughly divided into four groups in order of the quantity of their reinforced concrete buildings:

- (1) Miscellaneous industrial and commercial companies.
- (2) Co-operative Societies.
- (3) Railway Companies.
- (4) Grain Companies (Excluding the Co-operative Wholesale Society).¹⁰⁰.

The main building types in this period were: warehouses, factory buildings and granaries,¹⁰¹ which accorded with the chief advantages attributed to reinforced concrete - economy (for large buildings), fire-resistance, strength and durability and superior adaptation to vibrating machinery and uneven loading.

However, an examination of the clients for a number of buildings shows that they tended to have a reputation (prior to their adoption, to a greater or lesser extent, of reinforced concrete) for enterprise, dynamicism and innovation, or showed a previous willingness to adopt new processes or materials.

The Co-operative Societies, for example, represented a radical tradition of organising commerce, and the C.W.S. (who built the Quayside warehouse, Newcastle, in 1899 and silos at Dunston (1901)¹⁰²) had a

100. Mouchel-Hennebique Ferro-Concrete - List of Works, op.cit. (25): extrapolated. S.a: Appendix.

101. Ib.

102. Chapter 10 and Appendix I.

Chairman (1895-1915) known for his wide interests - intellectual, social and scientific.¹⁰³ The C.W.S. at this time was energetically expanding its productive activities and in 1906, became one of the largest flour-milling concerns in the world.¹⁰⁴ (It is possible that the International Co-operative Alliance, founded in 1895, with depots in France, may have been a means of contact with Hennebique's construction, since Hennebique himself (not Mouchel) obtained the contract for the first (Quayside) C.W.S. warehouse in the U.K.¹⁰⁵). Economy was obviously a particular motive for Co-operative Societies, but the use of ferro-concrete still entailed risking a material comparatively untried in Britain.

The Unbreakable Pulley & Mill Gearing Co. Ltd., of Manchester, who reconstructed their office and workshops (1908) in ferro-concrete, after a fire,¹⁰⁷ were known for their enterprise, for example, designing the latest kinds of pulleys and bearings.¹⁰⁸

Likewise, John Buchanan & Bros., Ltd., Confectioners of Glasgow (who used Hennebique's system for their buildings, from 1907.¹⁰⁹) had a reputation for particular enterprise, rapid development and the use of modern facilities in production;¹¹⁰ their works (1901) had 1,000 employees (paid the "highest wages" and a profit-related bonus) and a,

"pantomime of machinery".¹¹¹

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103. G.D.H.Cole, A Century of Co-operation, Manchester, 1944; C.W.S. Annual, 1916, Preface, iii.
104. Cole, *ib.*, p.258.
105. *Ib.*
106. Chapter 7.
107. Yorkshire Hennebique Contracting Co. Ltd., Leeds, brochure, n.d., c.1919, not paginated. Mouchel-Hennebique Ferro-Concrete: List of Works, op.cit. (25). S.a: Chapter 10 and Appendix.
108. Trade and Industry, Manchester, vol.4, no.47, (New Series), 31.3.1900, p. 432.
109. Appendix I.
110. Glasgow and its Environs, Lond., 1891, pp.147-8.
111. Murphy, op.cit. (93), pp.200-1.

William S. Murphy drew attention to the inventiveness of Alley & MacLellan Ltd., builders of "portable ships" and parts, who erected a four-storeyed pattern shop in ferro-concrete, in Glasgow in 1905;¹¹² Murphy (1901) said their works (which made use of light railways to convey products between departments) exhibited, "originality and energy".¹¹³

Alley & MacLellan's pattern shop on Hennebique's system (architects, Brand and Lithgow¹¹⁴) perhaps inspired the use of the same construction for Lion Chambers, Glasgow, since it was cited by Salmon, Son & Gillespie (1905), the architects for Lion Chambers, in relation to their proposed plans for this building, in ferro-concrete.¹¹⁵

When William G. Black, F.S.A., Scotland,¹¹⁶ commissioned James Salmon and John Gaff Gillespie to design Lion Chambers, Hope Street, Glasgow, for him, James Salmon had already made a novel, artistic and practical use of iron and steel, for a ten-storeyed, narrow-fronted, office building in Glasgow, dubbed, "The Hatrack".¹¹⁷

W.G.Black was a partner in an established legal firm in Glasgow; he had liberal-political and artistic, interests and was a prolific author on legal, archaeological, and other, subjects;¹¹⁸ Black was elected a lay-member of Glasgow Art Club in 1896, (whose artist-members in 1900 included "avant-garde" artists such as J. McNeil Whistler, Paris, although not James Salmon or John Gaff Gillespie).¹¹⁹

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112. Mouchel-Hennebique Ferro-Concrete: List of Works, op.cit. (25). Abbey (sic) & MacLellan, Glasgow. Notes to: Plans of Proposed Building, 172, Hope Street, op.cit. (64): Allie (sic) & MacLellan.
113. Murphy, op.cit. (93), pp.123-4, 126.
114. Mouchel-Hennebique Ferro-Concrete: List of Works, op.cit. (25).
115. Plans of Proposed Building, 172, Hope Street, op.cit. (64).
116. William George Black, F.S.A., Scot., in: Who's Who in Glasgow in 1909, compiled by George Eyre-Todd, Glasgow and London, 1909, p.19.
117. David Walker, The Partnership of James Salmon and John Gaff Gillespie, in: Alastair Service, ed., Edwardian Architecture and its Origins, 1975, p.240; illust., p.241.
118. William George Black, op.cit. (116). William George Black, card index, National Library of Scotland.
119. Glasgow Art Club. List of Members, 1900, p.24.

From 1899, W. G. Black was associated through marriage with Blackie & Sons, publishers;¹²⁰ Walter Blackie in 1902 had commissioned Hill House in Helensburgh from Charles Rennie Mackintosh,¹²¹ who was a friend of James Salmon, F.R.I.B.A.¹²²

It might be surmised from William George Black's activities, interests, and connections, that he might be open to new ideas, for example in design and construction, and that like the architects he selected,¹²³ he would require an artistic, as well as a practical, ferro-concrete building.

No doubt W.G.Black's status as a Senior Partner in an old Glasgow legal firm, as well as his academic and political reputations,¹²⁴ assisted the project for Lion Chambers to be accepted by the Corporation. Furthermore, the Town Council, and the Glasgow Art Club, had a tradition of amicability between them,¹²⁵ which perhaps indicates that the Council too might be susceptible to accepting new ideas in design and materials.¹²⁶

The client for a slightly later, but unusual, ferro-concrete building in Scotland, a private mansion in Tillycorthie, Aberdeenshire (1912), was James Duncan, a stone-mason who made his fortune in a Bolivian tin mine;¹²⁷

120. William George Black, op.cit. (116).

121. E.g: Nikolaus Pevsner, Studies in Art, Architecture and Design Vol.2: Victorian and After, London, 1968, p.162.

122. Jack Coia, J. Gaff Gillespie's former pupil, from 1916: personal interview, 30.5.1979.

123. See: Chapter 10.

124. See: William George Black, op.cit. (116).

125. E.g: Glasgow Art Club, 1867-1967, n.d., p.19.

126. Cf: Chapter 5 : Corporations and Early Reinforced Concrete Buildings.

127. From Country "Loon" to Mine Magnate, Aberdeen Press & Journal, 4.10.1933.

Duncan selected Hennebique's system for his mansion following a visit to the U.S.A., where "concrete" houses were, "plentiful",¹²⁸ and because,

"if something was new, he must try it." 129

The Directors of the North-Eastern Railway Co. who built two early goods stations/warehouses entirely in ferro-concrete in Newcastle on Tyne,¹³⁰ had earlier (1899) demonstrated a practical interest in another novel building process and a means of protecting timber from decay, invented by Colonel Haskin, when they visited him and placed a large order for Haskinised Wood for works at Dunston on Tyne.¹³¹

The Manchester Ship Canal Co. (1899) used "acres" of Expanded Metal, (only recently introduced for purposes other than lathing¹³²) in floors,¹³³ before adopting Hennebique's system (1902-3).¹³⁴

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128. F.C., vol.4, 1912-13, p.123.

129. J.Taylor, Tillycorthie, formerly Farm Manager (1946-53) to the Duncan family - he knew James Duncan's wife: personal conversation, June, 1979.

130. New Bridge Street and Forth Banks Stations: Appendix I and Chapter 7.

131. Frank Caws, Haskinised Wood, J.R.I.B.A., vol.6, 11.3.1899, (pp.270-4), p.273.

132. See: Chapter 1.

133. B.N., 1.12.1899, p.726.

134. S.a: Chapter 7: A Manchester Failure and Others.

Conclusion.

Some of the early clients for Hennebique's system (mainly industrial and commercial companies) were firms which already had reputations for enterprise and innovation or who were willing to risk new constructions, or individuals, who again evinced particular enterprise, energy and openness to new methods, necessary characteristics, perhaps, in clients who undertook such construction, comparatively untried in Britain, despite the practical advantages claimed for ferro-concrete over other materials, including steel-framing, and which were the chief motives for its use.

The main advantages claimed for reinforced concrete by L.G.Mouchel and other specialists were: fire-resistance, imperishability, strength and monolithicism. The chief motives for which it was used (usually in preference to steel framing) were: fire-resistance and economy of cost and space for heavy duty structures, but other motives were sometimes influential, such as superior structural adaptability and relative freedom from vibration; salubrity was also a consideration for food and confectionery factories.

The economic advantages of reinforced concrete were most apparent in large, heavily loaded, plain, buildings - such as warehouses and granaries - where fire-resistance was also a consideration - and in Britain, these were the kinds of buildings chiefly erected by L. G. Mouchel.¹³⁵

Architects endeavoured to overcome their, "plainness"¹³⁶ but L. G. Mouchel (1904) commented that,

"I have constantly had to bear in mind the necessity of keeping the cost at a minimum, and therefore our works appeal to the observer more from their mass and outline than from their architectural detail",¹³⁷

(suggesting that L.G.Mouchel simplified such detail in order to enhance economy).

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135. See Appendix for further examples.

136. Chapter 10.

137. Mouchel, op.cit. (2), 1904, p.57.

CHAPTER 10: THE ARTISTIC PROBLEMS OF FLATNESS AND CHARACTER.

Introduction.

The Problem of Character.

The Attribute of Plasticity.

The Problem of Flatness.

Classical Articulation and the Imitation of Stone.

"A Field for the Colour-Artist".

In the "Functional Tradition"?

Conclusion.

Introduction.

Chapter 10 considers:

- (1) Certain artistic problems in the use of reinforced concrete perceived by architects in Britain, around 1900 (and similarly identified in France), which may be related to the contemporary architectural ideals discussed in Chapter 4.

- (2) The formal character of buildings constructed entirely in reinforced concrete in Britain between 1897 and 1908, with some comparative examples in France, considered largely as responses to these problems, (remembering that architects, or less often, engineers, not the reinforced concrete specialists, executed the initial and general designs for the early framed buildings); Chapter 11 examines one unique, British example; Lion Chambers in Glasgow.

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The Problem of Character.

In 1911, Sir Henry Tanner, F.R.I.B.A., discussing the question of reinforced concrete in architecture at the Concrete Institute, asserted,

"The great desire is to make the whole building of reinforced concrete including the external walls.....developing some new method of architectural treatment",
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but Sir Henry Tanner himself, in common with a number of other architects, was doubtful whether, especially in towns, anything but stone or brick front elevations could be satisfactory. The use of reinforced concrete at this time posed a number of "artistic problems". These related to the indefinite character of the material, yet its novel formal implications and, in particular, the characteristic "flatness" of the external walls.

Louis Cloquet (1906) noted as the "most characteristic" consequence of the use of reinforced concrete, the, "suppression of the roof", replaced by an inhabitable terrace.² However, flat roofs could be and were happily adapted in a popular classical style. As a framing material, however, reinforced concrete appeared to subvert contemporary notions of architectural character.

Victor D. Horsburgh, A.R.I.B.A. (1907), for example, noted that reinforced concrete obviated the need for the usual disposition of solids and voids; furthermore, its monolithic continuity of structure (which distinguished reinforced concrete from wooden or metal framing), appeared to destroy the structural meaning of lintels, together with associated forms and details - such as capitals.³ M. Rabut (1908) of Paris further pointed out that in reinforced concrete buildings, ceilings

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1. Sir Henry Tanner, The First Presidential Address to the Members of the Concrete Institute, C. & C.E., vol.6, no.12, Dec., 1911, (pp.930-7), p.934.
 2. Professor Louis Cloquet, Belgium, I.C.A., London, 1906, Summary of Proceedings, J.R.I.B.A., vol.13, (pp.i - lxxii), xxviii-xxix.
 3. Victor D. Horsburgh, A.R.I.B.A., On the Influence of the Use of Iron and Steel on Modern Architectural Design, J.R.I.B.A., vol.14, 19.10.1907, (pp.689-701), p.698.

might be placed at different levels on the same floor and cantilevers extended without limit.⁴

In practice, the most significant and unavoidable problems of architectural character in reinforced concrete framed buildings, were the thin proportions of the walls, and their monotonous and sometimes defective surfaces (as we shall see).

A further difficulty in the architectural use of reinforced concrete was its adaptability to the various functions - and to some extent the forms - of different materials, and a related problem, that its proportions in relation to strength were variable, on account of the concealed reinforcement;⁵ (the existence of different systems contributed to an indeterminate character⁶). T. J. Gueritte (1905) observed that reinforced concrete possessed the characteristics of different materials, but was unlike any.⁷ However, it could be, and was in practice, substituted for various materials in their special functions.⁸

Reinforced concrete interior framing generally resembled wooden construction (and L.G.Mouchel suggested colouring beams to represent timber)⁹ and it was occasionally employed in "king-post trusses",¹⁰ but reinforced concrete might be applied instead in latticed girders in imitation of steel,¹¹ while it could also (for example) replace stone cornices; this adaptability, turned, as far as possible, to architectural advantage, resulted in some curious buildings which themselves expressed the characteristics of various materials.

4.M.Rabut, Annales des Ponts et Chaussées, vol.4, July - Aug., 1908, cited in: Le Béton Armé en Architecture, Le Bét. Armé, Dec., 1908, p.164.

5.Bernard E.Jones, ed., Cassells' Reinforced Concrete, London, 1913, p.233.

6.E.Arnaud, Paris, 16.4.1901, Le Bét. Armé, May, 1901, (pp.3-5), p.3.

7.T.J.Gueritte, B.Sc., M.Inst.C.E. (Fr.), Ferro-Concrete Construction, pr. to Edin.Arch.Assoc., 13.12.1905, Trans., vol.5, 1910, (pp.16-28), p.28.

8.Cf: Arnaud, op.cit. (6).

9.L.G.Mouchel, M.Inst.C.E. (Fr.), The Hennebique Ferro-Concrete System, London, 2nd edition, 1905, p.7. Chapter 3.

10.Cf: M.T.Cantell, Reinforced Concrete Construction, Lond., 1912, p.91.

See also: Appendix I: St.Lawrence Wire Rope Works (1909) Newcastle on Tyne.

11.Chapter 3.

However, on account of its "easy" mouldability, some architects considered reinforced concrete a, "docile" material, without visible evidence of the,

"noble struggle between the artisan and matter" 12

which insofar as the quality of effort in a work was perceived as related to its worth, undermined its architectural potential.¹³

In fact, the concrete surface was often covered anyway, and this presented additional problems of character: for example, there were a number of facing materials which might be considered appropriate;¹⁴ if Portland cement rendering were applied, there were problems of indeterminate mouldability¹⁵ and indefinite colour (likely to be both dull and mottled), as well as a problem of cracking.¹⁶

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12. Cloquet, op.cit. (2), xxix.

13. W.R.Lethaby, Some Things To Be Done, pr. to Arch. Assoc., 10.2.1913, Jour. Arch. Assoc., April, 1913, (pp.294-9), p.298.

14. Arnaud, op.cit. (6), p.4.

15. Cf: R. Plumbe, On the Treatment of Portland Cement, Bldr., 24.6.1871, pp. 484-5.

16. E.g: Lethaby, op.cit. (13), p.298.

The Attribute of Plasticity.

Some architects and others believed that certain characteristics of reinforced concrete, notably its mouldability, structural adaptability and continuity of structure and surface,¹⁷ could be "rationally"¹⁸ and artistically embodied in plastic forms (as opposed to forms of "joinery",¹⁹ in imitation of wood or steel frames, or indeed of stone). T. J. Gueritte (1905), lecturing on the subject of ferro-concrete to the Edinburgh Architectural Association, cited as an example of the,

"new, and somewhat undefined as yet, style which such a plastic material requires",²⁰

the reinforced concrete interior of a swimming pool building (in Stockholm²¹) with slightly undulating beams and ceilings, and a strong hint of Art Nouveau, (figure 1), (despite Peter Collins' (1959) assumed incompatibility of reinforced concrete and Art Nouveau, because of the difficulty of making moulds²²).

Edwin Seward (1906), a Cardiff architect, thought reinforced concrete had architectural potential in vertically curved surfaces.²³ Seward had employed Hennebique's system for shop premises in Queen Street, Cardiff, which nearly failed, but for the unexpected capacity of the material to "lean" to its correct position.²⁴

17. Many, later, reinforced concrete examples of "plasticity" were largely precast, however.

18. Chapter 4.

19. Frank Lloyd Wright, in the U.S., advocated: "plasticity not joinery" for reinforced concrete: D. Gifford, ed., The Literature of Architecture, N.Y., 1966, pp.524-5.

20. Gueritte, op.cit. (7), pp.27-8.

21. Mouchel, op.cit. (10), p.90.

22. Peter Collins, Concrete, London, 1959, pp.121-2.

23. Edwin Seward, Cardiff, I.C.A., London, 1906, Trans., London, 1908, p.251.

24. Described in Chapter 7.

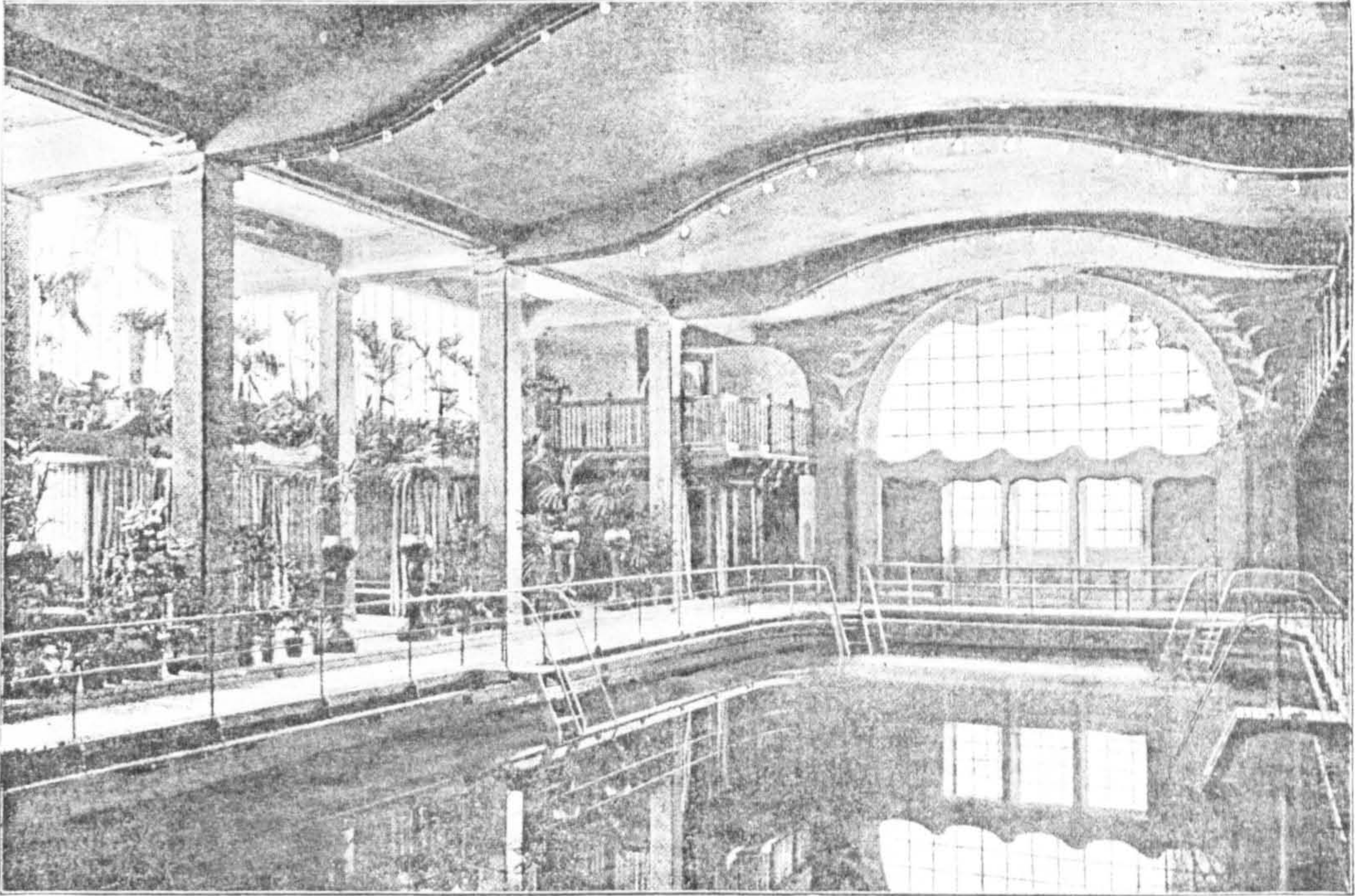


Figure 1: Swimming Bath Stockholm.

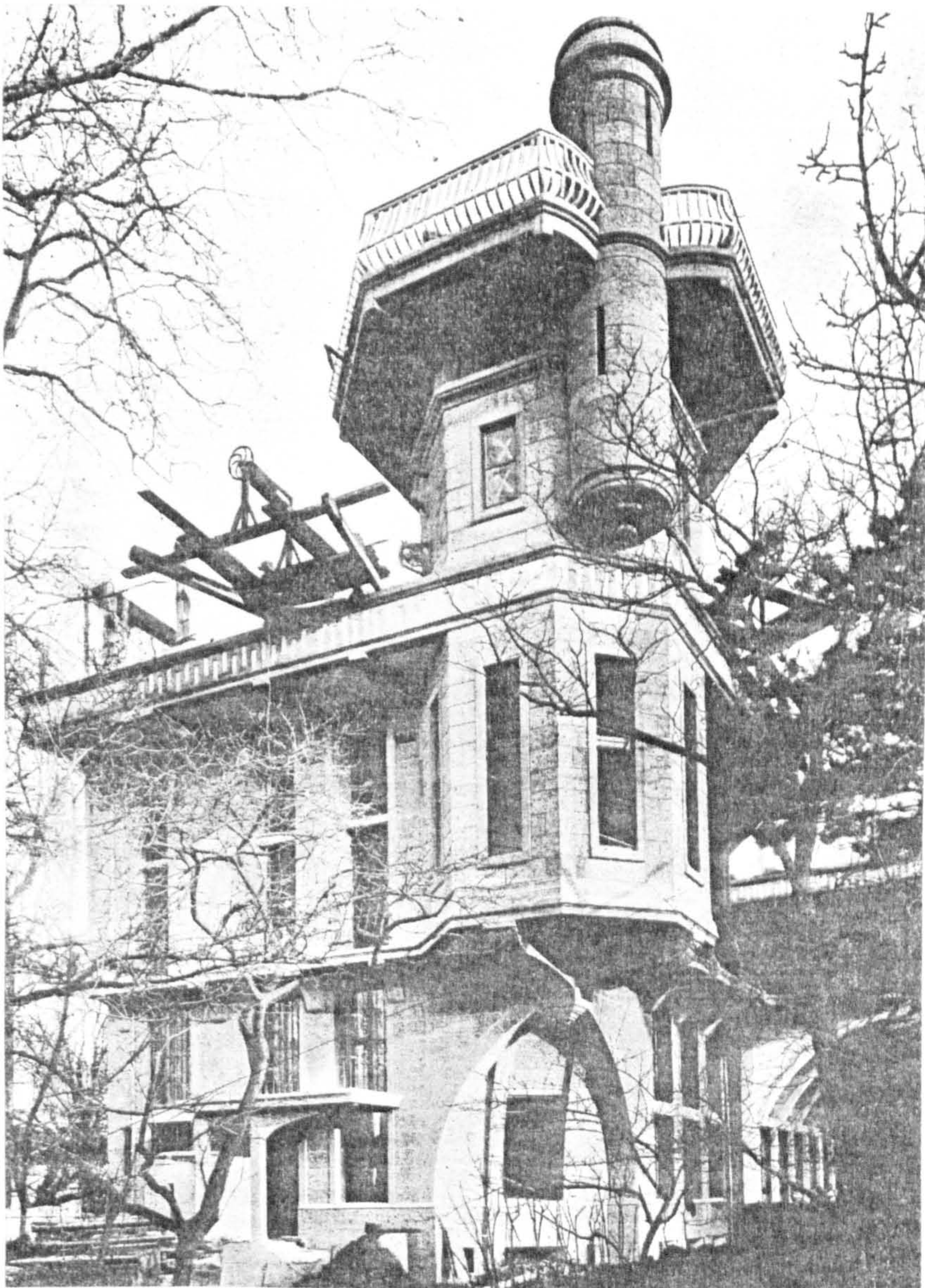


Figure 2: Villa Bourg-la-Reine.

W. R. Lethaby (1913), a little later, envisaged as appropriate to "concrete" - or reinforced concrete²⁵ - construction, large, rounded forms and smooth surfaces:

"colossal pottery".

26

Lethaby's image derives from a non-architectural "plastic" source, (which with implications of a certain, functional, visual regularity does not tend to suggest Art Nouveau forms) and it is also, perhaps unconsciously, a reference to hand-work (to which Lethaby attached a moral and aesthetic significance).

W. R. Lethaby considered concrete surfaces should always be veneered with other materials, otherwise the problem of cracks in the rendering destroyed pleasure in,

"a fabric which should be continuous as a china vase"

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(and he confounded critics of the "falsity" of veneers by asking whether one assumed, for example, that a carpeted floor was solid carpet²⁸).

L. G. Mouchel (1904) advocated the formal adaptability of reinforced concrete as one of its characteristic aesthetic advantages, but in particular its facility for moulded ornamentation,²⁹ and not necessarily plastic in form. In fact, reinforced concrete was unsuited to the fine (or, "refined"³⁰) detail generally preferred - as Lethaby acknowledged³¹ - and where detailed ornamentation was employed, as in L.G.Mouchel's own cited example - the interior of a theatre in Lille - it

25. Lethaby is concerned with: "the most modern forms of construction in steel and concrete", op. cit. (13), p.298.

26. Ib.

27. Ib.

28. Ib., p.299.

29. L.G. Mouchel, Monolithic Constructions in Hennebique's Ferro-Concrete, pr. to R.I.B.A., 21.11.1904, J.R.I.B.A., vol.12, 26.11.1904, (pp.47-61), pp.57, 59.

30. H. Heathcote Statham, Modern Architecture, London, 1897, p.271.

31. Lethaby, op.cit. (13), p.298.

was only roughly cast in ferro-concrete and completed with plaster.³²

H. Wilson's and W. R. Lethaby's and others' unexecuted competition design (1902) for Liverpool Cathedral, included an undulating, vaulted "concrete" roof (apparently not reinforced),³³ cumulatively plastic or moulded in effect and a compromise, perhaps, between, "colossal pottery" and Art Nouveau, the latter quite possibly H. Wilson's influence.³⁴

At about the same time, in France, François Hennebique's personal villa (1902) at Bourg-la-Reine³⁵ (which he appears to have designed himself³⁶) was partly a (slightly awkward) attempt to demonstrate the monolithicism and plasticity of reinforced concrete and (in illustration) a prominent corner turret with a staircase "folded" into its outer face, has a certain organic, even Expressionist, vigour, (figure 2).³⁷ The shape of the villa resulted largely from planning and not aesthetic, nor advertising, considerations, and the interior, designed to accommodate three - four households, was planned at each level to meet family preferences.³⁸ The corner turret resulted from a wish to include an additional room for the first floor "ménage" over some old tracks which had to be conserved at ground floor level³⁹ - but the positioning of the exterior staircase was an, "engineer's whim"⁴⁰ (presumably, Hennebique's).

32. Mouchel, op.cit. (10), p.82.

33. Illust: G.Rubens, William Lethaby's Buildings, in: A Service, ed., Edwardian Architecture and its Origins, Lond., 1975, pp.140-1.

34. Other designs by H. Wilson suggest Art Nouveau, e.g: interior, Welbeck Abbey, illust: A.R., vol.1, p.320.

35. Villa a Bourg-la-Reine, Relevé de Travaux Executés, Année 1902, Bétons Armés Système Hennebique, Paris, p.10, fig.2. The villa was almost finished by 1902, although Collins, op.cit. (22), p.73, incorrectly says work started in 1904.

36. E.g: La Villa en Ciment Armé de Bourg-la-Reine, Le Bét. Armé, Jan., 1905, p.10.

37. This illustration was reproduced in: Charles Marsh, Reinforced Concrete, Lond., 1904, frontispiece. Visit to Paris, C.I.Trans. & Notes, vol.2, pt.2, xlv, shows scale of building. Collins, op.cit.(22), Pls.17,18, show other views.

38. La Villa en Ciment Armé de Bourg-la-Reine, Le Bét.Armé, Dec., 1904, pp.284-5. La Villa en Ciment Armé, op.cit. (36), p.6. Collins, op.cit. (22), p.73, perhaps overemphasises the "demonstration" of reinforced concrete.

39. La Villa en Ciment Armé, op.cit. (36), p.7.

40. Ib.

There are occasional examples of plasticity in reinforced concrete in Britain in this period, but none like Hennebique's, nor examples of curvilinear Art Nouveau (although Lion Chambers (1904-7) in Glasgow had some association with aspects of "Glasgow Art Nouveau"). Parts of the interior of a mill and granary (1902) designed by F.E.L.Harris for the Cooperative Wholesale Society at Dunston on Tyne, for example, have some near-plastic arches (terminated with "classical" features: figure 3) - but the parabolic roof arches of a reinforced concrete factory (1902) in Stockholm (figure 4) for instance, are a more dramatic example.

If formwork costs and difficulties, in practice, might tend to discourage curvilinear forms⁴¹ and if reinforced concrete was most economical for, "plain structures",⁴² it is also noteworthy that architects' designs for reinforced concrete facades which adopted classical articulation and imitated stone, were also uneconomical, and indeed, "architectural detail" for such buildings had to be minimised or simplified for economy by L. G. Mouchel.⁴³

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41. E.g: Collins, op.cit. (22), pp.121-2.

42. Discussed in Chapter 9.

43. Ib.

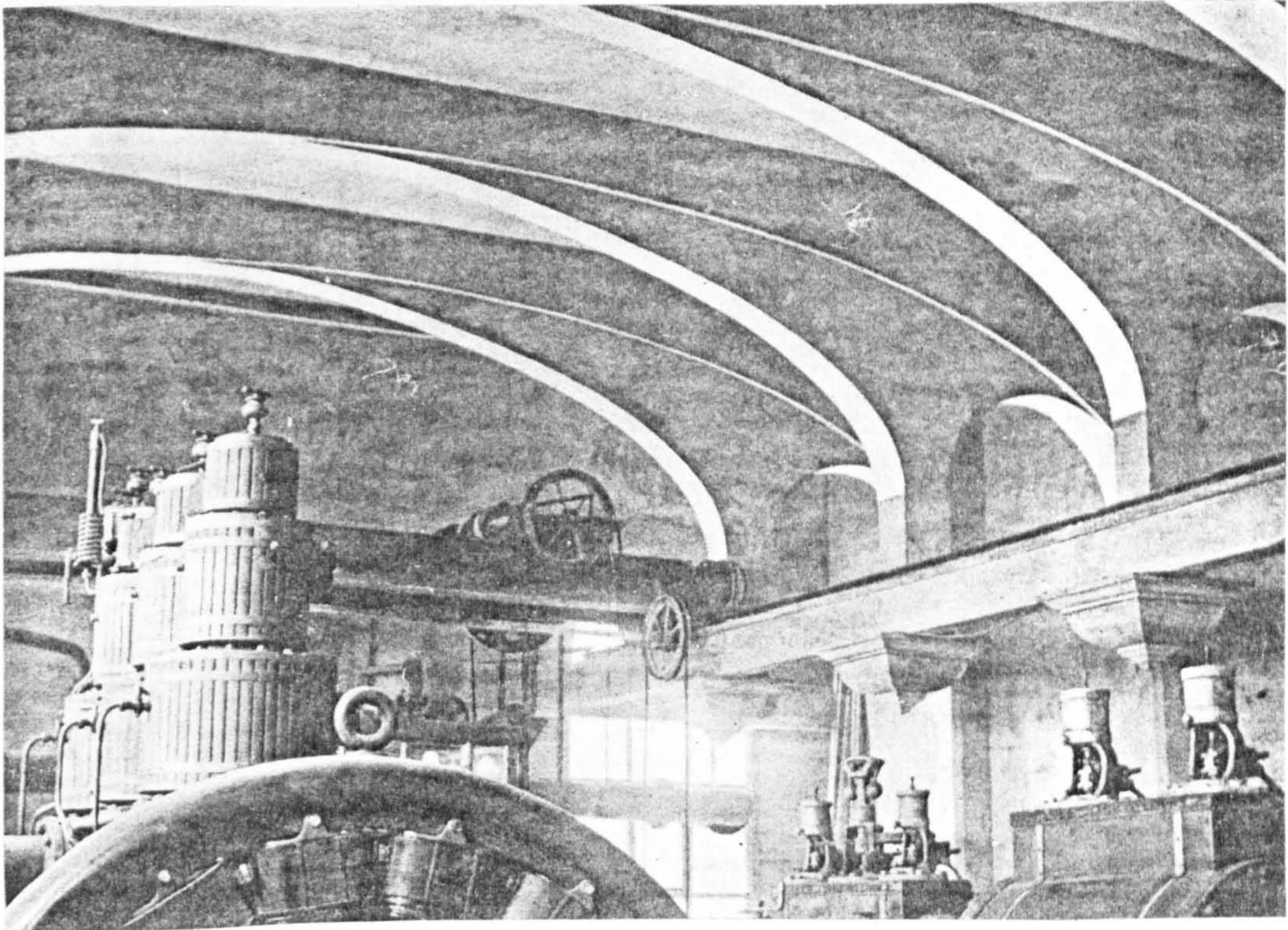


Figure 3: Grain Silos and Cleaning House Dunston:
machine-room.

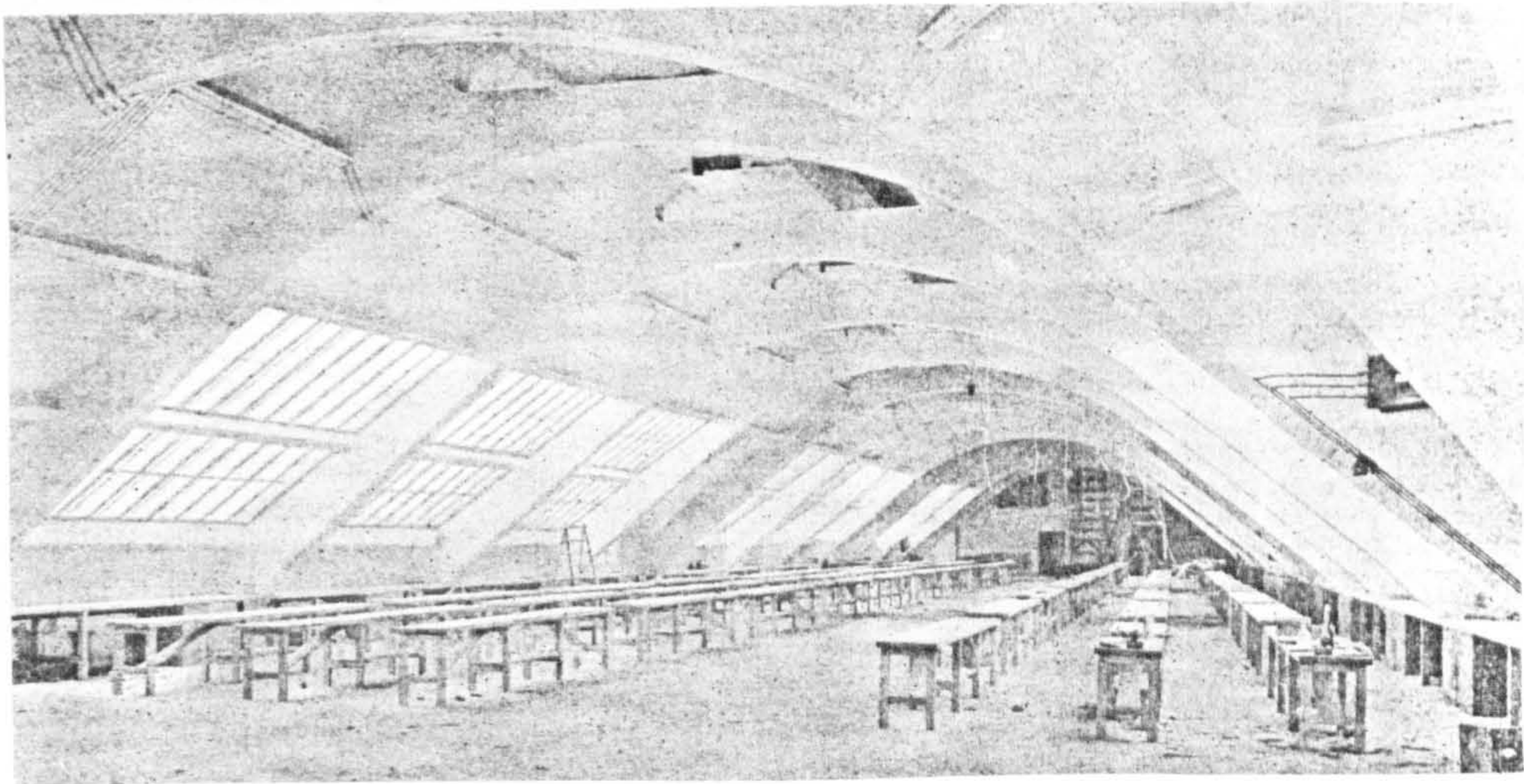


Figure 4: Factory Stockholm.

The Problem of Flatness.

Despite the attribute of "mouldability", the central artistic problem in the use of reinforced concrete framed construction, for many architects, emerged as the thinness, and consequent flatness, of the exterior, panel walls, without relief or shadows, and in the context of a general architectural preference for "solidity", and sculptural features (whether, for example, in "Renaissance" styling, or "Arts and Crafts" architecture).⁴⁴ Where the reinforced concrete frame was expressed in the facade, there was again an unaccustomed slightness of proportion,⁴⁵ (metal frames, for instance, being chiefly used in the interiors of buildings).

The insubstantiality of reinforced concrete facades was early identified as an architectural problem by Edouard Arnaud, in France, who, in 1901, discussed his problems in designing François Hennebique's offices (1898-9⁴⁶) at 1, rue Danton, Paris,⁴⁷ intended by Hennebique to represent an exemplar of architecture in ferro-concrete. Much in Arnaud's elevation (he said), such as the bow-windows, was guided by an attempt to give depth and variety to the reinforced concrete facade.⁴⁸

L. G. Mouchel (1904), in a lecture to the R.I.B.A., cited Arnaud's offices as an example of the formal adaptability of reinforced concrete,⁴⁹

44. Cf: Chapter 4.

45. E.g: C.Howard Walker, The Artistic Expression of Steel and Concrete, pr. to American Institute Architects, Nov., 1907, B.J., vol.27, 1.1.1908, (pp.18-21), p.19.

46. Chapter 6.

47. Elevation and Ground Floor Plan: Maison d'Habitation, 1, Rue Danton, Relevé de Travaux Executés, Bétons Armés Système Hennebique, 1898-1902, p.18, figs. 8-9. Own photographs. Illust. also in: Collins, op.cit.(22), Pl. 15.

48. Arnaud, op.cit. (6), p.4.

49. Mouchel, op.cit. (29), p.57, cont. on p.59.

although Arnaud said he had had to keep to straight lines or, "well-determined curves" easily marked out for formwork;⁵⁰ (the resulting design has a certain plasticity - but no more than was achieved in stone⁵¹).

Auguste Perret may well have decided upon the unusual plan for his well-known early reinforced concrete framed apartments (1902 - 3) in rue Franklin, Paris,⁵² as a result of reading E. Arnaud's account (1901) in Le Béton Armé (Hennebique's journal with which Perret may have had a connection⁵³), projecting the tiers of bay windows as a means of giving expression - and depth - to a thin, reinforced concrete facade and thus arriving at the idea for his plan with projecting wings and a regulation light well in the front, instead of the usual position, behind, the building.⁵⁴ At the same time, Perret incorporated a lightness of construction in his design, which L. G. Mouchel (1905) for example, advocated as an aesthetic advantage of reinforced concrete.⁵⁵

The only parts of Tony Garnier's architectural project for an Industrial City in Reinforced Concrete characterised by exceptionally, (even impossibly⁵⁶), light proportions, however, with curtain walls and adumbrated slender, mushroom columns, may not have been designed in this

50. Arnaud, op.cit.(6), p.4.

51. Cf: local designs (Paris): own photographs.

52. Illust: e.g: Jacques Roederer and Rob. Mallet Stevens, Notes From Paris. Block of Flats, No. 25A Rue Franklin, A.R., vol.23, 1908, (pp.254-7), p.257. Collins, op.cit. (22), Pls . 50-1. Own photographs.

53. Discussed in Chapter 6.

54. A contemporary study of low-cost sanitary housing in Paris, in progress several years, in 1906 recommended reinforced concrete framed construction with open courts in front: A. Augustin Rey, Les Constructions en Acier et en Ciment Armé, I.C.A., London, 1906, Trans., London, 1908, (pp.188-204), pp.191 - 2.

55. Mouchel, op.cit. (10), Introd., p.1.

56. Dr. Dora Wiebenson, Tony Garnier: La Cité Industrielle, radio prog. no. 5, course A305, Open Univ, 1975.

period, in 1901 - 4, (as generally assumed⁵⁷), but, as D. Wiebenson (1960) suggests, between then and 1917⁵⁸, and, since Garnier adopted existing constructions in his project, should perhaps be dated after the first application in Europe of mushroom columns (1910).⁵⁹

In a R.I.B.A. discussion (1904) on reinforced concrete, S. Perkins Pick, F.R.I.B.A.'s opinion, relating to its inartistic results in buildings, would appear to refer to designs such as A. Perret's, rather than anything in Britain,

"the hanging up, as it were, to the clouds of great oriel and bay windows and balconies and over-hanging awnings, and the thinness of the construction generally, was altogether destructive of good architecture". 60

Philip H. Palmer, M. Inst. C.E. (1905) in Britain similarly observed that some reinforced concrete works erected abroad appeared to him (an engineer), "absurdly light",⁶¹ while in his Presidential Opening Address (1908) to the R.I.B.A., Ernest George asked whether, in using ferro-concrete, architects should be satisfied without an apparent thickness, light and shadow; he was,

"not anxious to anticipate so violent a change" 62

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57. E.g: S. Giedion, Space, Time and Architecture, Camb., Mass., 5th edn., 1967, p.332. A. Raafat, Reinforced Concrete in Architecture, N.Y., 1958, p.44.
58. Dora Wiebenson, Utopian Aspects of Tony Garnier's Cité Industrielle, J.S.A.H., vol.19, no.1, March, 1960, (pp.16-24), p.22, n.38.
59. *Ib.*, p.21, and Chapter 3.
60. S.Perkins Pick, F.R.I.B.A., Discussion on Reinforced Concrete, 5.12.1904, J.R.I.B.A., vol.12, 10.12.1904, p.94.
61. Philip H. Palmer, M.Inst.C.E., Armoured or Reinforced Concrete, Incorp. Assoc. Munic. & Co. Engrs., vol.31, 1905, (pp.343-55), p.351.
62. Ernest George, President, The Opening Address, 2.11.1908, J.R.I.B.A., vol.16, 7.11.1908, p.5.

(and G. Trelat of Paris at the International Congress of Architects (1906) suggested using sandstone with reinforced concrete, to provide substance and solidity, "of a nature to assure beauty".⁶³)

Sir Aston Webb, F.R.I.B.A. (1911), who had himself employed Hennebique's system for a factory (1904) in Liverpool,⁶⁴ believed that if reinforced concrete must eventually be visible in street facades, it should by some means be given,

"that architectural character of solidity and permanence without which no architecture can be satisfactory to the eye". 65

F.E.L. Harris, A.R.I.B.A. (1906) who again had designed buildings entirely on Hennebique's system, found the flatness of the material, "objectionable" without applying an uneconomical excess of material,⁶⁶ while E.O.Sachs (1906) agreed that the problem was,

"how to deal with these large flat surfaces". 67

Harris (1904) indeed, concluded that ferro-concrete was undesirable for,

"city streets....domestic work or in elevations which need great architectural expression..Thin concrete walls, stucco-finished, will not, I feel sure, commend themselves to the majority of architects ". 68

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63. Gaston Trelat, Paris, Reinforced Concrete at the International Congress of Architects, C. & C.E., vol.1, no.4, Sept., 1906, p.291.

64. See Appendix I.

65. Sir Aston Webb, F.R.I.B.A., Discussion of Sir Henry Tanner's Paper, 2.1.1911, J.R.I.B.A., vol.18, 7.1.1911, p.171.

66. F.E.Harris, Manchester, I.C.A., London, 1906, Trans., London, 1908, p.246. S.a: later this chapter.

67. E.O. Sachs, ib.

68. F.E.L. Harris, Manchester, Notes, Queries and Replies, J.R.I.B.A., vol.12, 24.12.1904, p.142.

Classical Articulation and the Imitation of Stone.

Some architects therefore believed that the only architectural value of reinforced concrete lay in what it could achieve as a skeleton, rather than as a visible architectural material⁶⁹, and this achievement in practice was frequently limited to supporting fireproof floors and stone external walls with "Renaissance" arches built up against the frame.

The Royal Liver building (1907 - 11), Liverpool, designed by W. Aubrey Thomas for the Royal Liver Friendly Society, used reinforced concrete framing for the tallest office block in Britain,⁷⁰ but the frame (originally intended to be steel⁷¹), was concealed behind 14" granite curtain walls,⁷² (figure 5), thus,

"permitting the realisation of appropriate architectural forms".⁷³

Architects who, for practical motives, adopted reinforced concrete for the external walls, as well as frame, of their buildings, endeavoured to give their elevations an identifiable architectural character, and to counteract the flat and uneven quality of rendered surfaces (which were necessary on account of economy), by means of classical articulation and details imitating stone construction (themselves derived from timber construction). They ignored the monolithic character of reinforced concrete and usually the possibilities of framing in varying the usual dispositions of solids and voids.

69. Cf: Henry S. Hill, The Influence on Architecture of Modern Methods of Construction, J.R.I.B.A., vol.16, 25.9.1909, (pp.705,ff.), p.706.

70. First skyscraper in Britain: Editorial Notes, F.C., vol.1, no.1, July, 1909, p.6. Cf: Jones, op.cit. (5), pp.329-30.

71. Royal Liver Building Liverpool, B.J., 5.6.1907, p.286.

72. E.g: Albert Lakeman, The Royal Liver Building, Liverpool, C. & C.E., vol.6, no.10, (pp.727-35), p.735.

73. Royal Liver Building Liverpool, F.C., vol.1, no.5, Nov., 1909, (pp.91-4), p.94.

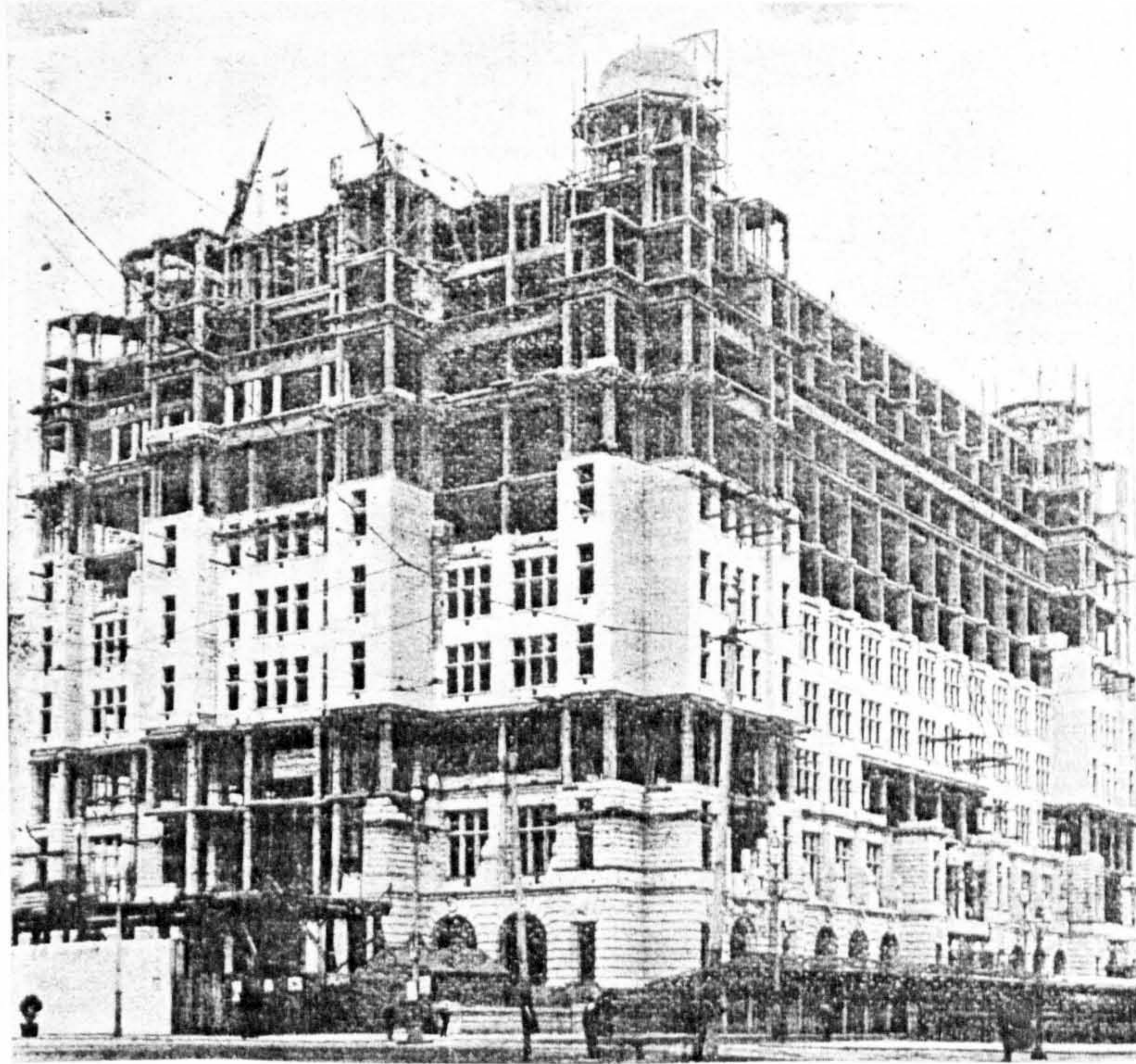


Figure 5: The Royal Liver Building Liverpool
under construction.

Perhaps the original designation - and architectural use - of concrete as artificial stone encouraged this association, but there was an aesthetic preference for stone and for "Renaissance" styling, and some efforts were made to disguise the thin proportions.

The first such "classical" example in Britain was the entirely reinforced concrete eight-storeyed "Quayside" warehouse (1899-1901) in Newcastle on Tyne, (figure 6) designed for the Cooperative Wholesale Society by their Architect, F.E.L.Harris, A.R.I.B.A., at the C.W.S. Architects' Department, in Manchester,⁷⁴

The external walls were 4" thick at roof level, and at the ground floor, 12"⁷⁵ - rather thicker here than usual in "Hennebique" buildings, no doubt because the lower floors were designed as a cold storage area⁷⁶ - but not thick enough, perhaps, to justify the massive, rusticated arches of the street elevations, the "heavy" corners and wide pilasters: the real thinness or flatness of the reinforced concrete facade, (figure 7) is apparent, standing near the building.

Classical detail and again, large, classical proportions are also represented in a heavy reinforced concrete cornice cast with dentils, ^{consols} and a large, curved, pediment in front of the flat roof, (breaking the skyline in "1900" fashion).⁷⁷

In a recent short paper (1976) on the history of concrete and reinforced concrete in North-Eastern England, D.G.McBeth and A.M. Garratt commented that the shuttering for the Quayside warehouse must have been,

74. Mouchel-Hennebique Ferro-Concrete. List of Works Executed in the U.K., 1897-1919, p.17. Percy Redfern, The Story of the C.W.S. The Jubilee History of the Cooperative Wholesale Society Ltd., 1863-1913, Manchester, 1913, p.325. S.a: Appendix I.

75. Marsh, op.cit. (37), p.425.

76. Relevé de Travaux Executés - Bétons Armés Système Hennebique, Liste, Année, 1901, p.52, fig. 22.

77. An additional storey was added behind the pediment in 1910: Test of Ferro-Concrete Works: Quayside Warehouse, Newcastle on Tyne, F.C., vol.1, no. 10, April, 1910, pp.220 - 1. Hennebique Factors of Safety, F.C., vol.3, no.10, p.300.



Figure 6: Quayside Warehouse Newcastle on Tyne.

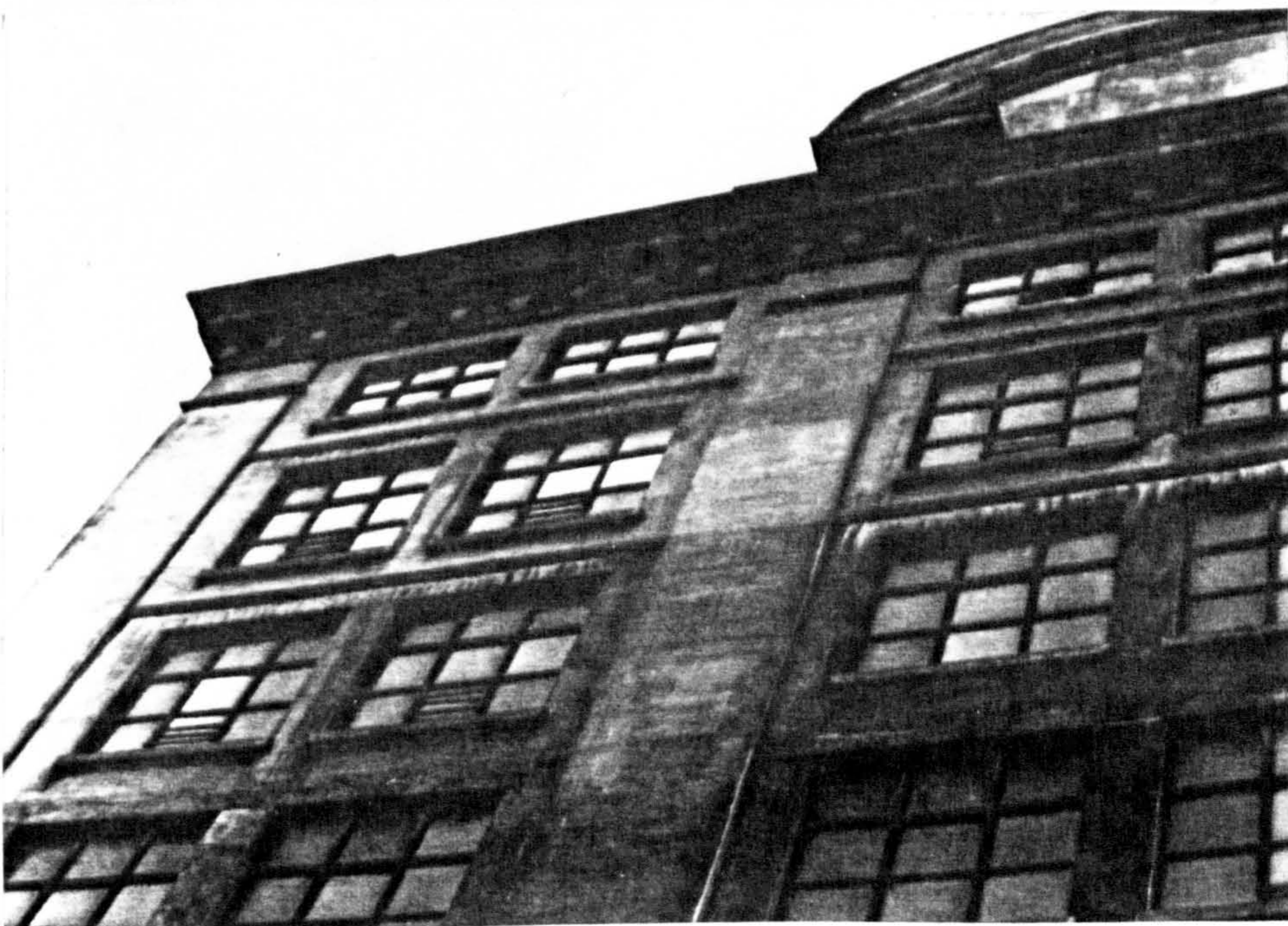


Figure 7: Quayside Warehouse Newcastle: detail.

"very complex",⁷⁸ and perhaps, as the first example of Hennebique's system in the North of England, this building was allowed to be less economical for the constructors than subsequent commissions, (just as Weaver's Mill (1897) Swansea, South Wales, was carefully erected to the designs of a well-known local architect, with superior - and imported - materials, but at a very low cost to the clients⁷⁹).

Flexible planning was not generally cited, at least in Britain, as an architectural advantage of reinforced concrete framing - although the constructive adaptability of reinforced concrete to otherwise awkward plans was sometimes the motive for its use. The interior of the Quayside warehouse, typically, consists of large storage areas, with each floor similar in plan. Neither is there any classical or other "architectural" detailing here, industrial interiors being less considered as architectural subjects, at this time, than exteriors.

The general effect of the exterior design of the Quayside warehouse has a certain force and unity and is not unsuccessful, but especially perhaps, in illustration, where the surfaces are not clearly apparent and which, after a short time, are likely to have suffered from the defects to which architects drew attention. Photographs of the newly built Quayside warehouse were admired in Paris, where they were sent for exhibition at François Hennebique's Congress of Béton Armé (1902).⁸⁰

A group of three, entirely reinforced concrete, "classical" industrial buildings again for the Cooperative Wholesale Society, at Dunston on Tyne, designed between 1901 - 7, by F.E.L. Harris, and by L.G. Ekins, F.R.I.B.A., are first remarked, perhaps, on account of their uniform yellow-grey colour. Charles F. Marsh, Assoc. M. Inst. C. E. (1904), mentions a common practice

78. D.G.McBeth and A.M.Garratt, Historic Concrete Construction in the North East, Mag. Tyneside Industrial Archaeol. Group, May, 1976, (pp.1-5), p.3.

79. Discussed in Chapter 6.

80. Le Béton Armé, Feb., 1902, (pp.119-22), p.120.

of tinting facing mortar for reinforced concrete work, to avoid a patchy appearance, the most usual colours employed being yellow and black.⁸¹

The first of these buildings erected was a mill and granary (1901-2) designed by F.E.L.Harris,⁸² followed by some "circular" silos (1906-8),⁸³ and a soap factory, (1907-9, extended between 1911-16⁸⁴), both by L.G.Ekins, who had gone to Newcastle from the Architects' office at Manchester, to take charge of the Society's local work.⁸⁵

Possibly the formwork for F.E.L. Harris's mill, (figure 8) suffered greater economies than that for his Quayside warehouse, (although it too must have been fairly complex), since the executed building was characterised by coarser detailing, (figure 9). L. G. Mouchel (1904) implied that architectural detail had been simplified for economy in British industrial buildings to date.⁸⁶

In the elevations to the mill, F. E. L. Harris projected the reinforced concrete frame from the outer walls, creating pilasters, with "rusticated" bases: in this way, perhaps, Harris again intended to counteract the flatness of reinforced concrete construction, which he noted as a problem. Harris also intended that all these piers should be 2' 3" wide,⁸⁷ but this dimension may not have been retained,⁸⁸ since the

81. Marsh, op.cit. (37), p.204.

82. Mouchel-Hennebique Ferro-Concrete, op.cit. (74), p.49. Appendix I.

83. *Ib.*, p.50. Appendix I.

84. *Ib.*, pp.33, 38, 41-2. Appendix I.

85. Redfern, op.cit. (74), p.325.

86. Discussed in Chapter 9.

87. C.W.S. Flour Mill. Dunston on Tyne. End Elevation, signed, F.E.L. Harris, A.R.I.B.A., Architect, 1, Balloon Street, Manchester, 11.3.1902.

88. *Ib.*: not quite as executed; own photographs. (Mill demolished, since I saw it (1977): Appendix I.)

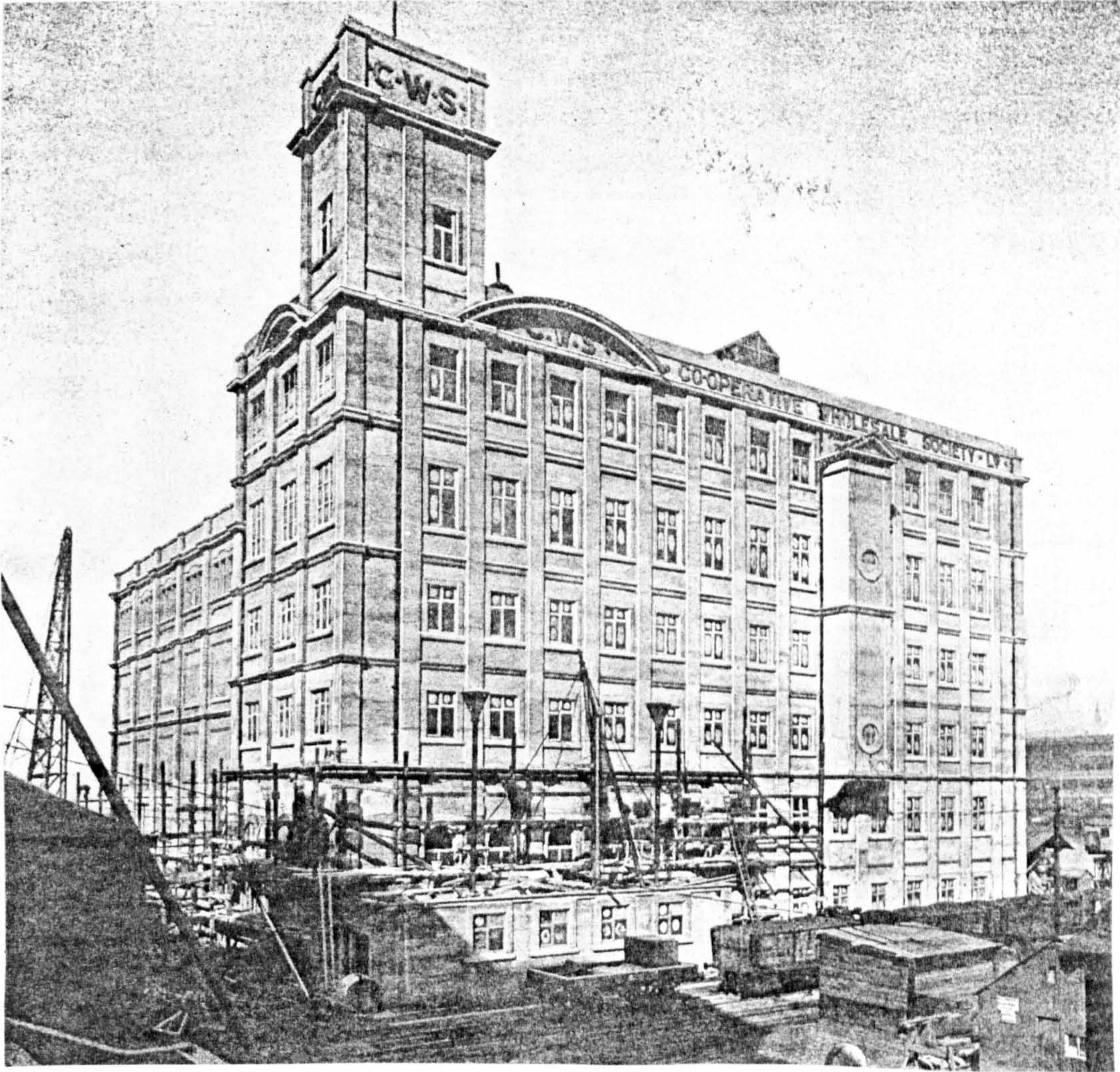


Figure 8: Grain Silos and Cleaning House Dunston.



Figure 9: Grain Silos and Cleaning House Dunston: detail.

close-spaced pilasters, if they do - rather baldly - articulate the facade, also make apparent the thin proportions of the frame, (which has the appearance of extended wooden construction).

F.E.L. Harris's drawings (1902) also show that a cleaning tower built at one corner of the building was a late addition and that the existing design was not modified to take account of it.⁸⁹

The final effect of the mill exterior, therefore, was somewhat ill-balanced and with coarse detailing - although the interiors were light, regular and pleasant. L. G. Mouchel (1904) however, considered this building a "handsome" example of its kind.⁹⁰

L. G. Ekins' two buildings at Dunston, on the other hand, appeared positively successful, if curious, classical renderings of reinforced concrete, and indeed, Percy Redfern (1913), in his history of the C.W.S., described the soap factory, (figure 10) as,

"an unusually attractive works building". 91

Like Harris's mill (1902), the soap factory, either deliberately or unavoidably, did not quite contradict the lightness of reinforced concrete construction, and again has some resemblance to wooden framing, while it also contained imitations of stone construction (as usually employed). The elevations include a broad string-course and cornice and moulded keystones to arched windows, (all in reinforced concrete).

89. C.W.S. Flour Mill, op.cit. (87). C.W.S. Flour Mill, Dunston on Tyne. Front Elevation, n.d., but accompanying End Elevation, dated, 11.3.1902. Hennebique Ferro-Concrete. Theory and Practice, London, 4th edition, 1921, p.224.

90. Mouchel, op.cit. (29), p.59.

91. Redfern, op.cit. (74), p.243.

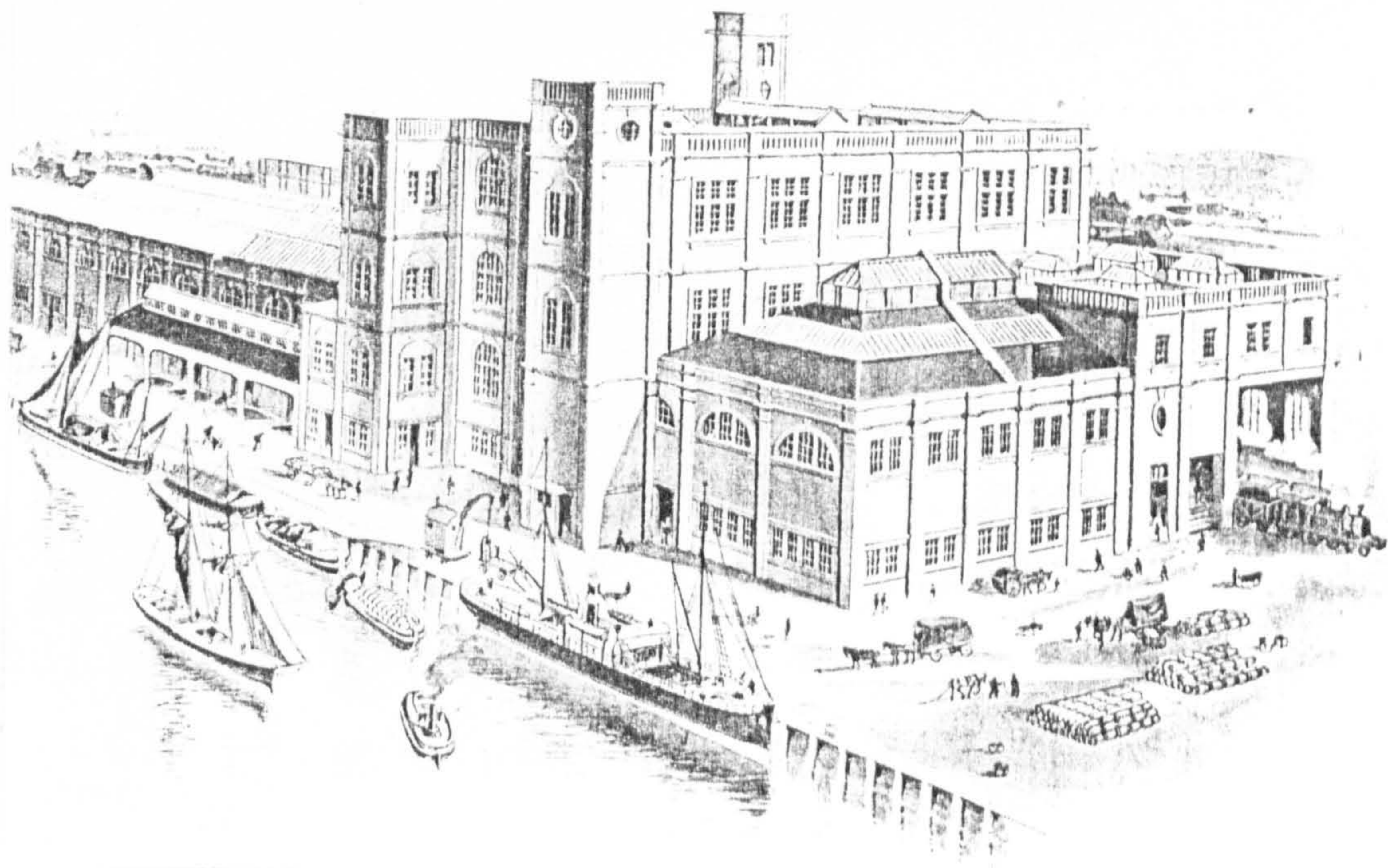


Figure 10: Soap factory Dunston: View from river.

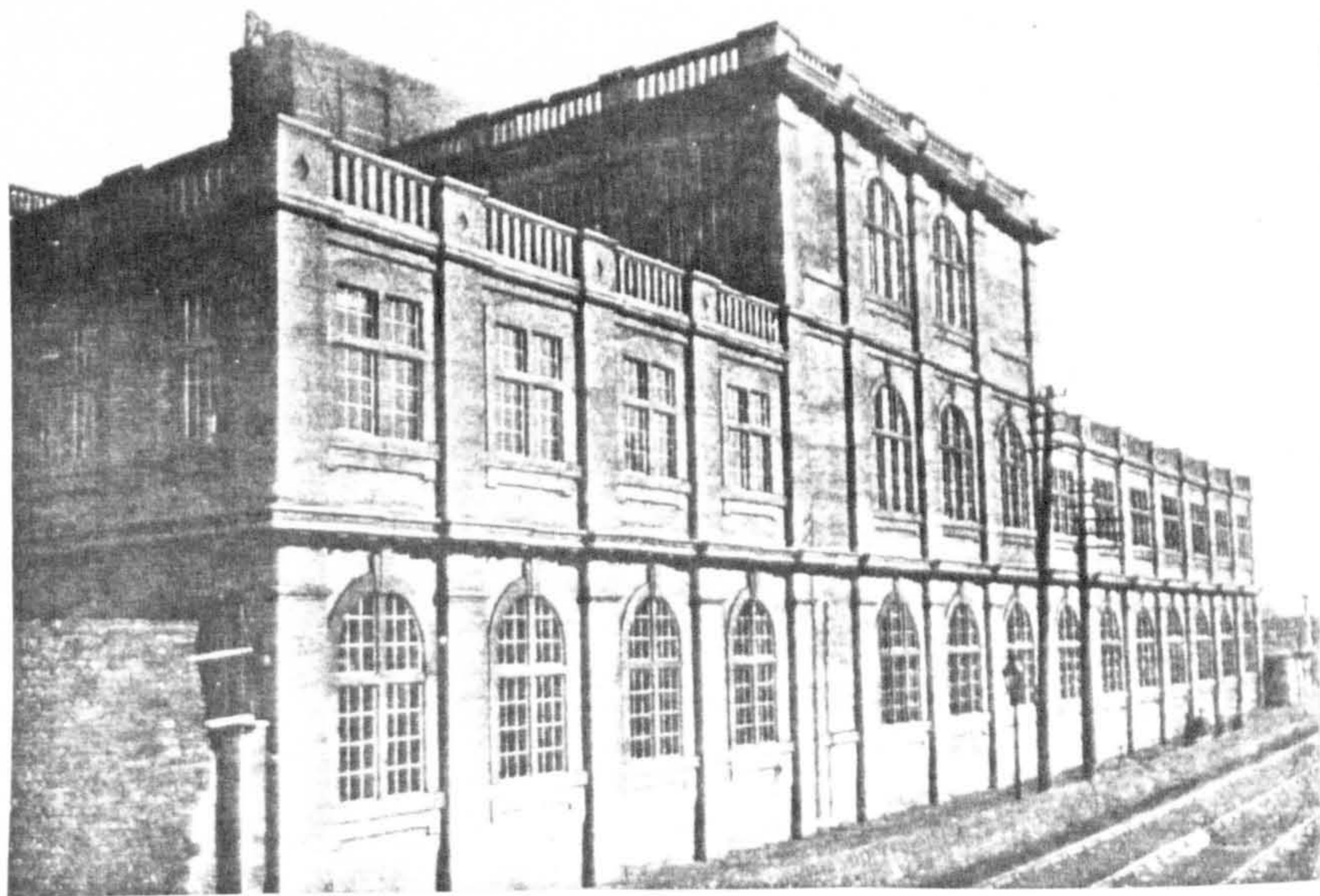


Figure 11: Soap factory Dunston: from Flour Mill Road.

Arched windows, between pilasters (the frame) articulated the main facade with a "colosseum" motif, alternated with lines of rectangular windows, with flat, curved heads, (figures 11 and 12). L.G.Ekins employed flat, decoratively shaped (reinforced concrete) window frames for both buildings, (not unlike those designed by F.E.L. Harris for the south elevation of his mill⁹²): the upper windows of the granary, (figure 13) had semicircular heads, ornamented with a "punched" diamond motif, which reappears in the elevations of the soap factory.

Such broad frames were later (1913) recommended as an architectural possibility in reinforced concrete work on account of the shallow reveals obtained,⁹³ but semicircular arches were condemned by Concrete and Constructional Engineering (1909), which observed,

"many things are possible in reinforced concrete that are not consonant with the spirit of the material, and amongst these are semi-circular arches. If arched forms are used at all they should be of very flat curvature ", 94

a comment perhaps applicable to decorative, as well as "structural" arches.

L.G.Ekins elaborated the flat roofline of the soap factory, (the "suppression of the roof" being noted as a prominent characteristic of the new construction), with a conspicuous cornice and dentils - in reinforced concrete - and parapets decorated with a diamond motif.

The semicircular silos of L.G.Ekins' granary, rounded, without any window reveals, resulted here in a certain substantiality of appearance.

92. C.W.S. Flour Mill, op.cit. (87).

93. Jones, op.cit. (5), p.234.

94. Editorial Notes, C. & C.E., vol.3, no.6, Jan., 1909, p.431.

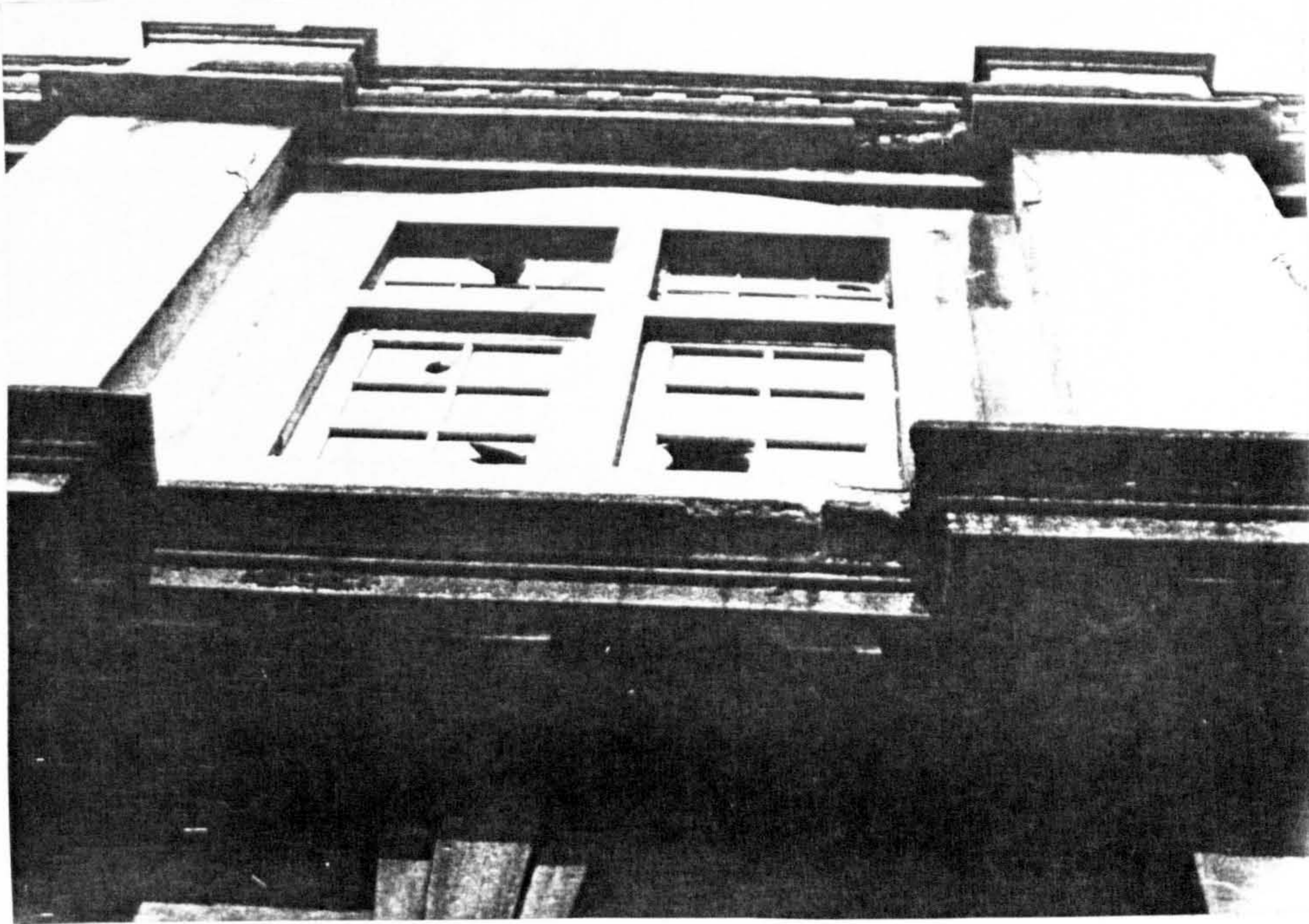


Figure 12: Soap factory Dunston: detail.

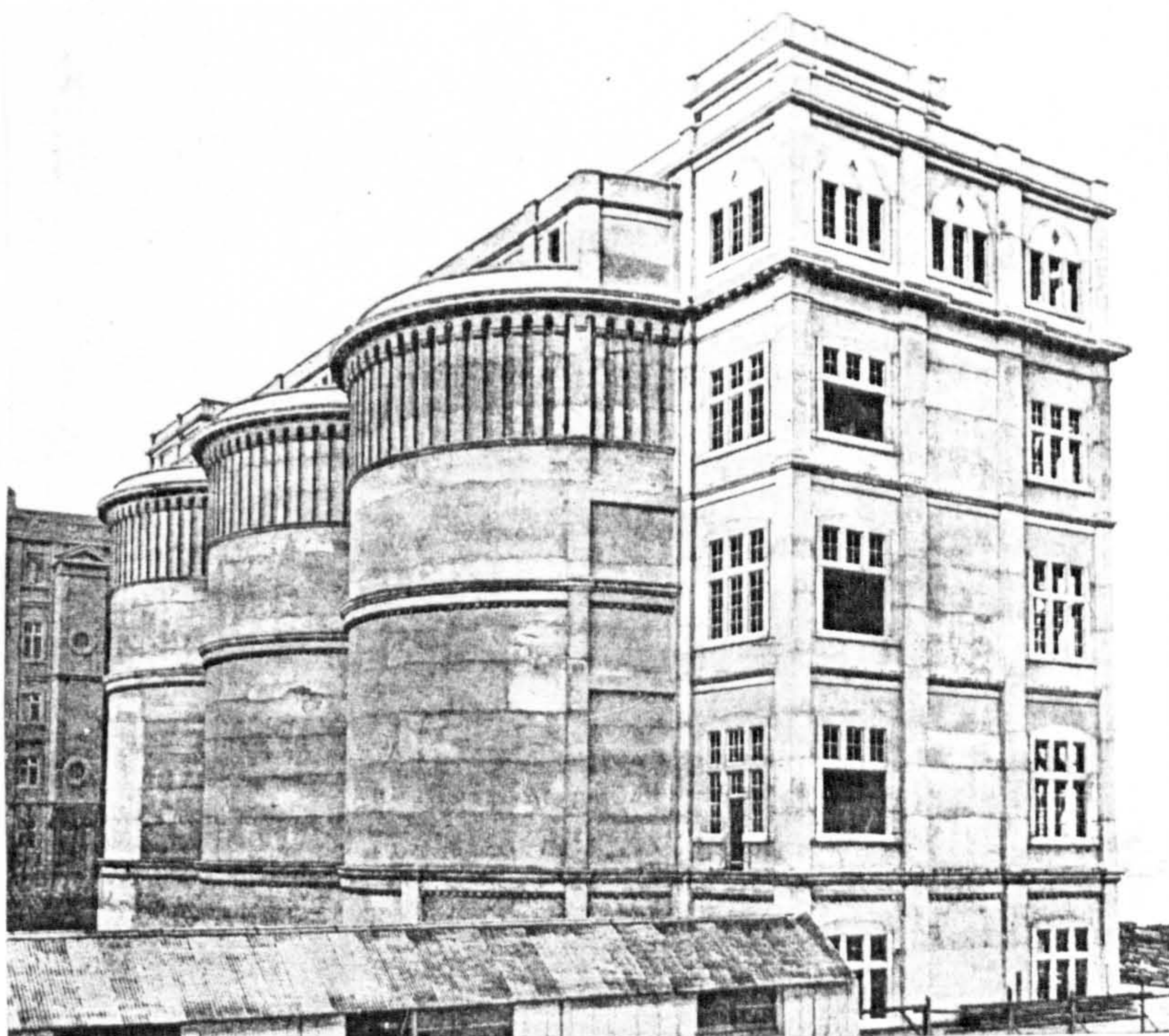


Figure 13: Circular Silos Dunston.

Apart from F.E.L. Harris's tall, stark, cylindrical silos (1908) in Silvertown, London,⁹⁵ these might have represented an unusual example of a "plastic" form in reinforced concrete - but Ekins was careful to articulate them with a deep frieze of vertical indentations, as he articulates the rest of the building.

In 1912, L.G.Ekins again used ferro-concrete, but for the frame only of a Co-operative store in Stockton Street, West Hartlepool; the exterior elevations are in stone, with solid, "baroque" features.⁹⁶

Two other successful "classical" designs in reinforced concrete were J. Cordiner's central premises (1903) and a drapery depot (1904), (figures 14 and 15) in Jarrow, Durham, built for the Jarrow and Hebburn Co-operative Society Ltd.,⁹⁷ but very likely again designed under the aegis of the C.W.S. Architects' Department, which undertook work for local retail societies in the North of England.⁹⁸ The central premises included stores, and provision for an occasional ballroom.⁹⁹

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95. Mouchel-Hennebique Ferro-Concrete, op.cit. (74), p.50.
Hennebique Ferro-Concrete, op.cit. (89), illust., p.223. Site visited, but apparently demolished. S.a: Chapter 5; Appendix I.
96. Cooperative Stores, Hartlepool, in: Hennebique Ferro-Concrete, ib. Recent photograph.
97. Mouchel-Hennebique Ferro-Concrete, op.cit. (74), p.18.
Jarrow and Hebburn Cooperative Society Ltd. - Central Premises - Construction in Hennebique's Patent Ferro-Concrete, project no.471, plan no. 4, London, 27.6.1903.
Jarrow and Hebburn Cooperative Society Ltd., Construction in Hennebique's Patent Ferro-Concrete, Frontages, project no. 471, plan no. 11, Working Plan, 14.8.1903.
98. Redfern, op.cit. (74), p.325.
99. Jarrow and Hebburn Cooperative Stores, London, no. 471, 13.4.1903, (sheet of notes and calculations in French).

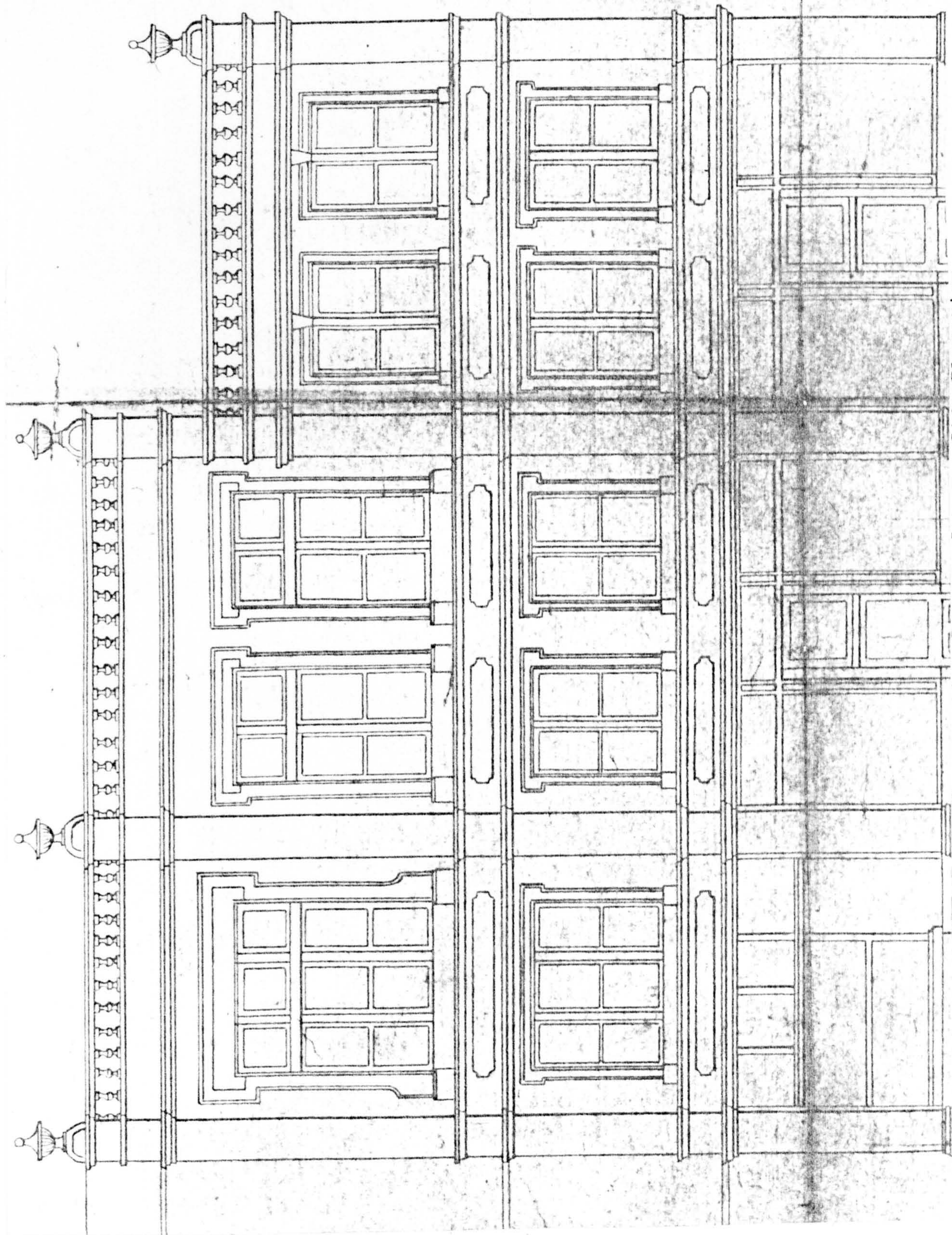


Figure 14: Co-operative Stores Jarrow: Side Elevation.



Figure 15: Drapery depot Jarrow.

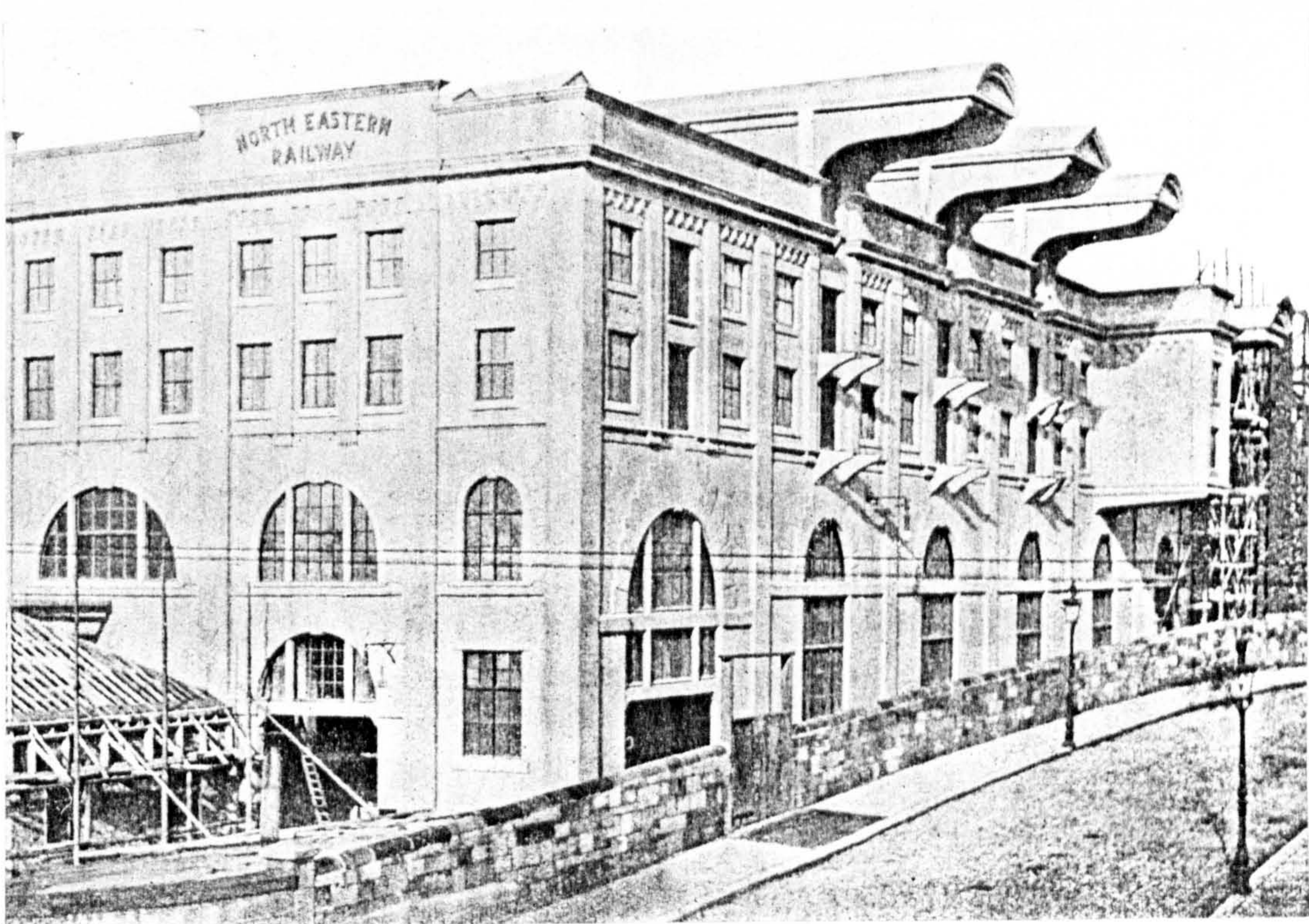


Figure 16: New Bridge Street Goods Station Newcastle on Tyne.

The exteriors of the stores and depot depended on generous and fairly substantial proportions, defined by the main reinforced concrete frame, lightened at the same time with large windows and an ornamental roofline, the flat roofs being enclosed with a small central pediment at the front, and balustered parapets supporting reinforced concrete urns.¹⁰⁰

William Bell F.R.I.B.A.'s large, New Bridge Street Goods Station, (1901-7: figure 16) in Newcastle on Tyne, for the North Eastern Railway Company,¹⁰¹ was greyer in tone than (for instance) the Dunston buildings, and The Northern Echo (cited in Le Béton Armé, 1906), observed approvingly that the rendered surfaces,

"resembled the texture of a fine-grained stone". 102

However, the large, imitation voussoirs over the arched windows, which were a major feature of the elevations, (figure 17)¹⁰³ do not add to the quality of the design: an upper series of arches with stylised indentations to represent voussoirs, again appear somewhat coarse and contradict the apparent thinness of the reinforced concrete walls. With two further rows of undistinctive, small rectangular windows above, neither are the elevations well-proportioned.

On account of its relative slightness for exceptionally heavy loading, its monolithicism, cantilevered hoists, and the boldness of the interior latticed girders (in reinforced concrete),¹⁰⁴ The Northern Echo (1906) described New Bridge Street Goods Station as worthy of Jules Verne; a free-standing spiral staircase (among several inside the building¹⁰⁵) was a further subject of wonderment.¹⁰⁶

100. Own photographs. Cf: urns and pediments, Maison de Rapport, Epinal, Vosges: E.g: Relevé de Travaux Executés. Bétons Armés Système Hennebique, Liste Année 1901, p.7. fig. 1.

101. Chapter 7; Appendix I.

102. Une Nouveauté Architecturale. L'Echo du Nord de Newcastle, (The Northern Echo), 27.4.1906, cited: Le Bét. Armé, May, 1906, (pp.61-3), p.62.

103. S.a: N.E.R. New Bridge Street Goods Station Newcastle, Half Side Elevation of Warehouse E., Architect's contract drawing, 31.10.1905. Own inspection of (partly ruined) building.

104. Chapter 3.

105. N.E.R. New Bridge Street Goods Station, Section on Line GH, Architect's contract drawing, 31.10.1905.

106. Une Nouveauté Architecturale, op.cit. (101), p.61.

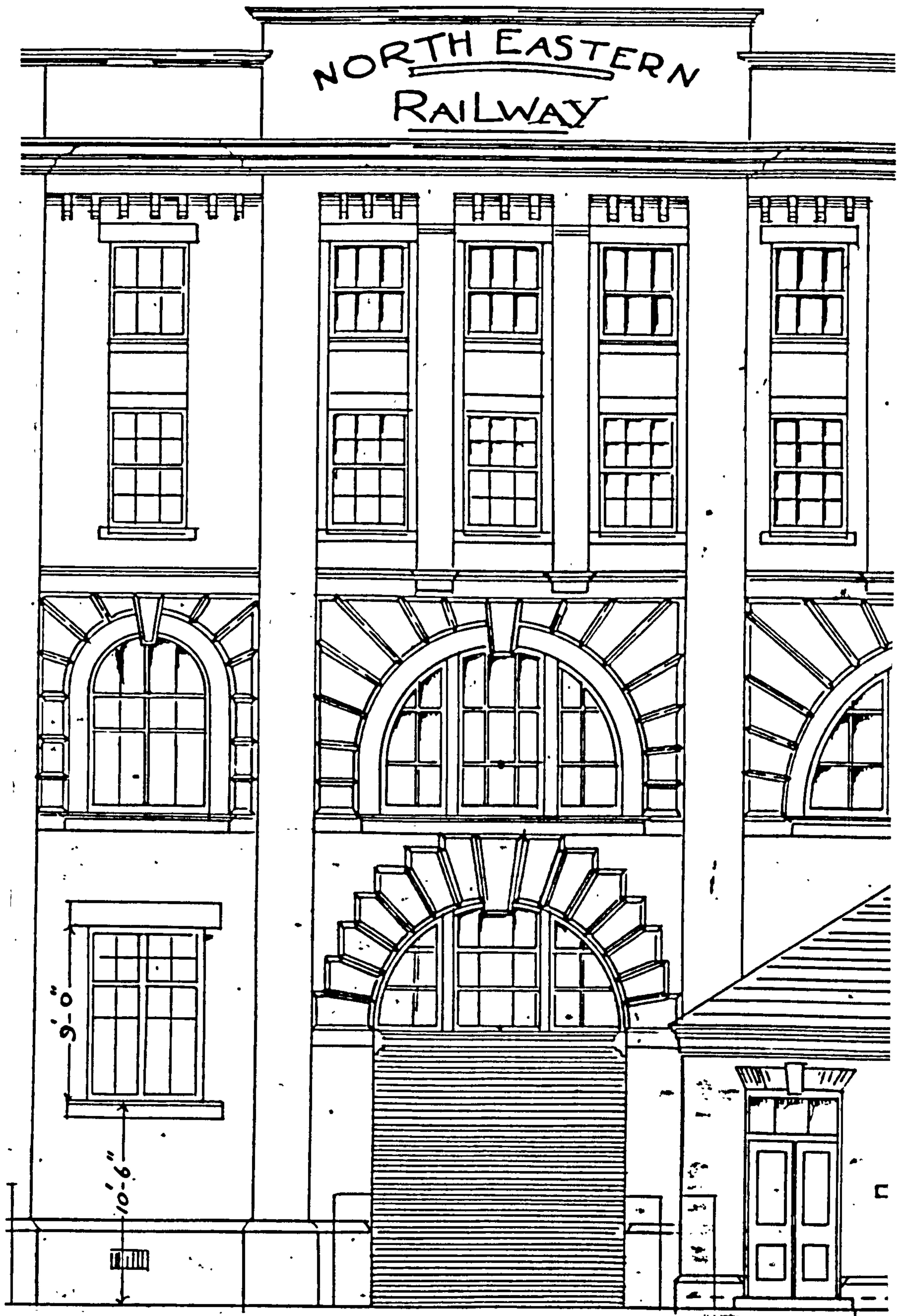


Figure 17: New Bridge Street Goods Station Newcastle on Tyne:
part Front Elevation.

William Bell's Forth Banks warehouse, (1907: figure 18), also for the North Eastern Railway Co., in Newcastle on Tyne, again had classical allusions in its general proportions and details. Further examples of classical adaptations in reinforced concrete in this period included a goods shed (1900: figure 19) for the Great Western Railway Co. at Royal Albert Docks, London, and a drill-hall (1904: figure 20) in Chatham, for The War Office (Territorial Department).

Although parts of the interior of F.E.L. Harris's mill and granary (1902) at Dunston, for instance, incorporated some almost plastic features, these classical examples were pre-eminently examples of "joinery", not "plasticity", (and the coarse detail in the elevations of Harris's mill approached, "angularity"), but a curious, monolithic quality was imparted (with their stone features) by the uniformly rendered, and sometimes yellow-tinted, surfaces.

In 1908, The Builder ran a competition for designing a club facade in ferro-concrete, to express the character of a,

"homogeneous and jointless"

structure, not the character of a masonry building.¹⁰⁷

The winning design,¹⁰⁸ (out of 52), by F.J.Lucas,¹⁰⁹ managed to appear classical and traditional, including a rusticated base. Concrete and Constructional Engineering (1909), which approved the choice of winner, observed that while the nature of reinforced concrete was monolithic,

107. Chronicle, J.R.I.B.A., vol.15, 17.10.1908, p.652.

108. Assessors: R. Blomfield, W. Cave and Ed., Builder: ib.

109. Editorial Notes, C. & C.E., vol.3, no.6, Jan., 1909, pp.430-1.
S.a: Collins, op.cit. (22), illust: Pl. 40. F.J.Lucas: Frederick James Lucas, Lic. R.I.B.A., Totteridge, High Wycombe: Who's Who in Architecture, London, 1914, p.140.

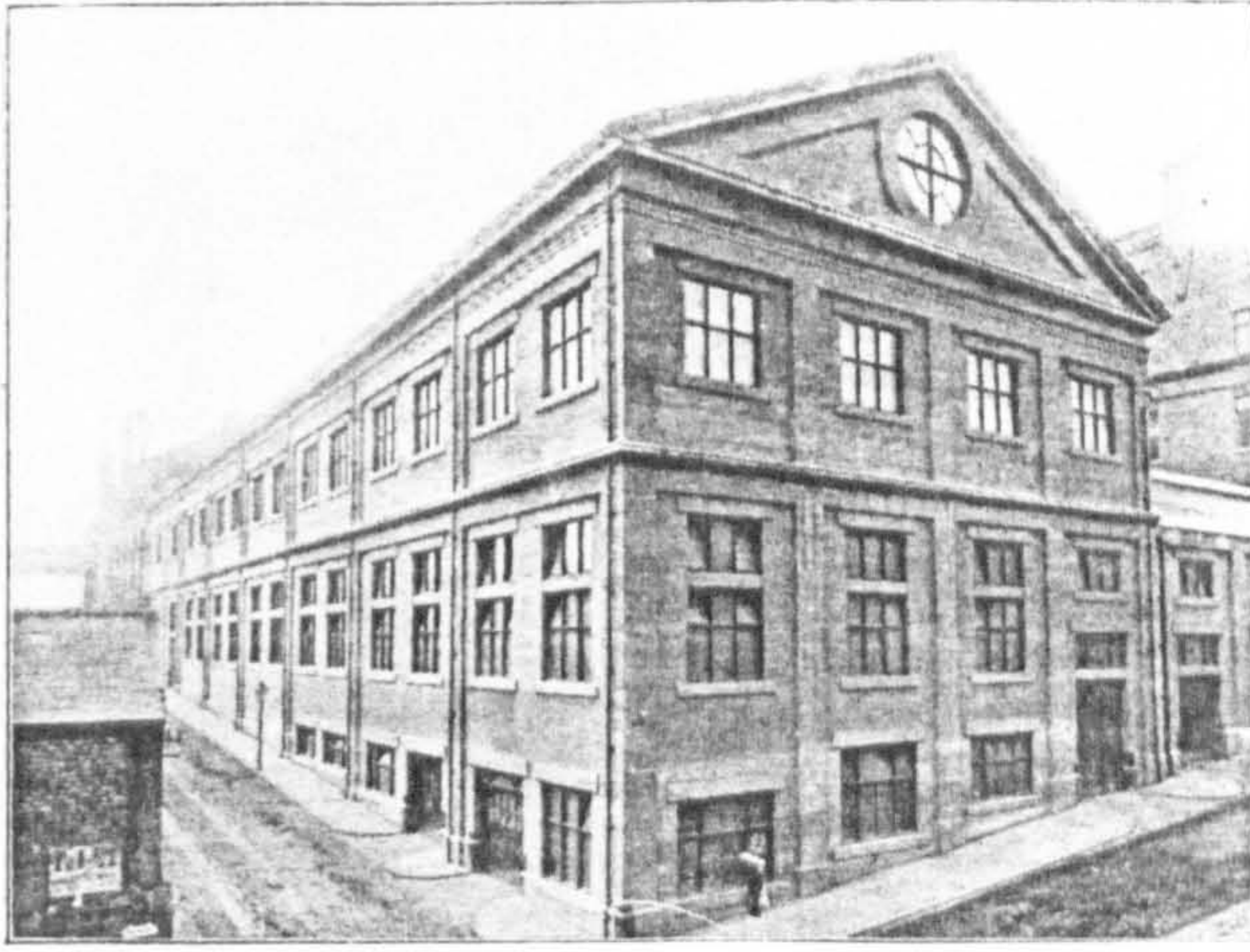


Figure 18: Forth Banks Goods Station Newcastle on Tyne.



Figure 19: Railway warehouse London.

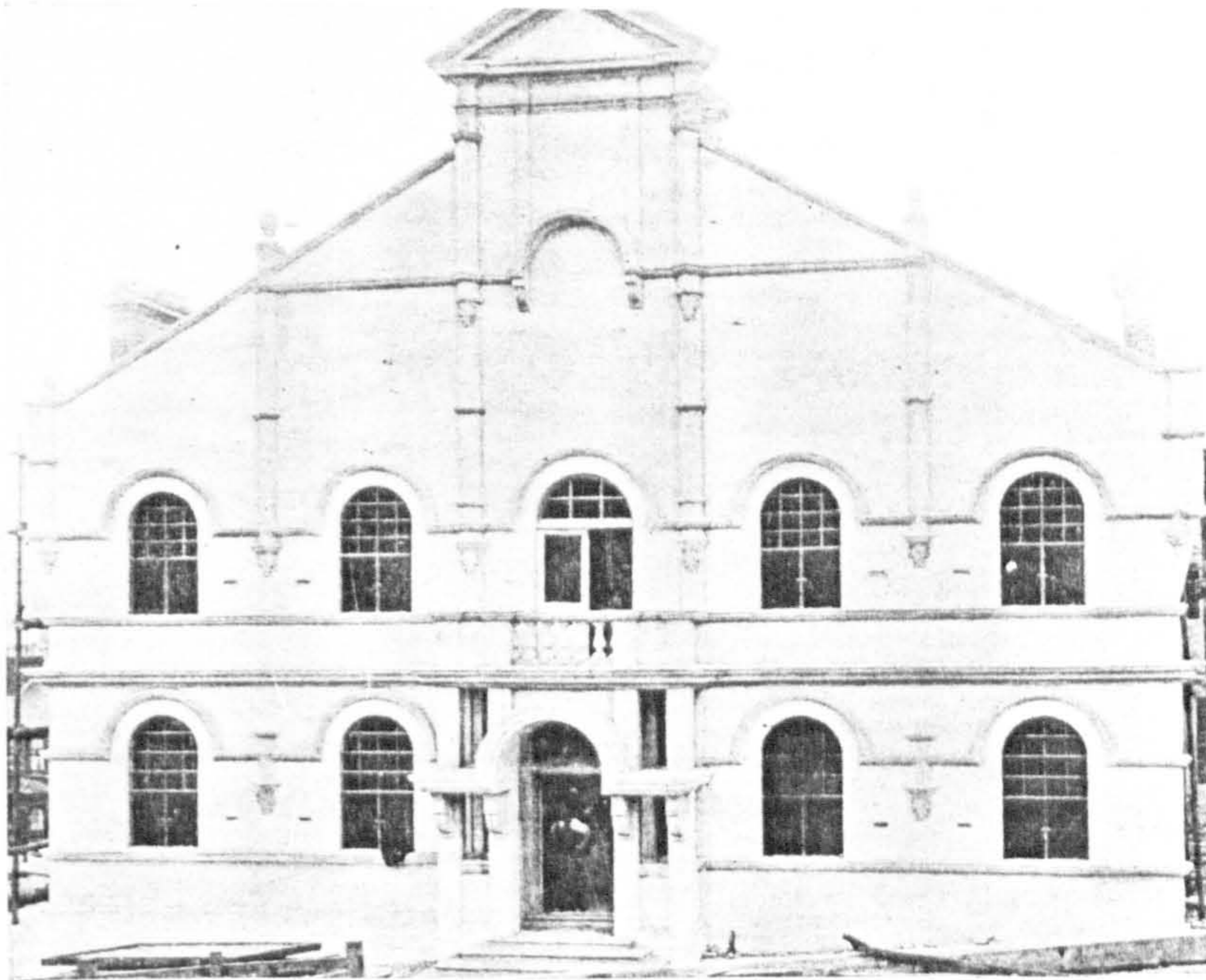


Figure 20: Drill hall Chatham.

"it seems appropriate that the lines of supporting structure should find artistic expression ". 110

Furthermore, the expression of the qualities of,

"dignity and repose, not to say, staid respectability",

associated with a town club house, was perceived surprisingly, as,

"peculiarly compatible with reinforced concrete construction ". 111

At the same time, there was some novelty in the design in the means of meeting the artistic problem of surface treatment. The rusticated pilasters at ground floor level were interpreted by alternating embedded grey granite with concrete visible in the channels; (otherwise, the frame was rendered with Portland cement and stone dust). Further variety of colour, and texture, was given by some use of green marbles, with visible bronze fastenings and bronze caps and swags; (bronze and marble were also applied with ferro-concrete in J. G. Gillespie's competition entry (1909) to The British Architect for a shop and office building¹¹²).

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110. Editorial Notes, ib.

111. Ib., p.430.

112. Discussed in Chapter 11.

"A Field for the Colour-Artist".

At the International Congress of Architects (1906) in London, where common artistic problems of reinforced concrete were discussed, Louis Cloquet (Belgium), having concluded that the material did not properly offer scope for the essential attributes of architecture - sculpture and modelled relief - suggested that its only artistic potential lay in decorative surfaces, for instance, in polychromic ceramic work, these constituting,

"a vast field for the colour-artist " . 113

Exterior surfaces of exposed aggregates,¹¹⁴ providing further possibilities of both colours and texture for reinforced concrete, (discussed in an American article in Concrete and Constructional Engineering in 1907¹¹⁵), were probably not used in Britain for example, in this period, although they were in the U.S.A., for instance, for a bottling factory (1908-9) at Waukesha, Wisconsin, (and with a pilastered and "solid" appearance).¹¹⁶

In France, Edouard Arnaud had designed areas of ceramic decoration to add colour to the elevations of Hennebique's Paris offices (1898-9),¹¹⁷ but the building was criticised by The American Architect (1901) for its "grey tone".¹¹⁸

113. Professor Cloquet, L'Emploi du Béton Armé en Architecture, I.C.A., 1906, Trans., London, 1908, p.171. S.a: Louis Cloquet, De l'Emploi du Béton Armé en Architecture, (illustrated), Le Bét. Armé, Feb., 1908, (pp.18 - 24), p.21.

114. That is, with the cement film removed by acid washing or other means.

115. Henry H. Quimby, M.Am.Soc.C.E., A Surface Finish for Concrete, C. & C.E., vol.2, no.2, May, 1907, (pp.107-11), p.107.

116. Reinforced Concrete and Tradition, Arch. Rec., vol.26, Oct., 1909, pp.301-2.

117. Arnaud, op.cit. (6), p.4.

118. Paris, Amer. Archt. & B.N., vol.74, 16.11.1901, (pp.54-6), p.55. Following such criticism, Hennebique employed precast slabs with coloured flints embedded, as permanent shuttering for his villa (1902) at Bourg-la-Reine: La Villa en Ciment Armé, op.cit. (36), p.7, and: F.E.Wentworth Shields, The C.I. Visit to Paris, C. & C.E., vol.5, no.6, June, 1910, p.404.

A. Perret, in his apartments (1902-3) in rue Franklin, Paris, subsequently met the problems of surface colour and texture, by applying buff-coloured, flower-patterned ceramic work to the entire surfaces of the wall panels, with flowers and small discs moulded in shallow relief: the frame was differentiated, but also encased in flat, buff-coloured tiles,¹¹⁹ (and not either, visible "reinforced cement"¹²⁰ or, bush-hammered with exposed aggregate¹²¹).

Perret's use of a ceramic veneer followed A. O. Elzner's American example, in his 16-storeyed reinforced concrete office block (1902-4) in Cincinnati, Ohio, although Elzner, who used white and grey bricks and tiles, was not concerned to decorate his surfaces but, (in the words of The Builder's competition guidelines (1908) for a ferro-concrete facade), "to express the character of a jointless and homogeneous structure".¹²²

In Britain, a little later, some shop/office premises (1906-7) in Lynn Street, West Hartlepool, built on Coignet's system for M. Robinson & Sons Ltd., were designed by Harry Barnes, A.R.I.B.A., and Charles F. Burton, M.S.A., with decorative faience panels to face the frame, and painted illustrations on glass inbetween - but the elevations here were designed to convey an impression of substantiality as well as a decorative effect.¹²³

Alfred E. Corbett A.R.I.B.A.'s Y.M.C.A. premises, (1908 - 11: figure 21) in Manchester,¹²⁴ had reinforced concrete walls completely veneered with terra-cotta tiles. This building was on Kahn's (American) system and Moritz Kahn (1908) advocated facing reinforced concrete walls with glazed tiles,¹²⁵ but perhaps borrowed the idea from Corbett.

119. Own photographs. Cf: Collins, op.cit. (22), p.182.

120. Roederer and Mallet Stevens, op.cit. (52), p.257.

121. Raafat, op.cit. (57), pp.43, 45.

122. Chapter 11.

123. Ib.

124. E.g: Alfred E. Corbett, The Y.M.C.A. Building, Manchester, C.I. Trans. & Notes, vol.3, 8.6.1911, (pp.282-318).

125. Moritz Kahn, Bldr., Feb., 1908, pp.202 - 3.

A. E. Corbett (1903) advised, in designing elevations,

"the factor of materials is of the greatest importance: the scheme must be mentally realised as a combination of materials of certain colours and textures", 126

so that when Corbett, (for practical motives) employed reinforced concrete, with its various surface defects, he was bound to consider the possibility of coloured veneers, especially as economy was not a prime motive for employing reinforced concrete in this instance.¹²⁷

The exterior tiles were in two main tones of dark brown for the ground storey, and light brown or buff for the upper storeys,¹²⁸ (and varied individually¹²⁹), although A. E. Corbett had intended,

"a more interesting colour scheme of "Marmo" ware (dark brown) throughout, with a green base and cream upper part, but, much to our regret, the (building) committee reversed their decision". 130

The base of the Y.M.C.A. building, in both schemes distinguished by colour, was also "rusticated", and the entire facades shaped and articulated to provide both substance and detail, although the reinforced

126. Alfred E. Corbett, A.R.I.B.A., Modern Domestic Architecture, pr. to Manchester Soc. Archts., 12.11.1903, J.R.I.B.A., vol.11, 9.1.1904, (pp.117-25), p.125.

127. Chapters 5 and 9.

128. Corbett, op.cit. (124), pp.290 - 1.

129. Own inspection.

130. Corbett, op.cit. (124), p.291.

concrete walls were in fact thicker than necessary in this building, since they were originally designed to accommodate brick and building permission was delayed.¹³¹

A. E. Corbett applied various veneers (such as marbles) inside, as well as outside, the Y.M.C.A. premises:¹³² similar decoration was employed for other, interior, reinforced concrete construction, for example, Sir Henry Tanner F.R.I.B.A.'s stone-fronted G.P.O. extension (1905-9), King Edward Street, London.¹³³

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131. *Ib.*, p.285.

132. A.E.Corbett, at C.I., C. & C.E., vol.6, no.7, (pp.502-15), p.508. Own inspection.

133. Sir Henry Tanner, The New G.P.O. Office London, J.R.I.B.A., vol.18, 7.1.1911, (pp.149-77), illusts., pp.149, 168. S.a: Chapter 5; Appendix I.



Figure 21: Y.M.C.A. Premises Manchester.

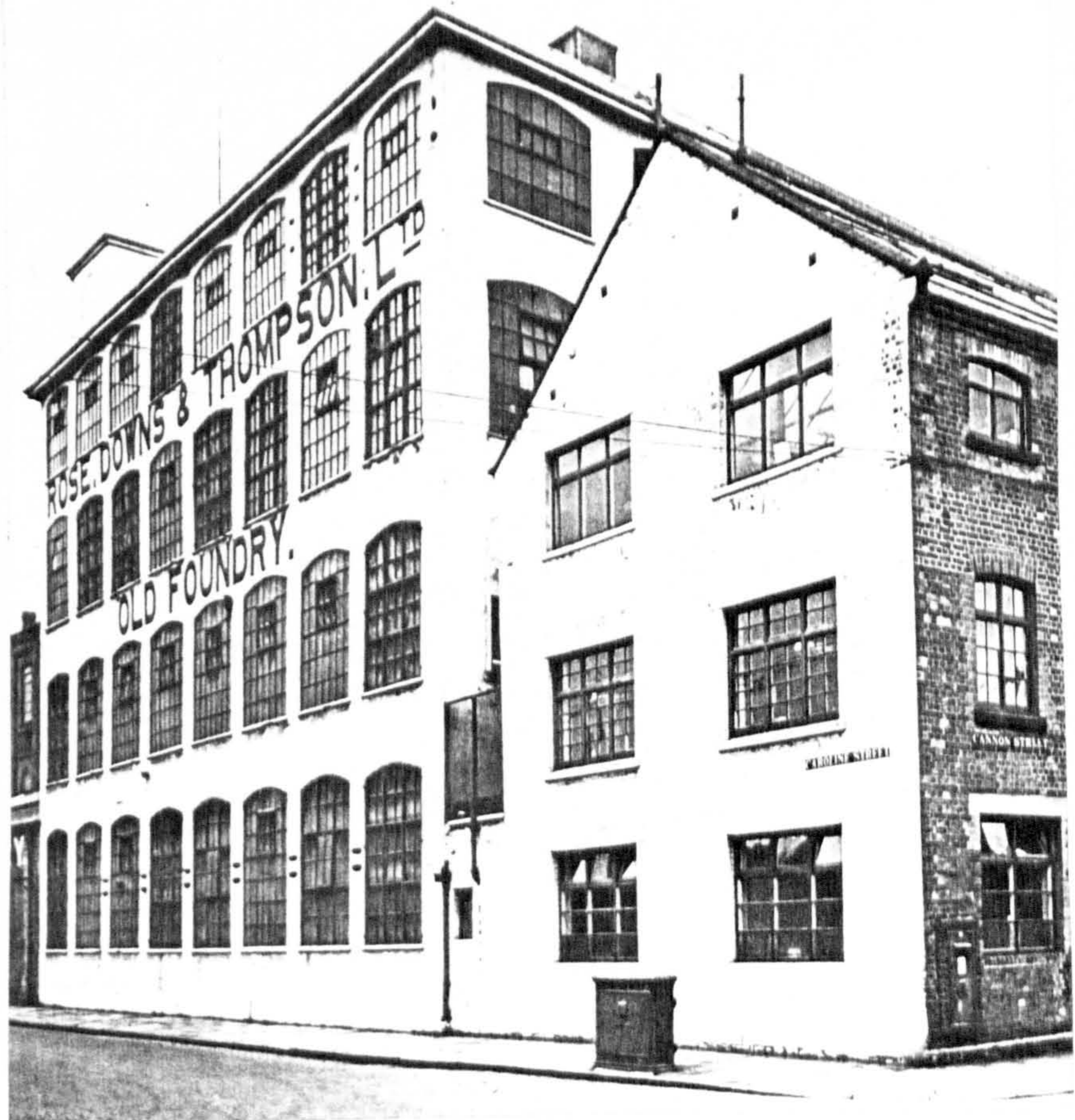


Figure 22: Workshop Old Foundry Hull.

In the "Functional Tradition"?

Some reinforced concrete industrial buildings were indeed, as in early reported criticism, "plain and even ugly";¹³⁴ for example, a granary (1908) for R. & H. Hall, at Westport, designed by W. Friel, Assoc. M. Inst. C.E.,¹³⁵ had a severe, exposed frame filled with ferro-concrete panels marked in imitation of ashlar. Silos had to be airtight and were virtually windowless, but here, small horizontal windows crowded into the upper section of each panel, give the latter, with the superficial markings, the appearance of a temporary blocking in.

However, (putting aside the "classical" industrial examples), a number of early reinforced concrete structures might perhaps be related to J. M. Richards' (1958) "Functional Tradition" in early industrial buildings,¹³⁶ on account of both qualitative, and very general, visual associations, (such as regular fenestration and relative plainness).

The design of "Functional Traditional" buildings, usually not involving architects, was dominated by their purposes and economical uses of materials, and such buildings were assumed to follow a tradition (or traditions) of functional design,¹³⁷ although without necessarily employing traditional materials and methods¹³⁸ - so that such a tradition becomes somewhat difficult to specify, even if its examples in a general way may be compared.

134. Mouchel, op.cit. (29), p.57.

135. Mouchel-Hennebique Ferro-Concrete, op.cit. (74), p.50. Illust: The Yorkshire Hennebique Contracting Co. Ltd. Leeds, catalogue, section A, n.d.

136. J.M.Richards, The Functional Tradition in Early Industrial Buildings, London, 1958.

137. *Ib.*, pp.14 - 21.

138. E.g: illust. early, multi-storeyed, cast-iron framed boathouse (1858-60), Sheerness: *ib.*, pp.64-5.

The functions of such buildings were usually simple, such as provision for large workshops or storage spaces - but so were they often behind the slightly more elaborated "classical" reinforced concrete facades.

"Functional" examples in reinforced concrete, at least two of which involved architects, might include the first reinforced concrete framed, multi-storeyed building in Britain, Weaver & Company's Provender Mill (1897-8) in Swansea. An architect, H. C. Portsmouth, M.S.A., was involved in the design and he had probably seen the earlier "daylight" factories in Hennebique's system in France,¹³⁹ which Weaver's Mill, to some extent, resembled.

Rose, Downs & Thompson's four-storeyed extension building (1900 - 1) to their Old Foundry in Caroline Street, Hull, (figure 22) also involving an architect,¹⁴⁰ required good lighting for a pattern shop and machine room and (although reinforced concrete was selected primarily for its economy) the design is dominated by this requirement. The street facade - quite flat - consisted largely of rows of windows, small-paned and arched (in imitation of the outline of brick arches), and with a light and decorative effect.¹⁴¹

Another pattern shop and office building (1908) in West Gorton, Manchester, for the Unbreakable Pulley & Mill Gearing Co. Ltd.,¹⁴² (figure 23), for which no architect is known, again not employing reinforced concrete primarily for its "daylighting" facility, yet exemplifies this, with a thin, exposed reinforced concrete frame and between horizontal strips of brick panelling, rows of nearly continuous fenestration, interrupted only by "mullions" of reinforced concrete, just slightly thickened at the street corner: with its flat roof and plain cornice, also,

139. Chapter 6.

140. The commission and construction of this building are discussed in Chapter 7. S.a: Appendix I.

141. The building is still extant, but some of the windows are blocked.

142. Mouchel-Hennebique Ferro-Concrete, op.cit. (74). Illustrated in catalogue, The Yorkshire Hennebique Contracting Co. Ltd., op.cit. (135), both under construction, and completed. S.a: Chapter 9, for reference to The Unbreakable Pulley Co.

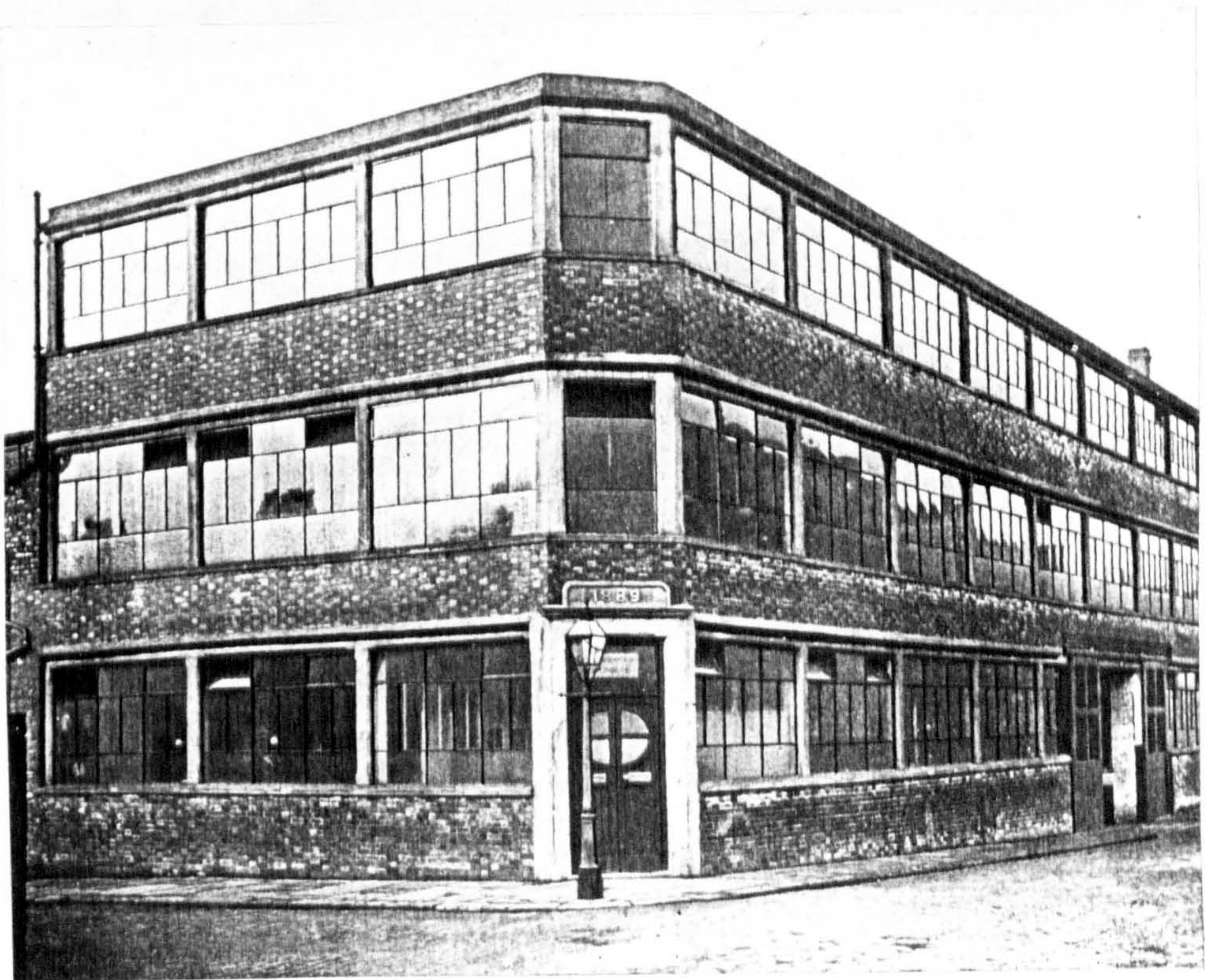


Figure 23: Office and Pattern Shop Manchester.

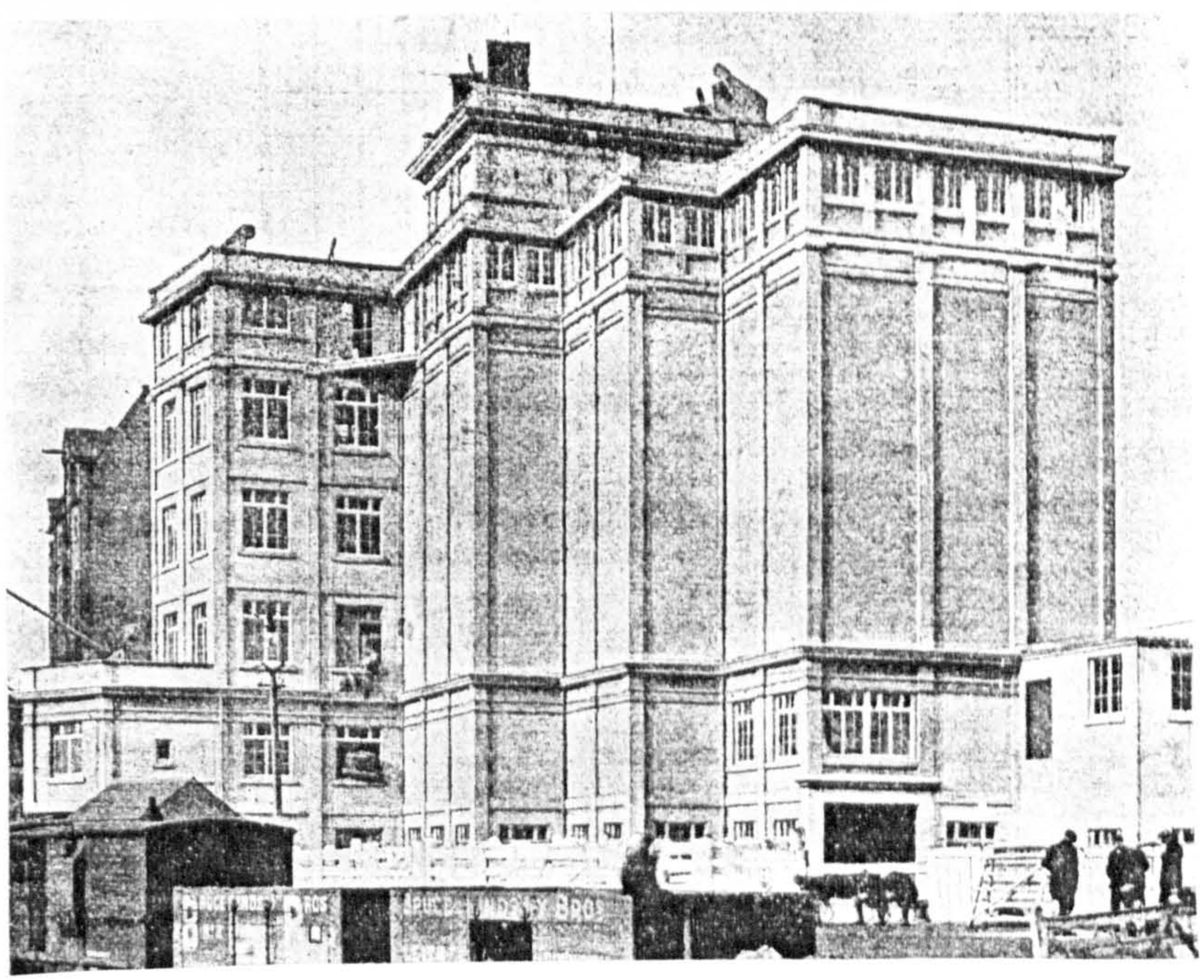


Figure 24: Granary Edinburgh.

the pattern shop, from its appearance, might be dated much later.

W. H. Hunter, M. Inst. C.E.'s series of reinforced concrete Transit sheds (1902-5) also in Manchester, for the Manchester Dock and Warehouse Extension Co. Ltd.,¹⁴³ (and on the borderline of qualifying as "Functional"), on the other hand, have spaced out individual windows, with pitched roofs over projecting wings (for hoists and stairs), with a generally "thin" appearance, suggesting earlier, wooden construction, either in domestic buildings, or industrial buildings derived from them.

A granary (1907) for J. Herdman in Edinburgh (figure 24) perhaps without an architect or engineer apart from the specialist, possibly T.J.Gueritte in this instance,¹⁴⁴ while built on an awkward site,¹⁴⁵ had a simple and rectilinear style, with panelled reinforced concrete wall surfaces, a broad cornice and dentils (all in reinforced concrete) and, if indeed designed by Gueritte, not exemplifying the plasticity which he advocated.

Reinforced concrete was employed unobtrusively in interior construction and lintels for otherwise traditional and "Functional" brick industrial buildings, such as Brearley Mills (1907), Luddendenfoot, (figure 25) and without any loss here for the architects, Sutcliffe and Sutcliffe, A.A.R.I.B.A.,¹⁴⁶ of "solidity" or repose.

143. Chapter 7; Appendix I.

144. Chapter 9.

145. Ib.

146. E.g: Mouchel-Hennebique Ferro-Concrete, op.cit. (74).

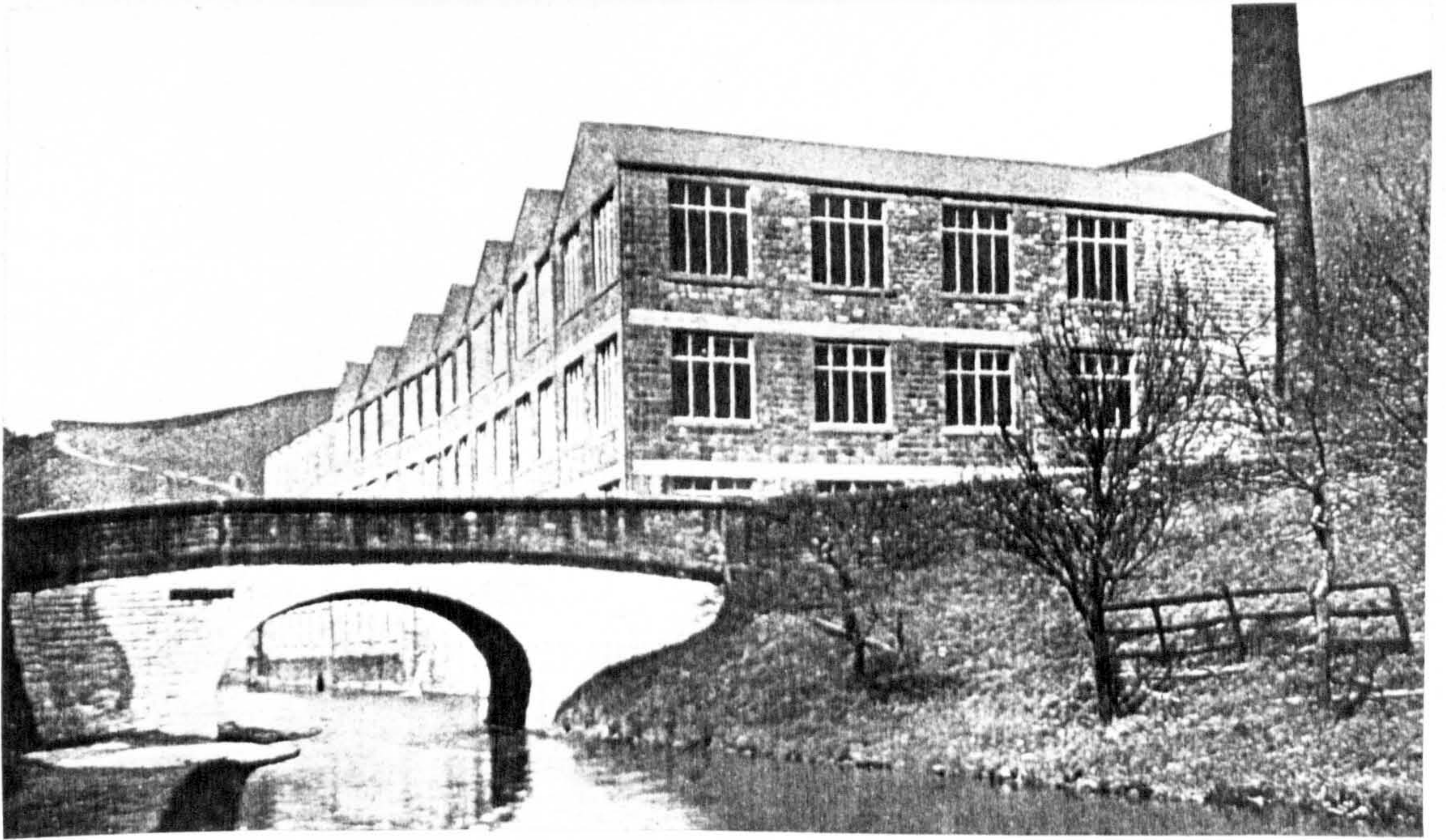


Figure 25: Brearley Mills Luddendenfoot.

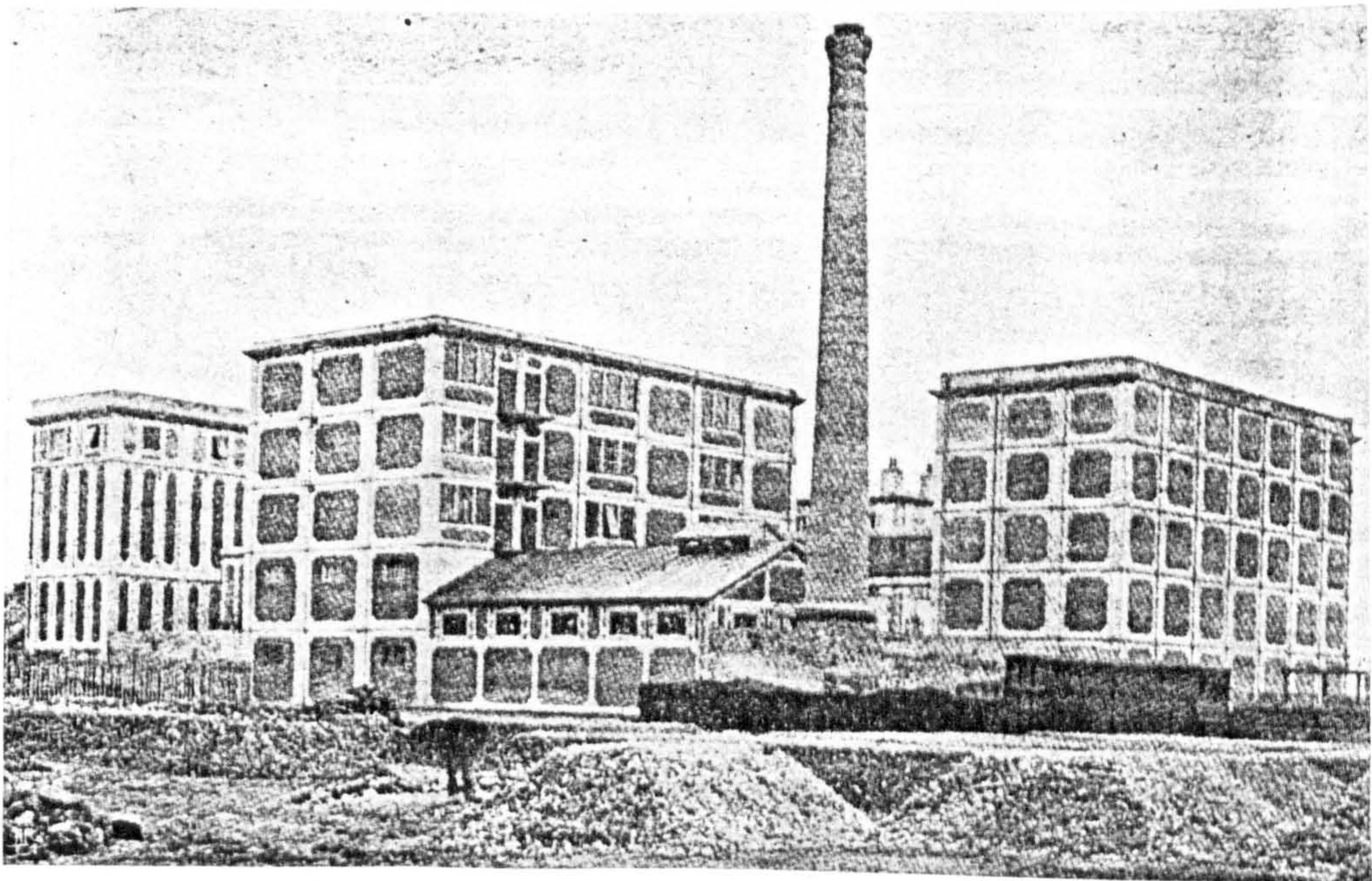


Figure 26: Flour mill and Grain silos Brest.

Finally, an early example in France is worth noting, a flour mill and granary buildings (1898) in Brest, employing Hennebique's system, (figure 26), illustrated in Britain by both C.F.Marsh (1904)¹⁴⁷ and L. G. Mouchel (1905),¹⁴⁸ but not imitated there. The silos are again windowless but articulated with light-coloured, exterior frames, simply shaped to present an appearance of plastic continuity, infilled with dark, brick panels, and with flat roofs: together with the mill they constitute a group of buildings abstract in shape and surface-pattern and an example of plainly decorative industrial design.

However, if two of these "Functional" buildings involved architects (excluding Brearley Mills), in general they would be considered by contemporaries to lack the "intellectual" interest of styling,¹⁴⁹ or, to some of those architects who proposed - or practised - a "styleless" architecture,¹⁵⁰ as lacking, at least, the preferred architectural quality of, "substance".

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147. Marsh, op.cit. (37), p.437, fig. 401.

148. Mouchel, op.cit. (10), p.57.

149. Discussed in Chapter 4.

150. Ib.

Conclusion.

Such "Functional" designs (despite occasional adaptations to awkward sites) were comparatively simple, regular and rectilinear in appearance - unlike F. Hennebique's functionally-shaped villa - while they tended to exemplify the lightness and thinness of reinforced concrete construction, sometimes with extensive fenestration, which L. G. Mouchel as well as Hennebique, recognised as a characteristic, practical advantage of the material.

However, for many architects, the thinness and flatness of reinforced concrete panel walls, (the "daylight frame" was hardly considered), emerged as the chief artistic problem in the use of the material: in a context of general architectural preferences for "substance" and modulated and articulated surfaces, these were without depth or shadows, monotonous in texture, as well as dull-coloured and frequently mottled.

These problems were first identified by E. Arnaud in Paris, when he was designing Hennebique's new Head Office and apartments (1898-9) at 1, rue Danton, as an exemplar of ferro-concrete architecture. In an attempt to meet them, Arnaud introduced bay-windows, and ceramic decoration, in a design not unlike local elevations in stone, features more singularly adopted subsequently by A. Perret in his well-known apartments (1902-3) in rue Franklin, which avoided flatness and monotony, but did not attempt to achieve substance, a point of contemporary criticism.

A. E. Corbett A.R.I.B.A.'s Y.M.C.A. premises (1908-11: Kahn system) in Manchester, in which the problem of surface defects was again met by veneering the reinforced concrete external walls with terra-cotta, also had copious, vaguely classical, detailing, as well as a distinctively coloured base, to emphasise "substance" as well as articulate the surface.

A number of designs for reinforced concrete in Britain, positively

"classical" in detail, with imitations of stone construction, although with some resemblances to wooden construction and often with rendered surfaces, were again attempts, (the first in 1899), to meet the problems of flatness and surface monotony, by means of a popular, contemporary style and no doubt encouraged by L. G. Mouchel's and T.J.Gueritte's assurances that as a plastic material, reinforced concrete might be shaped to any form or ornamentation, (although for industrial elevations, in which the motive of economy was significant, such styling was not the most economical). Classical detailing in reinforced concrete was also executed in France and the U.S. in this period.

Some of these classical designs were admired by contemporaries in Britain, as well as France, and indeed, L.G.Ekins' soap factory (1907) in Dunston and J. Cordiner's Cooperative stores and depot (1903-4) in Jarrow, for instance, are among early reinforced concrete buildings in Britain, including "classical" and "Functional" examples, which might have been admired still.¹⁵¹

Architects in Britain (and France) perceived various problems of formal definition in the use of reinforced concrete, while they were also aware of revolutionary formal, and planning implications in monolithic framing, flat roofs, and plastic shaping. In practice, they also recognised the characteristic thinness and "flatness" of reinforced concrete external walls. However, their main concern, frequently, was how to reconcile this flatness and the accompanying "featurelessness" of reinforced concrete construction, with their opposing aesthetic preferences, specifically, a contemporary mode of "Renaissance" styling and the use of stone.

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151. The Soap Factory, Dunston, and one of the Co-operative buildings in Jarrow, for instance, are now semi-derelict: Appendix I.

CHAPTER 11: LION CHAMBERS: A GLASGOW EXPERIMENT.

Introduction.

James Salmon and Reinforced Concrete.

Lion Chambers As Built.

Whose Building? The Progress of the Design.

John Gaff Gillespie's Competition Design for Ferro-Concrete
Shop/Offices.

Conclusion.

Introduction.

Chapter 11 examines one interesting and extant, eight-storeyed shop and office building: Lion Chambers in Hope Street, Glasgow, designed and built entirely in ferro-concrete between 1904-7 for William George Black, a Glasgow lawyer and writer.

Although ferro-concrete was probably preferred for a practical motive (fire-resistance¹), artistic considerations may also have been significant, given the positive artistic inclination of the client,² together with the fact that both the architects involved demonstrated a particular interest in the artistic possibilities of reinforced concrete.

Initial architects' and specialists' drawings for Lion Chambers, and the executed design, with which these are compared, are considered in relation to the ideals for reinforced concrete expressed by one of its joint architects, James Salmon, F.R.I.B.A., and the general formal interests of the other, John Gaff Gillespie, F.R.I.B.A., including reference to his competition design (1909) for a similar type of building in ferro-concrete.

The possibility that constructional difficulties influenced details of the designs as well as the execution of certain parts of the final design is discussed.

Lion Chambers is considered in relation to the artistic problems described in Chapter 10, and as incorporating formal influences largely peculiar to Glasgow at this time.

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1. Chapter 9.

2. William George Black was a lay-member of The Glasgow Art Club: ib.

James Salmon and Reinforced Concrete.

James Salmon F.R.I.B.A.'s views (1908) on the architectural expression of reinforced concrete³ are interesting, and even if, as seems likely, John Gaff Gillespie was responsible for the basic design for Lion Chambers, either Salmon's ideas, (which, perhaps, included some of Gillespie's), influenced the design, or Salmon partly articulated what had already been carried out in Lion Chambers.

James Salmon attached importance to the architect having a practical familiarity with the nature of a material - including reinforced concrete - before attempting to design for it.⁴ E. W. Hudson A.R.I.B.A., (1904) for example, had earlier considered the possibility of applying certain "Arts and Crafts" principles to design in reinforced concrete, such as the expression of the construction in design.⁵

Similar ideas were being proposed in the U.S. in relation to reinforced concrete, by A. O. Elzner (1904), joint architect of a sixteen-storeyed reinforced concrete office block (1902-4), in Cincinnati, Ohio, for whom the rational and aesthetic value of reinforced concrete lay in its capacity for expression, "without joints or deception", unlike encased (and concealed) steel framing.⁶ (The general notion of a, "living and rational architecture" was often expressed in this period⁷ and might be related to a contemporary movement for "stylelessness and plainness", as well as the Arts and Crafts Movement.⁸)

3. James Salmon, F.R.I.B.A., The Decoration of Steel and Reinforced Concrete Structures, pr. to Glas. Instit. Archts., 11.3.1908, B.J., vol.27, 25.3.1908, (pp.269-73).

4. *Ib.*, p.271.

5. E.W.Hudson, A.R.I.B.A., The Architect and Ferro-Concrete Construction, J.R.I.B.A., vol.12, 24.12.1904, p.143.

6. A.O.Elzner, The First Concrete Skyscraper, Arch. Rec., vol.15, June, 1904, (pp.531-44), pp.541, 544. Illustrated later this chapter.

7. Cf: P. Cusack, The Ideal of a Modern, National Style in Britain Around 1900, Edinburgh Architecture Research, vol.6, 1979, (pp.27-33), p.31.

8. Discussed in Chapter 4.

James Salmon believed that art must be left to follow good building carried out according to craft-orientated principles, and that the effort after art in buildings was generally counterproductive⁹. W. R. Lethaby, for example, held a similar view.¹⁰ Salmon anticipated that reinforced concrete should assist in eradicating the contemporary fault of "over-ornamentation" of buildings - somewhat different from advocating it - as did L. G. Mouchel - for its ornamental facility.

James Salmon did not himself expect to achieve a satisfactory, appropriate and original expression for reinforced concrete, because, (again like W. R. Lethaby later, and others¹¹), he believed that artistic conceptions evolved over time,¹² and so, like T. G. Jackson (1906) with a similar problem regarding iron architecture,¹³ he looked to earlier, "vernacular styles" in other materials - but with constructional features which seemed appropriate for the new material, and it was these features to which Salmon (and Jackson) drew attention.

James Salmon (1908) suggested that,

"The Scottish style,.....especially that of the old rough-cast castle, is eminently adapted to a development suited to reinforced concrete construction - the plain rough-cast surfaces, extending to the window-sashes, the simple corbelling, the small cornices, the straight lines, the rarity of arches, and other details difficult to construct: above all, the freedom to do anything you like, provided the shapes suit your material wants, and group well with the natural surroundings." 14

9. Salmon, op.cit. (3), pp.269, 272.

10. Discussed: P. Cusack, The Evolutionary Metaphor, Edinburgh Architecture Research, vol.4, 1977, (pp.7-10), p.9.

11. W.R.Lethaby used the phrase, "Art 1000 men deep": W.R.Lethaby, Architecture, London, 1911, p.249. S.a: Cusack, op.cit. (7), p.30.

12. Salmon, op.cit. (3), p.270.

13. Cusack, op.cit. (10).

14. Salmon, op.cit. (3), p.271.

Thus, a new conception of reinforced concrete, related to "Arts and Crafts" ideas¹⁵ - based on a vernacular source, related to its environment and, whilst taking advantage of its possibilities, shaped for easy construction.

A. Service (1977), who misunderstood that steel framing was used with concrete panels in the construction of Lion Chambers,¹⁶ also concluded that Salmon recommended the Scottish, rough-cast castle as a model for such combinations of steel frames and concrete.¹⁷ In fact, Salmon suggests a rather different expression for steel-framed buildings, in conjunction with steel-plate walls, on the lines of steel ships.¹⁸

A. Service (1977) further describes James Salmon as recommending exteriors "such as" the Lion Chambers,

"as combining a functional use of building techniques with a style which still retained a visual link with old Scottish castles ",
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an interpretation which tends to simplify Salmon's intention, which was to develop a style - specifically for reinforced concrete - from certain features of old Scottish castles which seemed appropriate to this type of construction.

15. S.a: quotation from Salmon relating to architect's sympathy with materials, and reference to Salmon's own possible knowledge of reinforced concrete: Chapter 8.

16. Alastair Service, Edwardian Architecture, London, 1977, pp.116, 132 and p.131, fig.156: source: James Salmon's (1908) lecture, as referred to by David Walker, The Partnership of James Salmon and John Gaff Gillespie, in: A. Service, ed., Edwardian Architecture and its Origins, 1975, p.245. Drawings by the Architects and from L. G. Mouchel's office, referred to shortly, show the construction: see also Appendix I for details of drawings and other sources.

17. Service, (1977), *ib.*, p.116: source: *ib.*

18. Salmon, *op.cit.* (3), p.272.

19. Service, *op.cit.* (16), p.116.

James Salmon did not intend to eliminate ornamentation altogether from reinforced concrete buildings and proposed adding decorative focuses of colour (such as heraldry), to enhance by contrast the rendered surfaces,²⁰ (as E. Arnaud had attempted earlier²¹). Salmon also suggested modelled ornaments to be attached to reinforced concrete walls (and giving attention to their method -or craft - of execution).²²

James Salmon also recommended (H.R.) Millar's illustrations of fairy palaces in The Strand Magazine as an inspiration for reinforced concrete design:²³ these showed interiors with tall, round columns, individually painted or otherwise decorated in various patterns, and Gothic arches²⁴ (figure 1), and exteriors with flat roofs and parapets ornamented with statues.²⁵

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20. Salmon, op.cit. (3), p.271.

21. Chapter 10.

22. Salmon, op.cit. (3), p.272.

23. Ib., p.271.

24. H.R.Millar, illust. to E. Nesbit, The Enchanted Castle, Strand Magazine, vol.34, London, 1907, p.354.

25. Ib., Strand Magazine, vol.33, London, 1907, p.473.



Figure 1: H.R. Millar: illustration to "The Enchanted Castle".

Lion Chambers As Built.

Lion Chambers was entered in L. G. Mouchel's Project Record in February, 1905, as (British) project no. 922, sent in by T. J. Gueritte.²⁶ It was designed for William George Black, of Glasgow by Salmon & Son & Gillespie, F F.R.I.B.A., between 1904-6,²⁷ passed by the Glasgow city authorities in June, 1905²⁸ and built between then and April, 1907,²⁹ (figure 2). The ferro-concrete contractors were the Yorkshire Hennebique Contracting Co. Ltd. of Leeds,³⁰ (and internal, fire-resisting partitions were supplied by a company which had early experimented with reinforced concrete: Stuart's Granolithic Stone Co., Glasgow³¹), and as Lion Chambers rose, it was,

"one of the sights of Glasgow; for, wet or dry, gloom or shine, it always had at least three or four arrested spectators, staring up at it from over the way, these spectators largely made up of members of the building industries".

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Reinforced concrete was used to advantage to construct a tall building on a relatively small site (33' 1" wide³³), with wall beams carrying thin (4") reinforced concrete curtain walls,³⁴ and a window-wall for light adjacent to a narrow lane.

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26. Project Record No. 1. Nos. 1 to 8750, L.G.Mouchel & Ptrs. Ltd., 38, Victoria Street, Westminster: no. 922 sent by "Guirette."
27. Architects' Drawings; referred to below and detailed in Appendix I.
28. Dean of Guild Glasgow, Register of Plans, 2nd Series, 1904-10: 172 Hope Street, for Wm. George Black: date of decree: 1.6.1905.
29. Ib: reported completed, 11.4.1907. However, in April, 1906, said to be "nearing full completion": Novel Methods of Building Construction: The Lion Chambers Hope Street, Glasgow, Build. Inds., 16.4.1906, (pp.1-2), p.1.
30. The Yorkshire Hennebique Contracting Company Ltd., Leeds: catalogue, n.d.
31. Office Buildings and Business Premises, B.J., 28.11.1906, p272. Some of these partitions may have been "Mack" slabs (plaster with embedded reeds), e.g : Proposed Building Hope Street for Wm. Geo. Black Esq., 1/4" Detail of S.W. Office on 2nd Floor, Messrs. Salmon & Son & Gillespie, 19.4.1905. S.a: Building Trades Exhibition, C. & C.E., vol.6, no.5, May, 1911, p.356.
32. Novel Methods of Building Construction, op.cit. (29), p.2.
33. E.g: Proposed Building Hope St. for Wm. Geo. Black Esq. Plan of 1st Floor, Salmon & Son & Gillespie, F F.R.I.B.A., n.d. but referred to in Dean of Guild's decree, 1.6.1905, op.cit. (28).
34. E.g: W.N.Twelvevrees, Concrete-Steel Buildings, reported in: Build. Inds., vol.18, 15.7.1907, p.53.

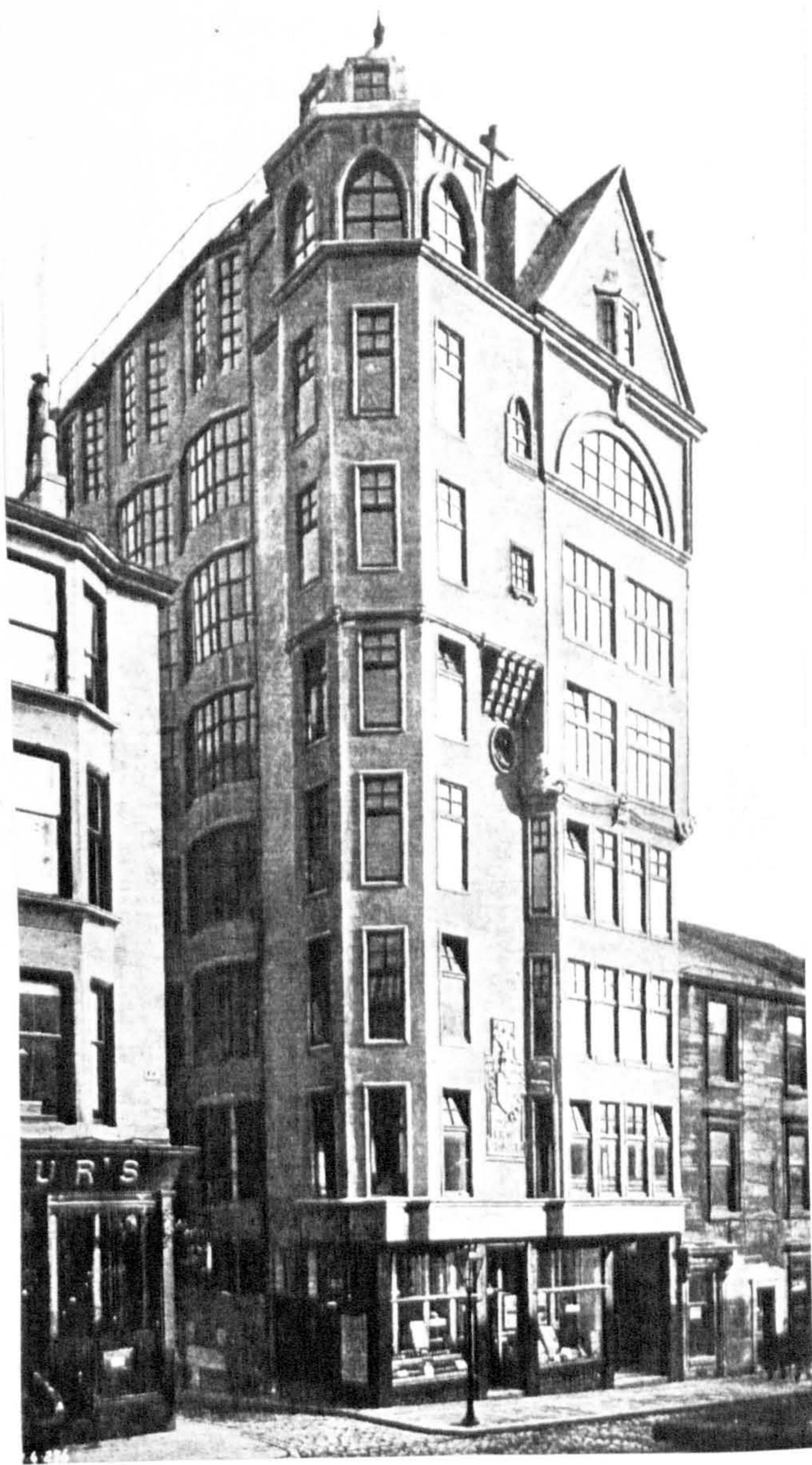


Figure 2: Lion Chambers Glasgow.

Before recent renovation,³⁵ Lion Chambers was visually recognisable as an early reinforced concrete (Hennebique) building by its peculiar yellow-grey rendered surfaces, but it is unique in style.

Apart from its practical virtuosity, Lion Chambers is one of many original (and often exuberant) buildings in Glasgow around 1900: a vertical, slightly picturesque building, with reference alike to vernacular Scottish and English influences and Glasgow Art Nouveau. There was almost some classical detailing too, subsequently eliminated from the design.

Lion Chambers has a curious, "house-style" for a tall framed building (although such treatment was not uncommon³⁶) and a reminder of Arts and Crafts architecture, and suggestion of "Tudor" in its plain, steep, gables and narrow overhanging front bay, (the latter perhaps emphasised in the reduced scale of illustration³⁷), but the "Tudor" reference is a result not only of the forms of the front elevation, but also an evident lightness of construction, (as in timber-framed houses).

Sir John Summerson (1976) considered "free Tudor" the most ubiquitous stylistic influence in an eclectic period, in 1900,³⁸ (although the lightness of its wooden houses may not have been the most fashionable allusion).

Then, Lion Chambers has evident references to the domestic Scottish castle discussed by James Salmon and which are significant in its style, notably the plain surfaces to the window edges, small cornices as well as its verticality, the corner turret and chimney stacks rising from the wall face.

35. Appendix I.

36. E.g: contemporary London tenements employed a house-style for tall (domestic) buildings.

37. See Figure 2.

38. John Summerson, The Turn of the Century: Architecture in Britain Around 1900, Glasgow, 1976, p.24.

Charles Rennie Mackintosh also made use of these features in the exteriors of his buildings,³⁹ (and, as John Summerson (1976) points out, Tudor influences⁴⁰), but unlike Lion Chambers, Mackintosh's buildings are substantial in appearance, although windows and decorative details in themselves might be delicate but positive expressions of "Glasgow Art Nouveau", (as for instance in the School of Art (1897-1909)⁴¹).

Lion Chambers, on the other hand, especially at the angle of the two street facades, (Hope Street and Bath Lane), has a general air of tenuity in its thin verticality, with the large areas of fenestration in these elevations, especially the faceted polygonal window-wall to Bath Lane and, notably, the evident thinness of the walls, emphasised by the windows being in virtually the same plane. The linear decorative effect of the glazing bars - the only ornament of much of the facades - contributes to the effect of a certain delicacy.

Furthermore, taking advantage of the frame, the building is designed as if "suspended" in two places; at street level, the walls "rest" lightly on vertical grilles of thin iron squares and glass,⁴² (figure 3), then the fascia over the shop defines itself visually as a "plinth" supporting the upper storeys, (especially as the shop beneath was coloured darker than the rest of the building over it⁴³). This effect, as well as the real lightness of the upper storeys was incidentally a successful resolution to the contemporary "shop problem".⁴⁴

39. E.g: Hill House, Helensburgh (1902-5) illust: Nikolaus Pevsner, Charles Rennie Mackintosh, in: Studies in Art, Architecture and Design, Vol.2, London, 1968, p.163, figures 27 - 8.

40. Summerson, op.cit. (38), p.24.

41. Illusts: Tim Benton and Sandra Millikin, Art Nouveau, 1890 - 1902, Open University Unit, 1975, p.36 ff., Plates 53-8, 73-5, 79-82. Own photographs.

42. Since I photographed the grille, it has been covered over.

43. See Figure 2.

44. Discussed in Chapter 4.

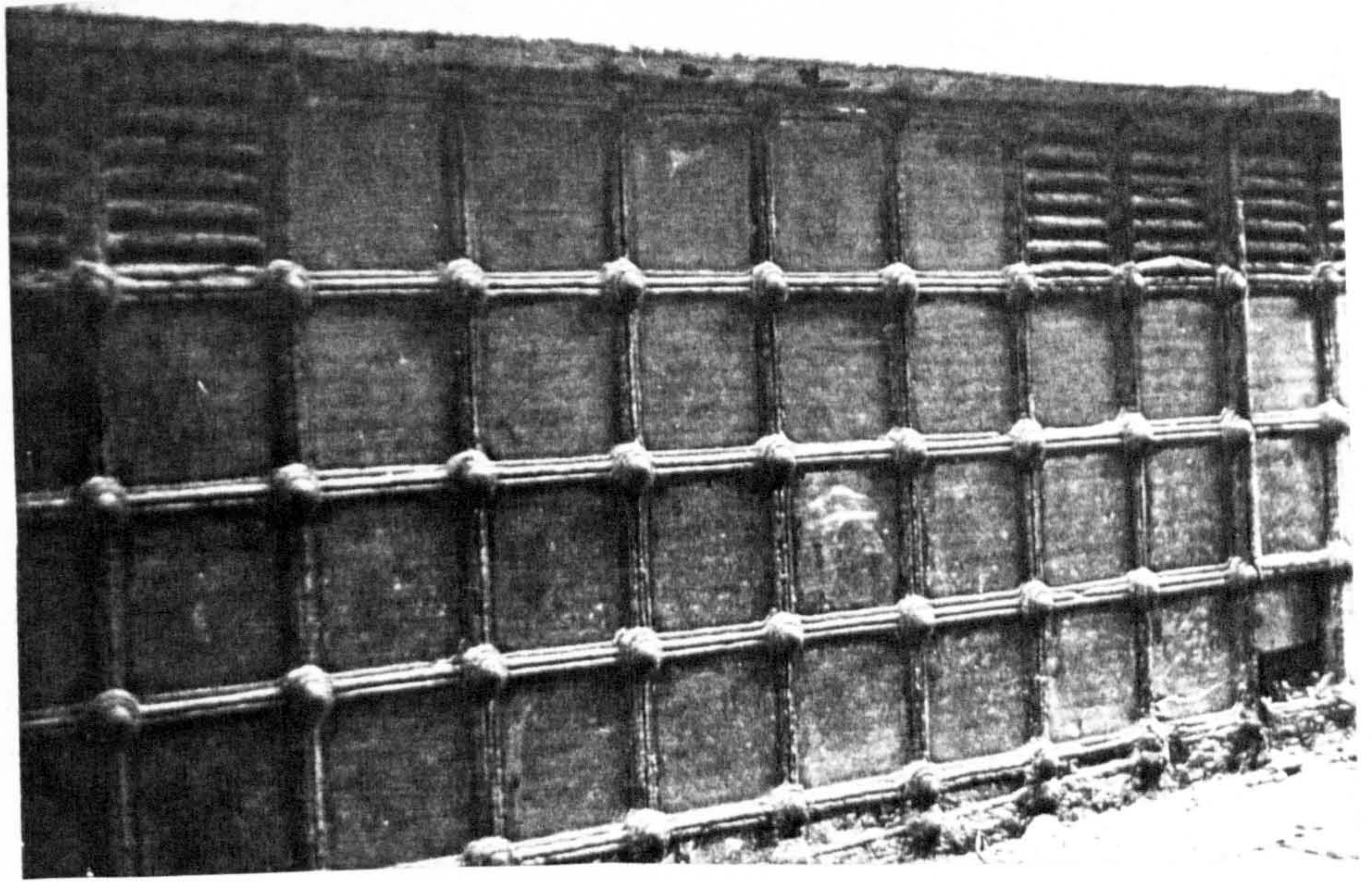


Figure 3: Lion Chambers Glasgow: detail of grille
ground floor level, Bath Lane.



Figure 4: Lynn House West Hartlepool.

The projections in the elevations, including the geometrical undulation of the window-wall, also give variety against flatness, as well as interior space.⁴⁵

The general effect of the street elevations, with their vertical tenuity, lightness and linear decorativeness - depending on the use of the reinforced concrete frame and thin (4"⁴⁶) reinforced concrete walls - has some affinity with Glasgow Art Nouveau (usually exemplified in interior design). James Salmon, and John Gaff Gillespie to a lesser extent, were both friends with Charles Rennie Mackintosh,⁴⁷ one of the key exponents of the new style.

The "parabolic" arches in the upper turret and wavy mouldings over the cupola windows have some reference to curvilinear Art Nouveau, but in relation to the design as a whole, the former appear disproportionate and ostentatious and the corbels over them somewhat coarse, (even though intended to be seen from ground level).

In the front (Hope Street) elevation of Lion Chambers, despite its apparent simplicity, there are several unusual or unexpected features and details, (perhaps not without some relation to Art Nouveau, insofar as unexpectedness is a characteristic of such design).

Thus, the turret and bay merge with the plane of the main facade for part of their height, while defined by their fenestration, while the transition is masked by the decorative corbels and porthole window.

45. Figure 2; Proposed Building Hope St. for Wm. Geo. Black Esq. Plan of 3rd Floor, Messrs. Salmon & Son & Gillespie, Architects, Glasgow, April 5th, 1905. S.a: Twelvetrees, op.cit. (34), and: David M. Walker, Salmon, Son, Grandson and Gillespie, Scot. Art Rev., vol.10, no.3, 1965-6, pp.21, 28-9.

46. Twelvetrees, op.cit. (34). Proposed Building for Wm. Geo. Black Esq. Elevations and Section, Salmon & Son & Gillespie, 53 Bothwell Street, Glasgow, 15.4.1904.

47. Jack Coia, (former pupil of John Gaff Gillespie), personal interview, Glasgow, 30.5.1979.

Then, at the angle of the front (west) and staircase (south) facades, the front bay starts from the adjacent wall, by means of a corner window, (enabled by the reinforced concrete frame), and marked by one of two sculptural figures of judges; (these were precast in plaster moulds and tied into the building⁴⁸). The placement of the judge-figure is itself slightly curious as it presides over this transition.⁴⁹

Three small windows at the front, porthole, oblong and arched, as well as three in the staircase facade next to the corner, (enabled by the frame) are again, odd, "picturesque" details.

The cupola was crowned with a metallic, tulip-like motif (less geometric than C. R. Mackintosh's metal decorations),⁵⁰ while the flow of a heraldic motif onto the adjoining bays perhaps borrows a technique from Art Nouveau. The heraldic emblem was apparently never coloured,⁵¹ although James Salmon recommended heraldry as a means of contrasting bright colour with the grey surface of reinforced concrete walls; (perhaps there were technical problems).

The interior of Lion Chambers, where little original remains in view, did not possess any unusual planning features, apart from the use of most of the ground floor as a clear shop space.⁵² The offices, and artists' studios on the top floor,⁵³ were extremely plain in appearance, although perhaps wood-panelled,⁵⁴ but on the landings to the southern staircase, some elongated door-frames (but not the original doors) remain, definitely Art Nouveau (of the vertical, rectilinear, Glasgow, kind) in quality.

48. Twelvetreets, op.cit. (34).

49. Own photographs.

50. Own photographs from roof of Lion Chambers. S.a: Building for Wm. Geo. Black Esq., Glasgow. Construction in Hennebique's Patent Ferro-Concrete. Cupola, no. 922, plan no. 24, 7.12.1905.

51. Figure 2. Own inspection.

52. Architects' Plans, 19.4.1905, including: 1/4" Plan of Shop Floor; Plan of 1st Floor (2nd Floor similar); Plan of 3rd Floor (4th Floor similar).

53. Plan of Top (7th) Floor, 6.4.1905; Office Buildings, op.cit. (31).

54. Illust. Hennebique Ferro-Concrete, London, 4th edn., 1921, p.113.

A smaller, (three-storeyed) reinforced concrete shop/office building, in Lynn Street, West Hartlepool, (figure 4), built entirely on Coignet's system, at the same time (1906-7) as Lion Chambers,⁵⁵ makes an interesting comparison, although unfortunately no longer extant.⁵⁶ Lynn House was designed for M. Robinson & Sons Ltd., (retailers of boots and clothing), by Harry Barnes, A.R.I.B.A., of Newcastle on Tyne, and Charles F. Burton, M.S.A., of West Hartlepool.⁵⁷

At the ground floor, Lynn House, situated on a street corner, has a continuous curve of glass, (later a feature of the "International Style" - but here its flat smoothness is broken by a series of globe lights suspended in front of the window plane⁵⁸). Such glazed corners were probably not uncommon at this time, when architects were deploring the, "acres of shining glass" in metal-framed shop buildings.

Above this, the frame is expressed in the elevation, faced with faience and infilled with windows, including large glass discs with paintings illustrating the company's other business premises.⁵⁹

Despite these features, the architects clearly intended an impression of a certain substance and depth as well as formal variety, in the elevations, demonstrated, for instance, in the general proportions, in oriel windows recessed under a deep cornice, and in a fairly substantial corner-cupola (not unlike one of the initial designs for Lion Chambers); in this, as in details, Lynn House diverges from the expression of Lion Chambers, although both are clearly framed constructions; (Lynn House could be metal framed from its appearance, although apparently the use of reinforced concrete enabled wider spaced pillars at the corner than would otherwise have been practicable.⁶⁰)

55. Lynn House 1907, Advert. feature, Northern Daily Mail, 20.3.1907.

56. Enquiries made by Reference Librarian (Miss Hoban) at Hartlepool Central Library (1979).

57. Lynn House 1907, op.cit. (55). Who's Who in Architecture, London, 1914, pp.22 and 41.

58. Illust: M.T.Cantell, Reinforced Concrete Construction, London, 1912, p.235, figure 242.

59. Lynn House 1907, op.cit. (55).

60. Ib.

Lynn House, again with faintly Tudor, as well as classical, references, was described in The Northern Daily Mail (1907), as,

"combining with the utilitarian requirements of today something of the picturesque effect associated with the buildings of an earlier date.....possessing.....an old-world-charm " . 61

Perhaps Lion Chambers, with its vernacular references, also possessed something of an "old-world-charm".

A. O. Elzner's slightly earlier reinforced concrete office block, (1902-4: the Ingalls building: figure 5), in Cincinnati, U.S.A., on the other hand, has an affinity with the American metal-framed tall office buildings developed from the 1850s. This again makes an interesting comparison with Lion Chambers, especially in view of general similarities of attitude to reinforced concrete noted between James Salmon and A. O. Elzner.

As in Lion Chambers, a positive - although different - use is made of the reinforced concrete frame in the design, (and in neither is it the "chief ornament" in the way that A. Perret for example perhaps considered appropriate⁶²). The Ingalls building has a regular grid of windows, flat roof, and wide-brimmed cornice, and the frame is employed effectively to differentiate the base and top of the building, in a classical tradition, by changing the grid pattern and proportions.

Although the Ingalls building was faced with glazed bricks and tiles, Elzner considered reinforced concrete, appropriately employed, should

61. Ib.

62. Auguste Perret, Contribution à Une Théorie de l'Architecture, Tech. et Arch., 1949, (pp.108-9), p.109. S.a: Peter Collins, Concrete, London, 1959, p.193, and illusts: A. Perret's aparts., rue Franklin (1903), Pls. 50-1; Garage, rue de Ponthieu (1905), Pl. 52A.



Figure 5: The Ingalls Building Cincinnati.



Figure 6: Spanish Villa Tillycorthie.

be "visible" and jointless⁶³ (not divorced from Salmon's "plain surfaces", perhaps) and the tiled surfaces were used to give a continuous, smooth effect (later a tenet of the International Style).

A later, ferro-concrete mansion (1911-12: figure 6) in Tillycorthie, Aberdeenshire, designed by John Cameron for James Duncan⁶⁴ is also worth mentioning briefly, as an example which drew more literally than Lion Chambers on Scottish, baronial, influences, complete with harled surfaces, as well as for its early use of reinforced concrete in a large domestic building in Britain,- although there is little evidence of this use in the design, apart from a tendency to rather coarse shaping. The mansion managed to indicate the solidity of stone with some success, (for example, in window reveals), since the walls were in reality 16" deep, although consisting of two reinforced concrete partitions (5" and 4"), with an airspace inbetween.⁶⁵

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63. Elzner, op.cit. (6).

64. E.g: Project Record No.1, op.cit. (26): recorded, 5.2.1912 and executed. See Appendix I for further sources. James Duncan was mentioned in Chapter 9.

65. Spanish Villa: Tillycorthie, F.C., vol.4, July, 1912, - June, 1913, (pp.123-4), p.123. Own photographs. S.a: Appendix I.

Whose Building? The Progress of the Design.

The question of who in the partnership of Salmon and Son and Gillespie designed Lion Chambers, and what modifications may have occurred in the course of translation to ferro-concrete, between the architects' and specialists' designs, is not entirely resolvable.

As far as authorship is concerned, architects' drawings which are available are signed jointly by the partnership.⁶⁶ James Salmon, F.R.I.B.A. is usually considered the dominant designer of Lion Chambers,⁶⁷ but although obituaries (1924), beginning with one in The Glasgow Herald, attribute Lion Chambers to James Salmon,⁶⁸ earlier articles on the building do not.⁶⁹

Jack Coia (1979), from 1916, John Gaff Gillespie's pupil, recognises the design of the front facade, notably the gable side, as, "undoubtedly" John Gaff Gillespie's work - and possibly also the turret (but excluding the "awkward" upper portion).⁷⁰ J. Coia adds that J. G. Gillespie's later partner, William Kidd, regarded Lion Chambers as Gillespie's building.⁷¹

A perspective of Lion Chambers published in Building Industries (April, 1906 and August, 1907) was signed by J. G. Gillespie,⁷² and is basically as executed, except that some decorative detail was omitted.

66. For details of drawings, see Appendix I.

67. Collins, op.cit. (62), p.82: source: A Reinforced Concrete Office Building, B.J., C. & S. suppl., 30.1.1907: but this does not specify Salmon. Walker, op.cit. (16), p.242: sources: Collins, ib; Novel Methods of Building Construction, op.cit. (29), and Office Buildings, op.cit. (31), do not specify Salmon. Service, op.cit. (16), p.115.

68. A Glasgow Architect. Death of Mr. James Salmon, The Glasgow Herald, 28.4.1924. James Salmon (F)., Obituary, J.R.I.B.A., 7.6.1924, p.513: partly based on the obituary in The Glasgow Herald, above.

69. E.g: op.cit. (67); s.a: Appendix I for further sources.

70. Coia, op.cit. (47).

71. Ib.

72. Illust: The Lion Chambers, Hope St. Glasgow, Build. Inds., 16.4.1906, p.9, signed J.G.G.: appears identical to illust. published in: Build. Inds., vol.18, 16.8.1907, p.73.

The window-wall elevation to Bath Lane, as executed, might have been introduced by James Salmon, considering its resemblance to the rear of Salmon's Mercantile Chambers (1897) in Bothwell Street⁷³ (where Salmon & Son & Gillespie had their offices⁷⁴). There is no indication that the third member of the partnership, James Salmon's father, W. F. Salmon,⁷⁵ was involved in the design of Lion Chambers.

If both J. Salmon and J. G. Gillespie were interested in Art Nouveau, John Gaff Gillespie, according to J. Coia, also had an inclination towards classical and "Spanish" influences.⁷⁶ The latter is perhaps discernible in a chequerboard motif, as if of coloured tiles, designed for the gable side of the front facade of Lion Chambers, in Gillespie's perspective drawing published in Building Industries (1906-7⁷⁷: figure 7), and which reappears in Gillespie's entry (1909) for The British Architect's competition for a ferro-concrete shop and offices.⁷⁸ However, although Gillespie's perspective of Lion Chambers was close to the executed building, this decoration was never applied.

Earlier architects' drawings, in April, 1904,⁷⁹ and in April, 1905,⁸⁰ (among those passed by the city authorities), differed from this, and from Lion Chambers as executed, in details and the upper part of the turret. The windows in the north elevation, to Bath Lane, (April, 1905: not visible in Gillespie's perspective sketch) - also differed from the executed design, repeating the basic shape of the front bay windows,

73. Illust: Walker, op.cit. (16), p.238; s.a: pp.237, 239.

74. The address of Mercantile Chambers (no. 53, Bothwell St: A Glasgow Architect, op.cit. (68), is the same as that on Architects drs. for Lion Chambers: Appendix I.

75. Walker, op.cit. (16), p.247, calls W.F.Salmon the firm's "commercial traveller".

76. Coia, op. cit. (47): Gillespie travelled in Spain.

77. Op. cit. (72).

78. Discussed later this chapter.

79. Proposed Building Hope St. for Wm. Geo. Black, Esq. Elevation to Hope St. and Section, Messrs. Salmon & Son & Gillespie, Architects, 53, Bothwell St., Glasgow, April 15th, 1904.

80. Proposed Building. Hope St. for Wm. Geo. Black Esq. Elevations: W.Elevation to Hope St. N. Elevation to Bath Lane, Messrs. Salmon & Son & Gillespie, Architects, 53, Bothwell St., Glasgow, April 18th, 1905.

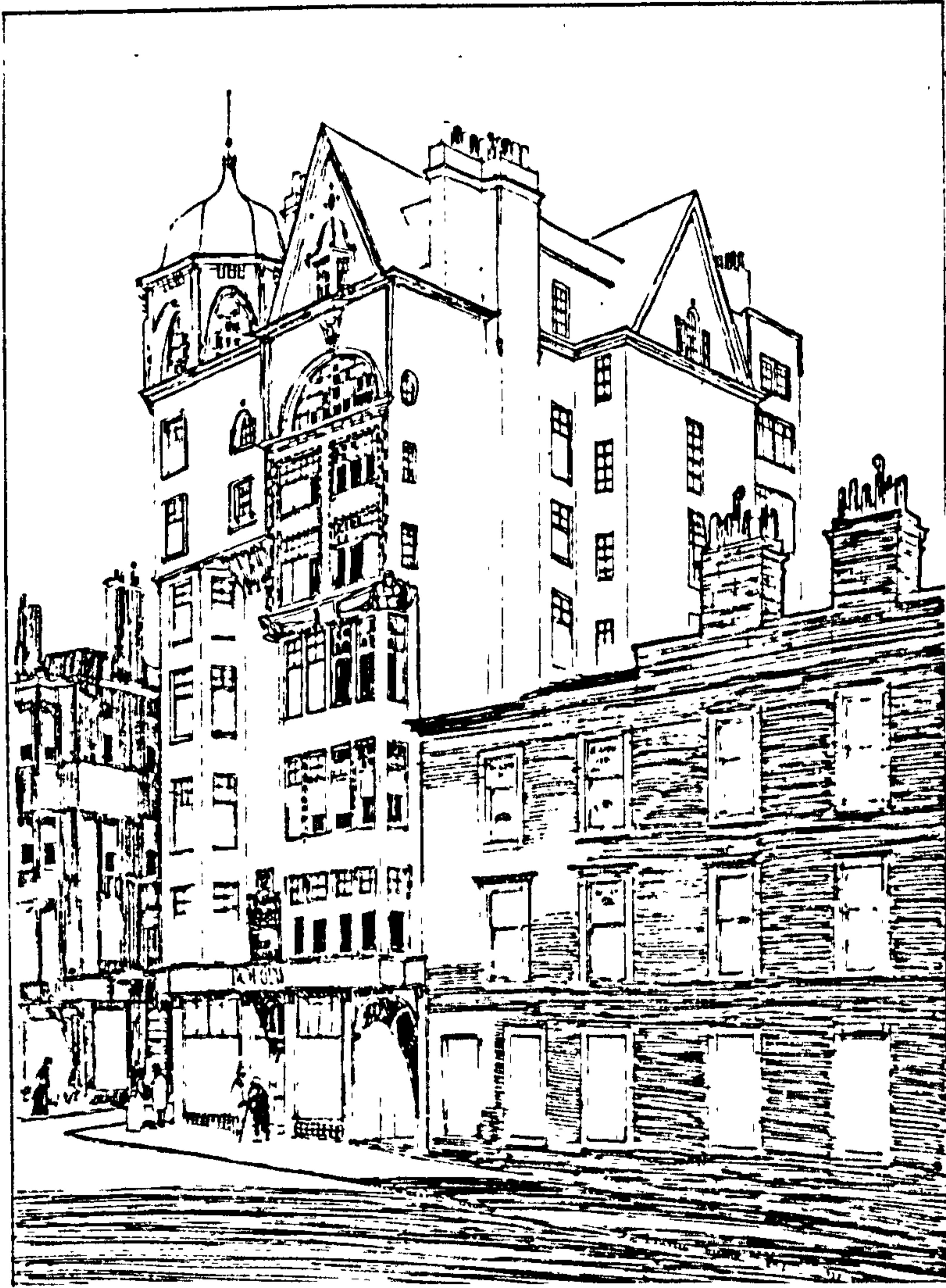


Figure 7: Lion Chambers Glasgow.

but as units in a "window-wall".⁸¹

The upper part of the turret, (that is, the arched windows, corbels and cupola), of Lion Chambers was eventually perhaps one of the least successful aspects of the executed design,⁸² and so its development and considerable modification, is of some interest. Notably, the cupola was taller in proportion than executed, without windows and supported by classical columns, enclosing an inner turret with thin, straight-sided, arched windows,⁸³ the columns again suggesting Gillespie's hand, (figure 8).

However, between the dates of these drawings, in January, 1905, an elevation for Hope Street and working plan, emanating from L. G. Mouchel's office, shows a design with a "shorter" cupola, no columns, the turret window approaching its more parabolic shape and with corbels above, more or less as executed,⁸⁴ and a note on the plan advises,

"for shape of opening, refer to architect's drawing ". 85

Apparently, the architects or perhaps J. Salmon, introduced such a design, or something near L. G. Mouchel's or his engineer's approximate shaping, for this part of the building, then returned to the previous design, (with elongated cupola and columns). Again it is possible that the client, William G. Black, a man with artistic interests, and, judging by his prolific writings, pronounced opinions, intervened at various stages in the design for Lion Chambers.

81. Ib.

82. Also J. Coia's opinion, op.cit. (47).

83. Proposed Building. Hope St., op.cit. (79). Proposed Building. Hope St., op.cit. (80). Cf: Proposed Building. Hope St. for Wm. Geo. Black Esq., Plan of Top (7th) Floor, Messrs. Salmon & Son & Gillespie, Architects, April 6th, 1905.

84. Own photographs, including cupola photographed from roof.

85. Building for W.G.Black Esq. Glasgow. Construction in Hennebique's Patent Ferro-Concrete. Hope St. Elevation Above 7th Floor, no.922, plan no. 26, Working Plan, L.G.Mouchel, C.E., 38, Victoria Street, Westminster, 17.1.1905.

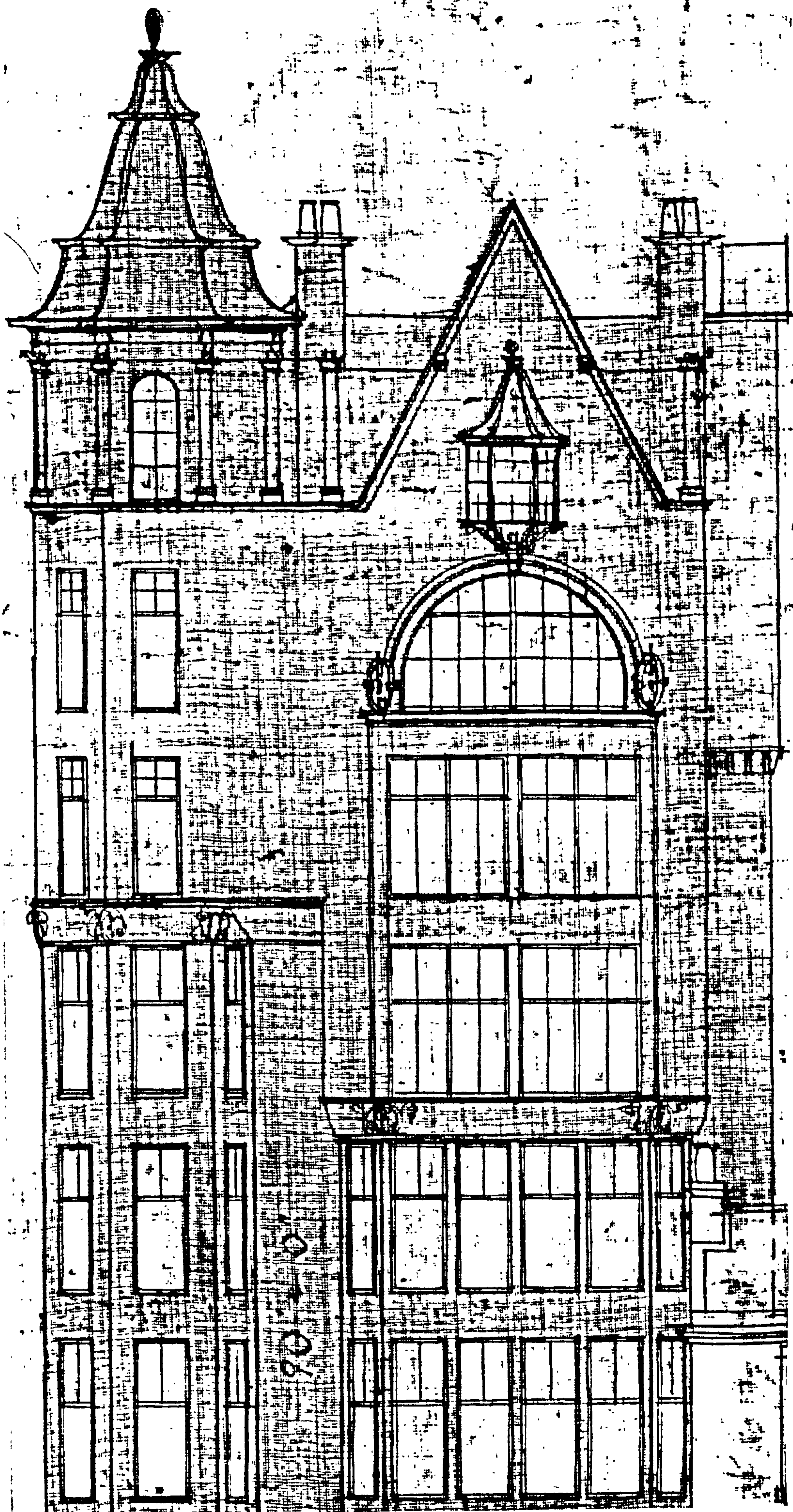


Figure 8: Lion Chambers Glasgow: Elevation to Hope Street,
April 1904.

A working plan from L. G. Mouchel's office later the same year, in October, 1905, is different again, with the cupola proportions more as in the earlier elevations, but small windows with curved heads perched near the top, and beneath, "parabolic" arched windows,⁸⁶ (figure 9). In December, the proportions are again similar to the executed cupola but a "shield" motif appears⁸⁷ - which was also employed by J. G. Gillespie in his competition design (1909) for a ferro-concrete shop/office building.⁸⁸

By January, 1906, when another working plan from L. G. Mouchel's office, shows the cupola again shaped as executed,⁸⁹ a late decision was taken to simply render it,⁹⁰ instead of applying asphalt.⁹¹ This was done, according to W. Noble Twelvetrees (1907) for the sake of "architectural effect",⁹² (although subsequently, the cupola was covered with copper⁹³).

The window-wall to Bath Lane changed between April, 1905, when the windows resembled those intended for the bay in the Hope Street elevation,⁹⁴ (more or less as executed), and December, 1905,⁹⁵ when the Bath Lane elevation was closer to the executed design, and more like the rear elevation

86. Building for W.G.Black Esq., Glasgow. Construction in Hennebique's Patent Ferro-Concrete. Hope Street Elevation, no. 922, plan no. 15, (modified), Working Plan, L.G.Mouchel, C.E., 38 Victoria Street, Westminster, 18.10.1905.

87. Building for W.G. Black Esq., op.cit. (50).

88. Discussed later this chapter.

89. Building for W.G.Black Esq. Glasgow. Construction in Hennebique's Patent Ferro-Concrete. Tower Roof, no. 922, plan no. 27, Working Plan, L.G.Mouchel, C.E., 38 Victoria Street, Westminster, 17.1.1906.

90. Ib: "cement coating" specified. Cf: Chapter 3, and Cantell, op.cit. (58), pp.88, .92.

91. Building for W.G.Black Esq., op.cit. (50): "asphalt" specified for cupola. Cf: Building for W.G.Black Esq., Construction in Hennebique's Patent Ferro-Concrete. Roof, no. 922, plan no. 22, (modified), 10.1.1906.

92. Twelvetrees, op.cit. (34).

93. Own inspection and photographs.

94. Proposed Building Hope St., op.cit. (80).

95. Building for W.G.Black Esq., Glasgow. Construction in Hennebique's Patent Ferro-Concrete. Bath Lane Elevation, no. 922, plan no. 16, (modified), Working Plan, 9.12.1905.

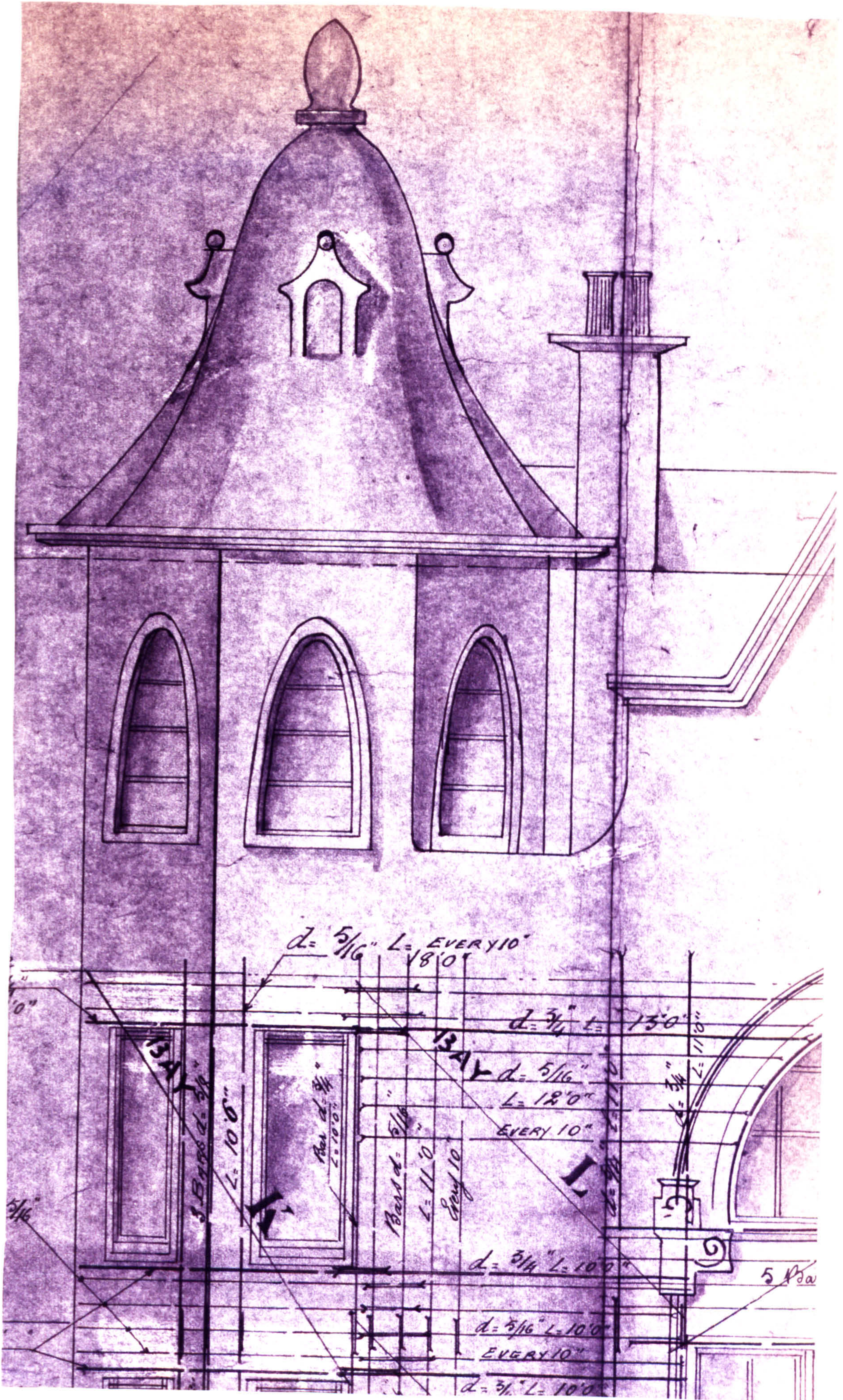


Figure 9: Lion Chambers Glasgow: Elevation to Hope Street: tower October 1905.

to Mercantile Chambers, Bothwell Street;⁹⁶ (on the assumptions that J. G. Gillespie designed the front elevation to Lion Chambers, and James Salmon, the rear of Mercantile Chambers, this suggests Salmon's design replacing Gillespie's).

The executed design, in this instance, was not inferior and in some details an improvement - notably, the upper row of three windows with reinforced concrete mullions, varying the design from the remainder of the facade, in place of, (in the design of April, 1905), a somewhat untidy arrangement for the upper storey to Bath Lane, of nine separate, small-paned windows in three new sizes.

Although the thin, vertical grille at the base of the building appears in an early architect's drawing (April, 1904), the fascia over the shop is not here yet visually defined as a "plinth" for the upper storeys,⁹⁷ but it was part of the design by April, 1905, perhaps initially to carry the shopkeeper's name, inserted in the drawing, (although not apparently added to the executed building).⁹⁸

At this time, also, a circular, decorated window was planned for the south elevation,⁹⁹ but eliminated, perhaps because of the difficulty of constructing arched shapes noted by Salmon (1908),¹⁰⁰ and replaced by a second gable, like that to Hope Street.

96. Illust. Walker, op.cit. (16), p.238.

97. Proposed Building.Hope St., op.cit. (79).

98. Proposed Building.Hope St., op.cit. (80).Cf: Figure 2.

99. Proposed Building. 172 Hope Street for W.G. Black, South Elevation, Messrs. Salmon & Son & Gillespie, Architects, 3.4.1905.

100.Salmon, op.cit. (3), p.271.

In October, 1905, the architects had also introduced mermaid "caryatids" around the turret,¹⁰¹ and by December a bubbly crown over an elongated cupola.¹⁰² The judge-figures and the little windows in mid-facade (Hope Street) were a later addition and had not appeared by late 1905.

The basic shape for Lion Chambers was therefore decided by early 1904: the overall design and especially the front facade was probably J. G. Gillespie's, with the window-wall to Bath Lane, as executed, possibly introduced by James Salmon, by the end of 1905. Other features of the design which visually acknowledged the framed construction were introduced separately - the "grille" in April, 1904, and the "plinth" by April, 1905.

An initial design for the cupola and turret, with a more elongated shape than executed and classical columns, was probably J. G. Gillespie's and this was retained for at least a year, although another design with "parabolic" windows and without columns intervened, and later reappeared, in drawings from L. G. Mouchel's office and was closer to that executed.

It is difficult to say whether this change took place for constructional (formwork) reasons - certainly it was based on a new architects' design, (to which L. G. Mouchel's plans refer).

The construction of Lion Chambers was carried out in peculiarly difficult circumstances, because of site restrictions,¹⁰³ but there is no reason to believe that the architects' adopted design (with its arched windows) would have been easier to execute than the versions it

101. Building for W.G.Black Esq., op.cit. (86).

102. Building for W.G.Black Esq., op.cit. (95).

103. Twelvetrees, op.cit. (34).

replaced: indeed, it may have been more difficult, and it is possible that the upper part of the turret was more coarsely executed in ferro-concrete than designed by the architects.

Alternative decorative features to those executed, included some mermaid-like figures (October, 1905), and some chequerboard "tile" motifs (April, 1906) almost certainly Gillespie's design, like previous, "classical" details.

J. Coia (1979) considered the corbels and heraldry "too fussy" for Gillespie,¹⁰⁴ although Gillespie's competition design (1909) contained a variety of curious details. Perhaps the sculptural judges added later were Salmon's idea, since he was interested in sculpture and the idea of decorating reinforced concrete buildings with modelled ornaments.¹⁰⁵

It is possible that further decoration was intended for Lion Chambers, since the existing (heraldic) decoration for some reason was apparently uncompleted.

James Salmon did not use ferro-concrete in practice again in this period, but John Gaff Gillespie included some ferro-concrete roofing, and a 55' ferro-concrete flagpole, in his Municipal office buildings (1914) in Stirling.¹⁰⁶

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104. Coia, op.cit. (47).

105. Salmon, op.cit. (3), pp.271-2.

106. Mouchel-Hennebique Ferro-Concrete. List of Works: 1897 - 1919,
L.G.Mouchel & Ptrs. Ltd., 38 Victoria Street, S. W. 1., p.27.
Own photograph.

John Gaff Gillespie's Competition Design for Ferro-Concrete Shop/Offices.

In 1909, John Gaff Gillespie won a competition in The British Architect for a design for a facade of a shop/office building in ferro-concrete,¹⁰⁷ (figure 10).

His design is somewhat different from Lion Chambers, insofar as it is severely abstract in outline and symmetrical, with a roofline something like a Scottish stepped gable on an exaggerated scale, (and not unlike a gable-front by W. Dunn and R. Watson, illustrated in The Architectural Review (1902)¹⁰⁸). At the same time, it is essentially decorative in conception, and with decorative features in common with Gillespie's perspective drawing for Lion Chambers. Bay windows and balconies vary the (otherwise flat) surface, with a small, upper bay similar to the front gable-window in Lion Chambers, and some unusual "corner" windows in the gable are not unrelated to the curiously placed corner windows in Lion Chambers.

The British Architect (1909) commended the design as,

"best for the specific material (being) an articulation of mass, as opposed to the usual constructive details of stone or brick",

and summarised its rather odd, decorative effect, with an exotic touch of marble cased columns with bronze caps and floated ground marble and cement surfaces, heraldic emblems and flowing "Art Nouveau" figures on the balcony and some Mackintosh-like mullions for the central shop window, somewhat inadequately as, "picturesque".¹⁰⁹

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107. Ferro-Concrete Design for Shop and Offices, Brit. Archt., 25.6.1909, p.454.

108. No.46 Gt. Marlborough St. London, W., W. Dunn and R. Watson, architects, A.R., vol.12, 1902, illust: p.78.

109. Ferro-Concrete Design for Shop and Offices, op.cit. (107).



Figure 10: John Gaff Gillespie's design for
Ferro-Concrete Shop and Offices (1909).

Conclusion.

It seems likely that John Gaff Gillespie was responsible for the basic design for Lion Chambers, and the front elevation to Hope Street, including some of its idiosyncratic details, but James Salmon may have contributed the window-wall to Bath Lane as executed, and possibly intervened to modify parts of the design which underwent considerable changes, (such as the upper part of the turret).

Had the front elevation to Hope Street been completed according to John Gaff Gillespie's design published in Building Industries as late as 1907 (the year the building was reported finished), it might have been decorated with chequerboard patterns and colours, instead of uniformly rendered with yellow-tinted mortar, making the effect here less allusive to the,

"plain.....surfaces extending to the window-sashes",

of the Scottish castle, (to which Salmon referred), and bringing it closer to J. G. Gillespie's opulent winning entry (1909) in The British Architect's competition for a shop and office building in ferro-concrete, (the subject perhaps inspired by Lion Chambers).

During the designing of Lion Chambers, there was some oscillation in shapes and details, particularly for the upper part of the turret which (leaving aside the blank East wall behind the building) emerged as one of the less successful features.

Although the reasons for such oscillation for this part are not clear, it seems likely that the final architects' designs may have been more coarsely executed than intended by the architects. A circular window for the upper storey of the South elevation was abandoned altogether, no doubt for constructional (formwork) reasons, and a second gable substituted on this side.

Ferro-Concrete (1910), which, like L. G. Mouchel earlier, asserted that,

"true ferro-concrete construction is characterised by lightness", 110
described Lion Chambers as,

. "One of the most successful attempts in this country to develop an appropriate style (for ferro-concrete)" . 111

In Lion Chambers, reinforced concrete was used not only to increase interior space, and provide the means for abundant light, (especially next to Bath Lane), but also in the exterior design to enable idiosyncratic decorative details and, notably, to give an impression of lightness. The faceted window wall, bay window and other devices modulate the elevations against "flatness" but the thinness of the construction remains clear.

In its impression of surface thinness, and in its verticality, Lion Chambers contrasts with another, smaller, reinforced concrete shop and office building, (Lynn House, West Hartlepool), built at the same time, and with an impression of depth and substance, although extensively glazed and more obviously a framed structure.

The lightness and linear decorativeness of Lion Chambers removes any literal reference to the Scottish castle style - in contrast to John Cameron's ferro-concrete, baronial mansion (1912) at Tillycorthie,

110. Ferro-Concrete in Architecture, F.C., vol.2, no.1, (pp.2 - 7), p.7.

111. Ib.

C O N C L U S I O N .

The Conclusion chiefly incorporates the main conclusions of individual chapters, with particular reference to the core themes described in the Introduction: L. G. Mouchel's establishment of Hennebique's system in Britain, and the architectural expression of the early buildings.

Since various companies and individuals had patented and employed reinforced concrete in Britain throughout the second half of the nineteenth century, chiefly for floors, beams and roofs, the general principle of reinforcing concrete was perhaps fairly widely known and practised in Britain when F. Hennebique and his agent, L. G. Mouchel, introduced and applied Hennebique's system of reinforced concrete framing there from the late 1890s.

Despite significant gaps in contemporary knowledge relating to reinforced concrete, different systems proliferated from the late nineteenth century, especially in Europe, among which Hennebique's set several important precedents, while it was further improved in details and extended in applications by L. G. Mouchel in Britain. L. G. Mouchel's main achievement however was to establish and represent a technical-commercial organisation for Hennebique's system in Britain.

This broadly followed a model originated by Hennebique in Belgium, with regional technical offices and a network of accredited contractors and which Hennebique, who at this time was engaged in rapidly extending his organisation and the use of his system, helped Mouchel in various ways to initiate. L. G. Mouchel's attitudes and business arrangements differed in various ways from Hennebique's (for instance his criteria for selecting contractors), and Mouchel became increasingly independent. His position in Britain resulted however from Hennebique's policy of local autonomy for his agents, as well as Mouchel's own independent and entrepreneurial character. L. G. Mouchel's eventual success in Britain depended partly on these qualities and his extraordinary industry and perseverance: none the less, from Mouchel's own account (1902) it took him,

"five years of anxious and arduous work"
to bring Hennebique's system to public notice.

Some of these efforts were directed towards persuading local authorities in Britain to permit reinforced concrete construction, for which there was generally no special provision in building Acts or regulations in this period, although there were cases exempt from the regulations. In this, L. G. Mouchel claimed success, except in London. Mouchel may well have been supported by his existing, influential business acquaintances, among whom he found some of his early clients.

Among the practical motives why clients - mainly industrial and commercial companies - adopted reinforced concrete, economy of cost and space, and fire-resistance, were salient, while attributes later claimed as peculiarly characteristic of reinforced concrete framing and associated with new formal possibilities - superior daylighting and "free" planning, were comparatively little regarded in this period. Reinforced concrete was considered most economical for large, heavily loaded (and also plain) buildings, so that it was rarely employed, for instance, for domestic work.

In addition to their special, practical requirements, the early clients, notably those who adopted reinforced concrete for entire buildings, also tended to have innovative predispositions, shown in their business organisations and previous willingness to adopt new materials or processes.

L. G. Mouchel erected approximately 130 fully framed buildings in Britain (and many other reinforced concrete works) before 1908. Among these, despite the uncertain state of theory and practice, there were no significant failures, (although there was a fault of giving reinforcement inadequate cover resulting later in concrete spalling and metal rusting in exposed parts of structures).

None the less, as L. G. Mouchel's specialist organisation became established, from about 1904-5 it was being criticised by architects and engineers on several grounds, including an assumption that Mouchel was attempting to monopolise reinforced concrete construction in Britain. There was considered to be a need for "independent" design in reinforced concrete by architects and engineers, drawing on different systems as required, and with reference to some objective standard or rules.

Three organisations resulted, largely created by a small, dynamic group of architects and an engineer, directed towards objective studies of reinforced concrete for the benefit of architects and engineers. Of these, the R.I.B.A.'s Joint Committee on Reinforced Concrete issued a Report to its members (without any reference to specialists) which (although alternately reviewed as illuminating and abstruse), gave some semi-official sanction to the material. Concrete and Constructional Engineering provided a fairly comprehensive and cosmopolitan coverage of reinforced concrete practice and examples, but tended to oppose not only the specialist system, but L. G. Mouchel personally, mainly on the ground that he was a "foreigner". The Concrete Institute on the other hand, formed in the year L. G. Mouchel died (1908), endeavoured - not quite successfully - to provide a forum for the different interests in reinforced concrete in Britain by then, including specialists, architects, engineers and local government representatives.

Although, around 1900, architects were engaged for only 10% of buildings in general, they were largely employed, together with the structural specialists, for the early reinforced concrete buildings, including the majority of those entirely in reinforced concrete (and a greater than average proportion of them were R.I.B.A. members, therefore having some guarantee of competence or training in architecture).

The specialist system allowed that while the specialist designed the structure for a building and the specialist's contractor executed it, the client's architect or engineer had overall responsibility. In any case, many clients tended to regard the architect's primary function as distinct from structural design, (and architects, from their own account, were not expensive, although this was not always the public view.)

It is possible that in the case of all-reinforced concrete works, L. G. Mouchel and T. J. Gueritte, his Northern representative, encouraged the employment of architects, instead of engineers, to assist the expression of the new construction. Certainly, architects were not infrequently employed for large, commercial and industrial works and some of the architects for early reinforced concrete buildings were attached to commercial companies.

In the contemporary architectural "ideology" of the period around 1900, there was a significant preoccupation with the ideal of evolving a modern, "style for the twentieth century" - especially to improve commercial architecture - but while there also existed stylistic ideologies of, "structural rationalism" (that styles should be derived from materials and structures), the ideal of a modern style was more frequently associated with formal adaptations of a "Renaissance" mode popular in Britain then. The modern structural materials, reinforced concrete and steel, were hardly mentioned in the expression of ideals for advances or innovations in architectural style, nor was reinforced concrete employed in, or relevant to, many novel, individual, eclectic, formal experiments at this time, as well as examples of an, "anti-style" movement, excepting an occasional use of flat, reinforced concrete roofs. This is not to say that architects were unaware of new formal implications in reinforced concrete construction.

A number of architects' designs for entirely reinforced concrete buildings conformed to the common "Renaissance" styling and perhaps without any particular efforts to innovate. This adoption of a popular formal mode was perhaps encouraged by the facts that:

- (1) In the usual sequence of design, the specialist adapted reinforced concrete to general designs first prepared by the architect, so that the chances of specific influences of structural designs on architects' designs were minimised.
- (2) While architects acknowledged that the structural and visual character of reinforced concrete presented new artistic problems, they were in general more concerned to mitigate the expression of the thinness and flatness of panel-walling and the monotony of plain surfaces, while L.G. Mouchel and T.J. Gueritte advocated the capacity of reinforced concrete for moulding to any shape or detail, (although the "Renaissance" styling employed was not economical and Mouchel may have had to simplify some of these designs.)

To meet a further problem, of the uneven colour and quality of bare or rendered surfaces, some of these "classical" buildings were faced with a rendering tinted yellow, which was considered to avoid a patchy appearance.

In France, the identification of similar artistic problems,

(flatness and surface quality) may have influenced certain aspects of A. Perret's design for his well-known apartment block (1903) in rue Franklin, Paris, which however incorporated the fine proportions which reinforced concrete allowed.

Some examples among the early buildings in Britain, including three designed by architects, also displayed the "thinness" of reinforced concrete framed construction, several in simple economical facades, styleless except insofar as they might be related to the Functional Tradition. In one, exceptional, example in Scotland, Lion Chambers (1904 - 7), in Glasgow, the architects, J. G. Gillespie and J. Salmon, F.F.R.I.B.A. - who probably had some technical understanding of reinforced concrete - referred instead to a Scottish, domestic, vernacular model, which Salmon subsequently described, in an adaptation of "structural rational" logic, as appropriate for reinforced concrete construction (although Lion Chambers almost included classical features too). At the same time, Gillespie and Salmon employed the frame and thin, (yellow-tinted) walls to create an idiosyncratic and "appropriate" expression for reinforced concrete, incorporating verticality and lightness in a style also allied to a contemporary artistic movement peculiar to Glasgow, ("Glasgow Art Nouveau").

Although part of Lion Chambers was roughly executed and the decoration incomplete, this and two Co-operative buildings (1903 - 4) in Jarrow, designed by J. Cordiner, represent interesting designs, among a number of quite successful buildings and including "classical" and "functional" examples, such as a soap factory (1907 - 9) at Dunston (architect, L. G. Ekins, F.F.R.I.B.A.) or a flour mill (1897 - 8), in Swansea (designed by H. C. Portsmouth, M.S.A.), several of which - among the classical examples - were particularly admired by contemporaries.

The contrasting, "International Style", developed by architects after the first War, closely associated with the use and expression of reinforced concrete, accommodated the flatness, as well as the thinness, of panel-walled construction and the want of shadows from projecting details, (although light and shadow, dramatised, were significant in its architecture), in an expression or group of expressions, which rejected traditional styles, including vernacular allusions such as Lion Chambers, and various, Functional examples, had incorporated.

However, the International Style, subsequently associated with a specific period, no less than previous architectural expressions for reinforced concrete, was perhaps more a question of aesthetic choice allied with contemporary and local expressive needs, than an outcome of employing a new construction; (while, in both periods, ideologies of "structural rationalism" were current, and interpreted, to some extent, to suit aesthetic preferences).

Architects' use of a new material in a particular culture, such as reinforced concrete framing in Britain around 1900, insofar as it offers, and is seen to offer, new formal possibilities, and makes customary expressions difficult, or inappropriate, may tend to demonstrate or emphasise prevailing architectural values through efforts to achieve them:- the adoption of a "Renaissance" mode in reinforced concrete for a small group of buildings in England, perhaps provides better supporting evidence for one of the stylistic propensities of the period and place than would the same designs executed for stone, (even though the architects were accustomed to work in stone). Lion Chambers, in Glasgow, represents an interesting example of the influence of a local artistic movement, as well as evidence of specific, local, aesthetic influences upon the exceptional use of a new construction.

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A P P E N D I X I.

Introduction.

Appendix I comprises a selective list with details of individual reinforced concrete framed buildings in Britain from 1897, with particular reference to those having reinforced concrete panel or curtain walls (but includes two examples of roofs, and the first two "Hennebique" water towers). Nearly four-fifths of these are mentioned in Chapters 1-11, while the remaining examples are justified by their early date, especially those built in the 1890s, because they represent other systems than Hennebique's applied in entirely reinforced concrete structures, or their intrinsic interest, and in the latter categories are included some buildings designed and constructed between 1908 and 1912.

Unless stated, Hennebique's system was employed and the structural drawings executed in L. G. Mouchel's (or in the case of the later buildings, L. G. Mouchel & Partners') offices.

The works are arranged chronologically: where possible, two dates are given, firstly the month and year of the earliest known drawings, or entry in L. G. Mouchel (& Partners') Project Record, or the signing of the contract (which sometimes predated such entry) and secondly, the date of completion of construction. The Summary of Structures Included gives the year of the first date only. Where the name of the architect/engineer, or contractor, is omitted, none has been found.

Sources, where given, are selective and include drawings, (supplementary) illustrations and articles relating to specific buildings as well as reference to the writer's own recent photographs. The bibliography includes reference to additional photographs (some of which duplicate illustrations reproduced here, or in the preceding chapters, from contemporary publications). Further sources are given in relevant footnotes in the chapters, or additional footnotes are provided in Appendix I where necessary.

Companies, or other bodies, or individuals, who have provided information about, or access to, these buildings, are acknowledged in Appendix I.

SUMMARY OF STRUCTURES INCLUDED IN APPENDIX I.

1897.	Weaver's Provender Mill, Swansea.	
1897.	Granary, Swansea.	
1898.	Granary, Birkenhead, Liverpool.	
1898.	Albion Oil Mill, Liverpool.	
1899.	Railway Warehouse, Brentford.	
1899.	Grain Warehouse, Plymouth.	
1899.	Quayside Warehouse, Newcastle on Tyne.	
1900.	Water Tower, Bournemouth.	
1900.	Railway Warehouse, London.	
1900.	Workshop, Old Foundry, Hull.	
1901.	New Bridge Street Goods Station and Warehouse, Newcastle on Tyne.	
1901.	Dunston Grain Silos and Grain Cleaning House, Dunston, Newcastle on Tyne.	
1902.	5 Dock Transit Sheds, Manchester.	
1903.	Co-operative Stores, Jarrow, Newcastle on Tyne.	
1903.	Drill Hall, Chatham.	
1904.	Newspaper Office Building, London.	
1904.	Drapery Depot, Jarrow, Newcastle on Tyne.	
1904.	Warehouse, Carmarthen.	
1904.	Drug Manufactory, Liverpool.	
1904.	Water Tower, Newton-le-Willows.	
1904.	Pattern-making Shop, Glasgow.	
1904.	Lion Chambers, Glasgow.	
1905.	Co-operative Store Buildings, Colne.	
1905.	G.P.O. Extensions, London.	
1906.	Lynn House, West Hartlepool.	<u>Coignet System.</u>
1906.	Melangeur Block, Cocoa Works, York.	
1906.	Circular Silos, Dunston, Newcastle on Tyne.	
1906.	Forth Banks Warehouse and Goods Station, Newcastle on Tyne.	
1906.	Second Tobacco Warehouse, Bristol.	<u>Coignet System.</u>
1907.	Chocolate Factory, Portobello.	<u>Wells System.</u>
1907.	Perfume Factory, London.	<u>Coignet System.</u>
1907.	Granary, Avonmouth.	
1907.	Granary, Edinburgh.	
1907.	Factory, Warrington.	<u>Paragon System.</u>

1907.	Soap Factory, Dunston, Newcastle on Tyne.	
1907.	Confectionery Factory, Glasgow.	
1907.	Royal Liver Office Building, Liverpool.	
1908.	Warehouse, Rainham, Essex.	<u>Coignet System.</u>
1908.	Grain Silos, London.	
1908.	Office Building and Pattern Shop, Manchester.	
1908.	Viaduct Works, Leeds.	
1908.	Y.M.C.A. Premises, Manchester.	<u>Kahn System.</u>
1909.	Organ Chamber, Alltwen, Pontardawe.	
1909.	St. Lawrence Wire Rope Works, Newcastle on Tyne.	
1910.	Central Hall, Spanish City, Whitley Bay.	
1910.	Keir Chapel, Dunblane.	
1910.	Shop Premises, Middlesbrough.	<u>Considère System.</u>
1911.	House, Fyling Hall.	<u>No special system.</u>
1911.	H. M. Stationery Office Warehouse, London.	
1911.	6 Dock Warehouses, Hull.	<u>Considère System.</u>
1911.	Spanish Villa, Tillycorthie.	
1911.	Lecture Theatre Extension to Museum, York.	<u>Kahn System.</u>
1912.	Atlas Spinning Mill, Ardsley.	

: : : : : : : : : : :

1897 (Oct) - 1898 (June). Weaver's Provender Mill, Victoria Wharf,
Swansea. (Chapter 6, figures 1, 2).

Construction: entirely reinforced concrete . 7 storeys.
Client: Weaver & Co., Swansea.
Architect: Henry C. Portsmouth, M.S.A., Swansea.
Contractor: D. Jenkins & Sons, Swansea.

Extant: Listed building, Grade II (1976); disused and derelict:
under threat of demolition (1981).

Probably first example of entirely reinforced concrete, multi-storeyed,
building in U.K.

Drawings: Elevation, N.E., not signed nor dated, but probably by
H.C. Portsmouth, 1897: not quite as executed.
Working drawings, executed in Hennebique's Nantes office:
plans nos. 4,5,6: 5th floor, roof, foundations, 10.10.1897 -
3.11.1897.

Articles: Robert G.Clark, A 14-year-old Ferro-Concrete Building, F.C.,
vol.2, no.10, pp.346-7.
C. Stanley, Weaver's Mill, Training News, Cement and Concrete
Assoc., 1972.
P. Cusack, What were the Conditions which led to the Design
and Construction of Weaver's Provender Mill and Silos in
Swansea, and were the Results Successful for both the
Constructors and Owners? Open Univ. Project, Sept., 1975,
pp. 1 - 20.
P. Cusack, A Reprieve for Weaver's Mill, Concrete, vol.10,
no.3, March, 1976, pp.20 - 3.

Own Photographs: June, 1975.

Acknowledgements: Mr. H. Portsmouth, Swansea, architect's grandson.
Mr. W. C. Rogers, former Borough Surveyor, Swansea.
L. G. Mouchel & Partners, West Byfleet (present Head Office).

Drawings from: H. Portsmouth and L. G. Mouchel & Partners.

1897 (Nov. - Dec.) - 1899 (Sep. - Nov.). Granary, Victoria Wharf, Swansea.

Construction: entirely reinforced concrete . 7 storeys.
 Client: Weaver & Co., Swansea.
 Architect: Henry C. Portsmouth, M.S.A., Swansea.
 Contractor: George Palmer, Neath.
 Extant: disused and derelict: under threat of demolition.
 Originally adjacent to Weaver's Mill (above), the granary was joined to it, before 1909, to form one building.
 Drawings: Plans nos. 1,2, horizontal and vertical sections of silos, 18.2.1898.
 Articles: Cusack, Open Univ. project, 1975, cited above.
 Own Photographs: June, 1975.
 Acknowledgements: As for Weaver's Mill (above).

1898 (Jan)¹ - 1899. Granary, Birkenhead, Liverpool.

Construction: reinforced concrete frame and silos. 5 storeys.
 Client: The Mersey Docks and Harbour Board, Liverpool.
 Engineer: A. G. Lyster, M.Inst. C.E., Liverpool.
 Contractor: Wilson & Co., Chester.²
 Possibly extant, but not traced.
 Acknowledgement: The Mersey Docks and Harbour Co., Pierhead, Liverpool.

1898 (Oct.)³ Albion Oil Mill, Boundary Street, Liverpool.

Construction: Partly and perhaps entirely, reinforced concrete.
 Client: Simonds, Hunt & Montgomery.
 Architect: John Clarke, F.R.I.B.A.,
 Contractor: Vermont & Breuder.⁴
 Apparently demolished - own visit to Boundary Street area, April, 1978.

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1. Project Record No.1 (Nos.1-8750), L.G.Mouchel & Ptrs., 38, Victoria St., Westm.
 2. Hennebique's Patent Buildings in Strengthened Concrete, n.d.
 3. Project Record No.1, op.cit. (1).
 4. Hennebique's Patent Buildings, op.cit. (2).

1899. Railway Warehouse, Brentford Docks, Brentford.

Construction: entirely reinforced concrete. 3 storeys.⁵
 Client: The Great Western Railway Co.
 Engineer: W. Y. Armstrong, M.Inst. C.E.
 Contractor: Jackaman & Son, Slough.⁶

1899. Grain Warehouse, Plymouth. (Figure 1).

Construction: entirely reinforced concrete, except the ground floor (plain concrete).⁷ 2 storeys.
 Client: The Great Western Railway Co.
 Engineer: W.Y.Armstrong, M.Inst. C.E.
 Contractor: George Palmer, Neath.⁸

1899 - 1901.⁹ Quayside Warehouse, Quayside, Newcastle on Tyne.
 (Chapter 10, figure 6).

Construction: entirely reinforced concrete. 7 storeys.
 Client: The Co-operative Wholesale Society Ltd.,
 Architect: F. E. L. Harris, A.R.I.B.A., Manchester.
 Contractor: D. N. Brims, Newcastle.

-
5. The Durability of Reinforced Concrete in Buildings, Nat.Build.Studies, Spec. Rep. No. 25, London, 1956, p.6, pl.4A. S.a: Hennebique Ferro-Concrete, London, 4th edn. 1921, p.122.
 6. Hennebique's Patent Buildings, op.cit. (2). S.a: Mouchel-Hennebique Ferro-Concrete :List of Works, London, 1920.
 7. Charles F. Marsh, Reinforced Concrete, London, 1904, p.423. S.a: L. G. Mouchel, The Hennebique Ferro-Concrete System, London, 2nd edn., 1905, pp.38, 156.
 8. Hennebique's Patent Buildings, op.cit. (2). S.a: Mouchel-Hennebique Ferro-Concrete, List of Works, op.cit. (6).
 9. E.g. F.C., vol.2, no.1, pp.14-16. F.C., vol.1, no.10, pp.220 - 1. F.E.L. Harris, letter, Bldr., 27.10.1900, p.369.

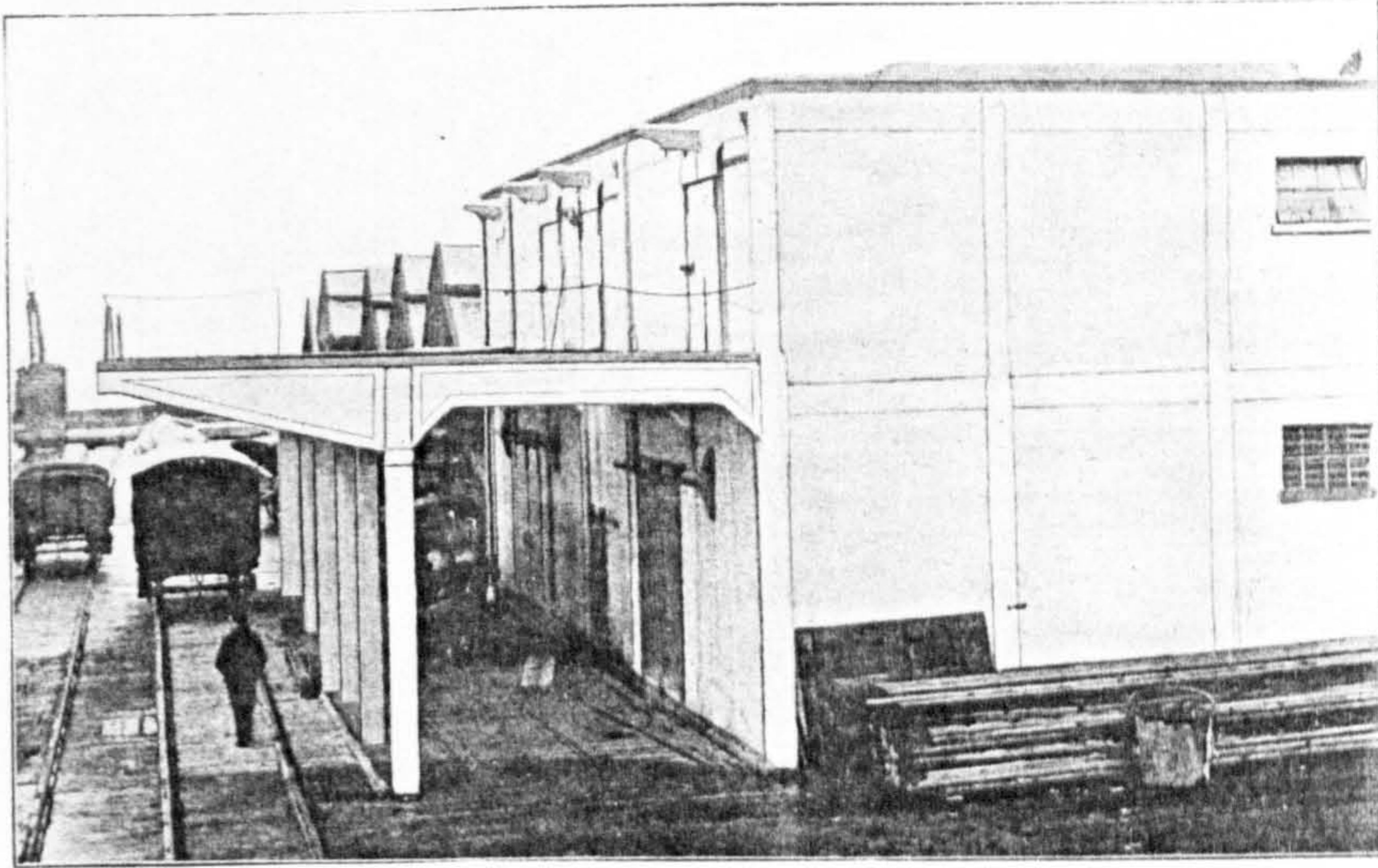


Figure 1: Grain warehouse Plymouth.

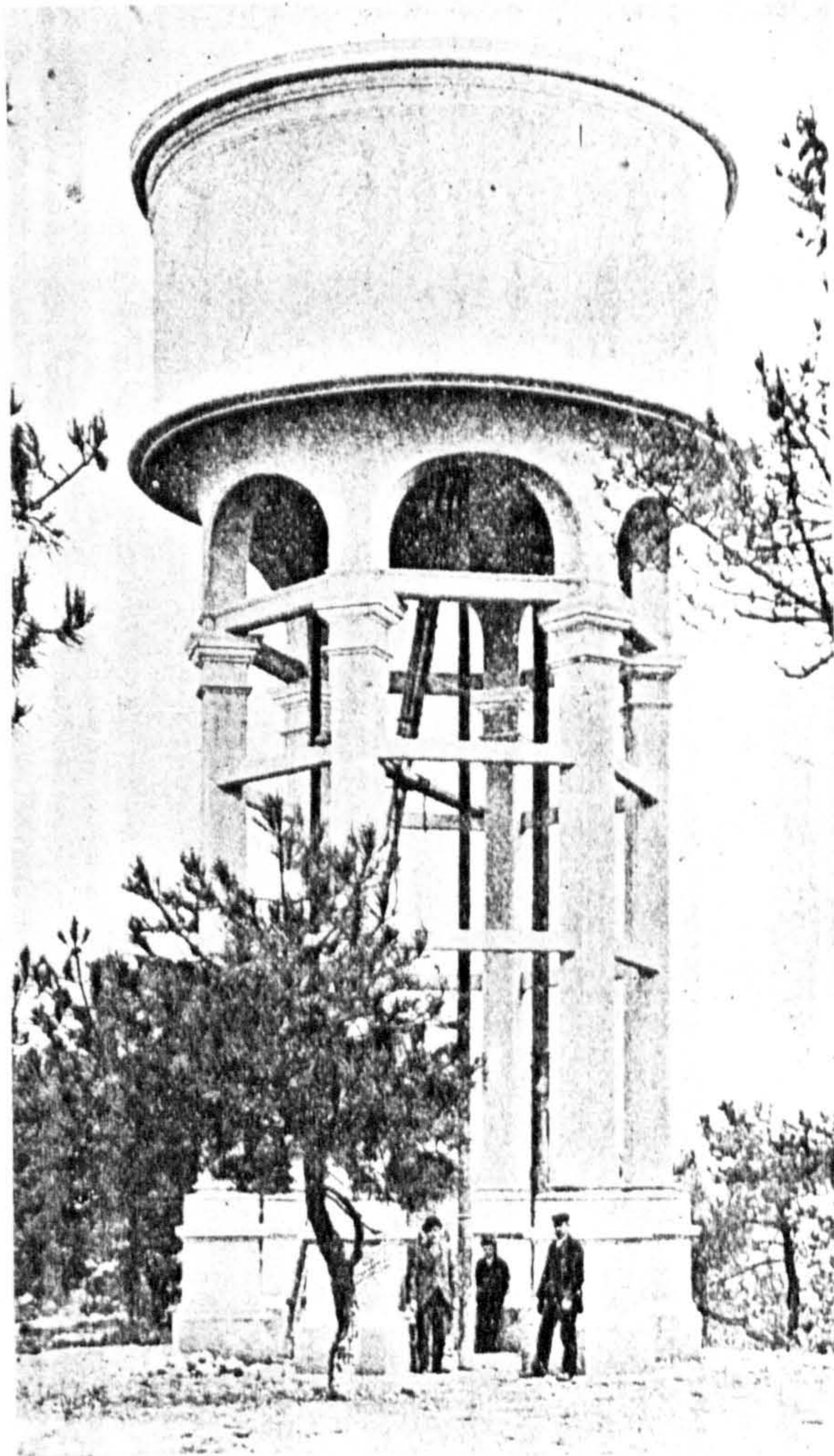


Figure 2: Water Tower Bournemouth.

Extant: occupied by Waverley Vintners, Ltd., Newcastle on Tyne, and
in use as bonded liquor warehouse, (1977).

Exposed surface found as shuttered (1954).¹⁰

Additional roof storey added behind the pediment in 1909 - 10.

Illustrations: exterior view, under construction: Relevé de Travaux
Executés, Bétons Armés Système Hennebique, Année 1901,
p.52, figure 22. Exterior view: engraving: rather
elongated perspective, but interesting as showing
warehouse and surrounding site in use (1916): Annual, 1916,
The Co-operative Wholesale Societies Ltd., Manchester, p.27.

Own Photographs, March, 1977.

Acknowledgements: The Co-operative Wholesale Society, Estates and Property
Department, Manchester.

The Co-operative Wholesale Society, Architects' Department,
Newcastle on Tyne.

Waverley Vintners, Ltd., Newcastle on Tyne.

1900.¹¹ Water Tower, Meyrick Park, Bournemouth, (Figure 2).

Construction: entirely reinforced concrete.¹²

Client: The Bournemouth Borough Council.

Architect: F. W. Lacey, M. Inst. C.E., F.R.I.B.A., Bournemouth.¹³

Contractor: Lang & Jones, Liskeard, Cornwall.¹⁴

First reinforced concrete water tower in U.K.¹⁵

1900. Railway Warehouse, Royal Albert Docks, London. (Chapter 10, figure 17).

Construction: entirely reinforced concrete.

Client: The Great Western Railway Co.

Engineer: W. Y. Armstrong, M. Inst. C.E.

Contractor: Jackaman & Son, Slough.¹⁶

10. The Durability of Reinforced Concrete in Buildings, op.cit. (5), Table 2.

11. Test report of structure dated, 27.12.1900 - L. G. Mouchel, Hennebique
Ferro-Concrete, London, 2nd edn., 1905, p.160.

12. E.g., Hennebique Ferro-Concrete, op.cit. (5), p.466.

13. 1b.

14. New Works in Concrete, C.& C.E., vol.1, no.2, pp.133-4.

15. Cf: Hennebique Ferro-Concrete, op.cit. (5), p.466.

16. Hennebique's Patent Buildings, op.cit. (2); Mouchel-Hennebique Ferro-
Concrete. List of Works, op.cit. (6).

Extant: present owners: National Carriers Ltd. (July, 1977).
 Refaced with gunite.
 Illustrations: under construction, and exterior view, e.g. L. G. Mouchel, Hennebique Ferro-Concrete, London, 2nd edn., 1905, pp.45-6, and C. Marsh, Reinforced Concrete, London, 1904, p.157, figure 205.
 Own Photographs: July, 1977.
 Acknowledgements: British Railways, Eastern Region, Hamilton House, London.
 National Carriers Ltd., Victoria & Albert Depot, London.

1900 (April) - 1901 (June). Workshop, Old Foundry, Caroline Street, Hull.
(Chapter 10, figure 20).

Construction: entirely reinforced concrete, except, possibly, foundations¹⁷.
 3 storeys (1, double-height).
 Client: Rose, Downs & Thompson Ltd., Hull.
 Architects: drawings (see below) refer to an architect, but no name has been traced.
 Contractor: Rose, Downs and Thompson Ltd., Hull.
 Extant: still owned by descendant of original company, Simon-Rosedowns Ltd., Hull, and still in use.
 Exposed surface as found (1954): white cement on original concrete.¹⁸
 Windows now, altered or blocked, (1978).
 Drawings and associated sheets: Extension of Workshops, Old Foundry Hull.
Proposed Construction in Hennebique's Patent Ferro-Concrete:
 blueprint, plan no.1, sections and plans, roof, 1st floor, 21.4.1900; blueprint, plan no. 2, order (project no.) 125, 18.5.1900; sections, 24.6.1900; plan no. 6, order no.125, 27.10.1900: shows reinforcement of exterior walls, and wall thickness: 4 inches.

17. "Foundations to be provided by the architect" - Extension of Workshops, Old Foundry, Hull, Proposed Construction in Hennebique's Patent Ferro-Concrete, plan no. 1, 21.4.1900.

18. The Durability of Reinforced Concrete in Buildings, op.cit. (5), Table 4.

Extension of Workshops, Old Foundry, Hull, order no. 125, 19.6.1900, 3^e Etude, (sheet of calculations in French).

Extension of Workshops, Old Foundry, Hull, order no. 125, 25.6.1900. Approximated quantities subject to Messrs. Rose, Downs & Thompson's verification and approval.

Old Foundry, Hull - Fitting Pit, 19.2.1901, (2 sheets, mainly in French), signed: Francis Eliot, Manchester, (Chapter 7).

- Articles: L.A. Whittle, Leaves from the Rosedowns Story - No.2 - Reinforced Concrete Buildings, Rosedowns News Bulletin, no. 165, 26.10.1957, pp.4 - 5. H. Sykes, The New Drawing Office, Rosedowns News Bulletin, no. 183, Sept. - Oct., 1960, pp. 1 - 2.
- Illustrations: construction, and interior view: L. G. Mouchel, Hennebique Ferro-Concrete, London, 2nd edn., 1905, pp.43 - 4. April, 1978.
- Own Photographs: Simon-Rosedowns Ltd., Hull.
- Acknowledgements: Hull Record Office.
L. G. Mouchel & Partners, West Byfleet.
- Drawings from: Hull Record Office and L. G. Mouchel & Partners.

1901 (Oct.) - 1907 (Jan). New Bridge Street Goods Station and Warehouse,
New Bridge Street, Newcastle on Tyne.
(Chapter 3, figure 7; Chapter 10, figures 16, 17).

- Construction: entirely reinforced concrete. 4 storeys.
- Client: The North Eastern Railway Co.
- Architect: William Bell, F.R.I.B.A.
- Contractor: Joseph Howe & Co., West Hartlepool.¹⁹
- Part of building remains, derelict: upper storeys bombed (1939 - 1945).
- Largest railway goods station in reinforced concrete when built,²⁰ (430' l x 178' w x 83' h²¹).

19. New Works in Concrete, C. & C.E., vol.1, no.4, Sept., 1906, (pp.303-6), p.306.
20. T.J.Gueritte, The First Decade of Reinforced Concrete in the U.K., 1897-1906, C. & C.E., vol.21, 1926, p.92.
21. N.E.R. Co. New Bridge St. Goods Station Opened, Newc. Daily Journal, 3.1.1907.

Partly opened, October, 1906.²²

Drawings:

N.E.R. Trafalgar Goods Warehouse, Newcastle.²³
Proposed Construction in Hennebique's Patent
Ferro-Concrete, order no. 226, Head Office, 38, Victoria
 St., Westminster, S.W., plan no. 1, 1st floor, ground,
 plans, vertical section (steel columns), 12.10.1901;
 vertical sections, (steel columns, roof), 13.10.1903
 and 15.10.1903; 1st floor plan, 7.11.1903.

N.E.R. Trafalgar Goods Warehouse, Newcastle,
 contract drawings, $\frac{0365}{7}$, $\frac{0365}{11}$ referred to in tender
 dated 17.11.1903, signed: William Bell (architect)
 and J. Howe (contractor).

N.E.R. New Bridge Street Goods Station, order no. 226,
 Head Office, 38 Victoria St., Westminster, S.W.,
 Working Plans, plan no. 30, modified, North Elevation,
 21.8.1904: for Mr. Bell (private use); plan no. 25,
 modified, South Elevation, 16.9.1904; plan no. 44,
 spiral staircase: detail of step, 20.10.1904; plan no.
 48, West Elevation, 10.5.1905.

N.E.R. New Bridge Street Goods Station, Newcastle,
 original, hand-coloured, architect's drawings, referred
 to in tender dated 31.10.1905, signed A. Pollard (for
 W. Bell), $\frac{0794}{3}$, $\frac{0794}{4}$, $\frac{0794}{5}$, $\frac{0794}{6}$, $\frac{0794}{7}$,
 ground, 1st floor, 2nd floor, 3rd floor, roof, plans;
 $\frac{0794}{8}$, $\frac{0794}{9}$, $\frac{0794}{10}$, $\frac{0794}{11}$, $\frac{0794}{13}$, $\frac{0794}{14}$, $\frac{0794}{15}$,
 Elevations, Warehouse North, South, West, East, and
 vertical sections, showing spiral stairs.

Newcastle on Tyne New Bridge St. Goods Station, As
existing (1906) - Plans and Sections (8 sheets),
 104 139, plan of basement floor; 104 144,
 104 145, 104 146, vertical sections.

Articles:

Une Nouveauté Architecturale, Le Bét. Armé,
 May, 1906, pp. 61 - 3, citing

22. 1b.

23. Chapter 7.

an article in: The Northern Echo, Newcastle, 27.4.1906.
New Works in Concrete: North-Eastern Railway Goods Station
and Warehouse, Newcastle on Tyne, C. & C.E., vol.1, no.4,
Sep.,1906, pp.303 - 6.

N.E.R. Co. New Bridge St. Goods Station Opened, Newcastle
Daily Journal, 3.1.1907..

Own Photographs: April, 1977.

Acknowledgements: British Railways, Eastern Region, Newcastle on Tyne.
 Regional Architect, British Railways Board, Hudson House,
 York.

L. G. Mouchel & Partners, Newcastle on Tyne.

Drawings from: Regional Architect, British Railways Board and L. G.
 Mouchel & Partners.

1901 - 1902. Dunston Grain Silos and Grain Cleaning House, Dunston,
Newcastle on Tyne. (Chapter 3, figure 6; Chapter 10, figures 8,9).

Construction: entirely reinforced concrete. 6 storeys.

Client: The Co-operative Wholesale Society, Ltd.

Architect: F. E. L. Harris, A.R.I.B.A, Manchester.

Demolished. Previously sold by the Society to Spillers-French, Ltd., London,
 (now Dalgety-Spillers, Ltd., London.)

Drawings: End Elevation, signed F. E. L. Harris, A.R.I.B.A.,
 Architect, 1 Balloon St., Manchester, 11.3.1902.
C.W.S. Flour Mill, Dunston on Tyne, Front Elevation, copy,
 unsigned, n.d.

Co-operative Wholesale Society Ltd: Block Plan of Property
Dunston on Tyne, signed L. G. Ekins, architect, C.W.S.,
 West Blandford St., Newcastle upon Tyne, 7.9.1909.

Dunston Flour Mills - Existing Land and Buildings, (block
 plan for Spillers-French) , Architecture and Interior
 Design Group, 20.11.1975. Structural drawings, and
 calculations (in French) for this building were found by
 L. G. Mouchel & Partners, West Byfleet, and sent to their
 Newcastle office, in February, 1979.

Article: Ferro-Concrete Work at Dunston-upon-Tyne, The North of
 England Institute of Mining and Mechanical Engineers,
 Excursion Meeting, 29.8.1907, Instit. Mining Engineers, Trans.,
 vol. 34, 1907-8, pp.61-3.

Illustrations: Interior of cleaning house, ready to receive flooring:

L. G. Mouchel, Hennebique Ferro-Concrete, London, 2nd edn., 1905, p.54; general view of Dunston flour mills: Co-operative Wholesale Societies' Annual, 1916, p. 123.

Own Photographs: April, 1977.

Acknowledgements: Co-operative Wholesale Society, Ltd., Estate and Property Group, Manchester.
Spillers-French Milling Ltd., Old Change House, London.
Drawings from: Co-operative Wholesale Society, Ltd.

1902 (Nov.) - 1905. 5 Dock Transit Sheds, No. 9 Dock, Manchester.
(Chapter 7, figures 1 - 4).

Construction: entirely reinforced concrete. 3 - 4 storeys.
Client: The Manchester Dock and Warehouse Extension Co. Ltd., and The Manchester Ship Canal Co.²⁴
Engineer: W. Henry Hunter, M. Inst. C.E., Manchester.
Contractors: H. Lovatt, Wolverhampton and M. Breuder, Paris.
Extant: still owned, and maintained, by The Manchester Ship Canal Co. (1978); additional storey at some time, (after 1919).
Drawings: (2 untitled copies): elevations, sheds 1, 2, 3, 5, and back elevation, Head Office, 38, Victoria St., Westminster, S. W., signed: L. G. Mouchel, 15.12.1902, (modified from 1. 12. 1902 and from Nov. 1902), and 15.12.1902: "Referred to in the Agreement Dated the 23rd day of March, 1903 between the Manchester Dock and Warehouse Extension Co. Ltd. of the first part the Manchester Ship Canal Company of the second part, and Henry Lovatt of the third part": signed: H. Lovatt, Contractor and W. Henry Hunter, Engineer;

24. Both parties are mentioned in reference to Agreement of 23.3.1903 between them and Henry Lovatt (Contractor), on drawing for sheds executed by L. G. Mouchel, 15.12.1902.

- Manchester Dock & Warehouse Extension Co. Ltd. Transit Sheds No. 9 Dock. First Shed No. 5. Plan Showing Position of Doors, n.d., before Jan., 1904, (when copies distributed).
- Articles: Canal Maritime de Manchester, Le Bét. Armé, June, 1903, p.14.
- Canal Maritime de Manchester: Les Nouveau Magasins de Transit, Le Bét. Armé, May, 1904, pp.173-80.
- Historic Concrete No.17, Concrete, Jan., 1976, p.17.
- Own visit to sheds, April, 1978.
- Acknowledgements: The Manchester Ship Canal Co., Manchester.
L. G. Mouchel & Partners, Manchester and West Byfleet.
- Drawings from: The Manchester Ship Canal Co.

1903 (April) - 1904. Co-operative Stores, North Street, Jarrow, Newcastle on Tyne. (Chapter 10, figure 14).

- Construction: entirely reinforced concrete. 3 storeys.
- Client: The Jarrow & Hebburn Co-operative Society, Ltd.
- Architect: J. Cordiner.
- Extant: present owner - Mr. Pratt; semi-derelict: windows boarded, (1977).
- Drawings and associated sheets: Jarrow & Hebburn Co-operative Stores, order no. 471, Newcastle, no. 29, (sheet of notes and calculations, in French), 13.4.1903;
Jarrow & Hebburn Co-operative Stores, Newcastle office, 29, (sheet of accounts for contractor, in English with French term interspersed), 14.4.1903.
Jarrow & Hebburn Co-operative Society, Ltd. Central Premises, Construction in Hennebique's Patent Ferro-Concrete, order no. 471, L.G.Mouchel, C.E., 38, Victoria St., Westminster, S.W., plan no. 4, side and front elevations, 27.6.1903; plan no. 11, Working Plan, Frontages, 14.8.1903; plan no. 8 modified, Working Plan, Basement and Ground Floors Columns, 4.11.1903; plans of foundations, basement, ground, 1st, 2nd, floors, 1903.
- Own Photographs: April, 1977.

Acknowledgements: North-Eastern Co-operative Society Ltd., Works and Property Group, Gateshead.
L. G. Mouchel & Partners, West Byfleet.

Drawings from: L. G. Mouchel & Partners.

1903²⁵ - 1904. Drill Hall, Chatham. (Chapter 10, figure 20).

Construction: entirely reinforced concrete. 2 storeys.
Client: The War Office, Territorial Department, Queen's Own Royal West Kent Regiment.
Contractor: Cubitt & Co.²⁶

1904. Newspaper Office Building, Tavistock Street, London.

Construction: partly reinforced concrete, but exterior walls, and chimneys in stone and brick, tiled roof.
Client: Proprietors of Country Life Magazine.
Architect: Sir Edwin L. Lutyens, A.R.A., F.R.I.B.A.²⁷
Illustration: E.g. Nikolaus Pevsner, Building With Wit: The Architecture of Sir Edwin Lutyens, in: A Service, ed., Edwardian Architecture and its Origins, London, 1975, p.464.

-
25. Travaux du Mois de Décembre - Bureau de Londres, Le Bét. Armé, Jan.1904, p.123.
26. Mouchel-Hennebique Ferro-Concrete - List of Works, op.cit.(6), and, Hennebique-Ferro-Concrete, op.cit. (5), p.285, and Travaux, op.cit.(25).
27. Mouchel-Hennebique Ferro-Concrete - List of Works, op.cit. (6).

1904. Drapery Depot, North Street, Jarrow, Newcastle on Tyne.
(Chapter 10, figure 15).

Construction: entirely reinforced concrete. 3 storeys.
 Client: The Jarrow & Hebburn Co-operative Society, Ltd.
 Architect: J. Cordiner.

Extant: now occupied by the Cavalier Club; partly altered
 and refurbished, especially inside.

Own Photographs: April, 1977.

Acknowledgement: North-Eastern Co-operative Society, Ltd., Works
 and Property Group, Gateshead.

1904. Warehouse, Carmarthen. (Figure 3).

Construction: entirely reinforced concrete. 4 storeys.
 Client: The Western Counties Agricultural Co-operative
 Association, Ltd.

Architects: G. Morgan & Son, F.F.R.I.B.A.

Contractor: The Yorkshire Hennebique Contracting Co. Ltd., Leeds.²⁸

Extant: semi-derelict, (1977).

Article: Historic Concrete, No. 32, Concrete, April, 1977,
 p.17.

Own Photographs: June, 1977.

1904. Drug Manufactory, possibly Wood Street, Liverpool. (Figure 4).

Construction: likely to have been reinforced concrete framed.
 4 storeys.

Client: Evans, Sons, Lescher & Webb, Ltd.

28. E.g. Travaux du Mois d'Avril - Bureau de Londres, Le Bét. Armé, May, 1904,
 p.184, and, Mouchel, op.cit. (11), p.46.

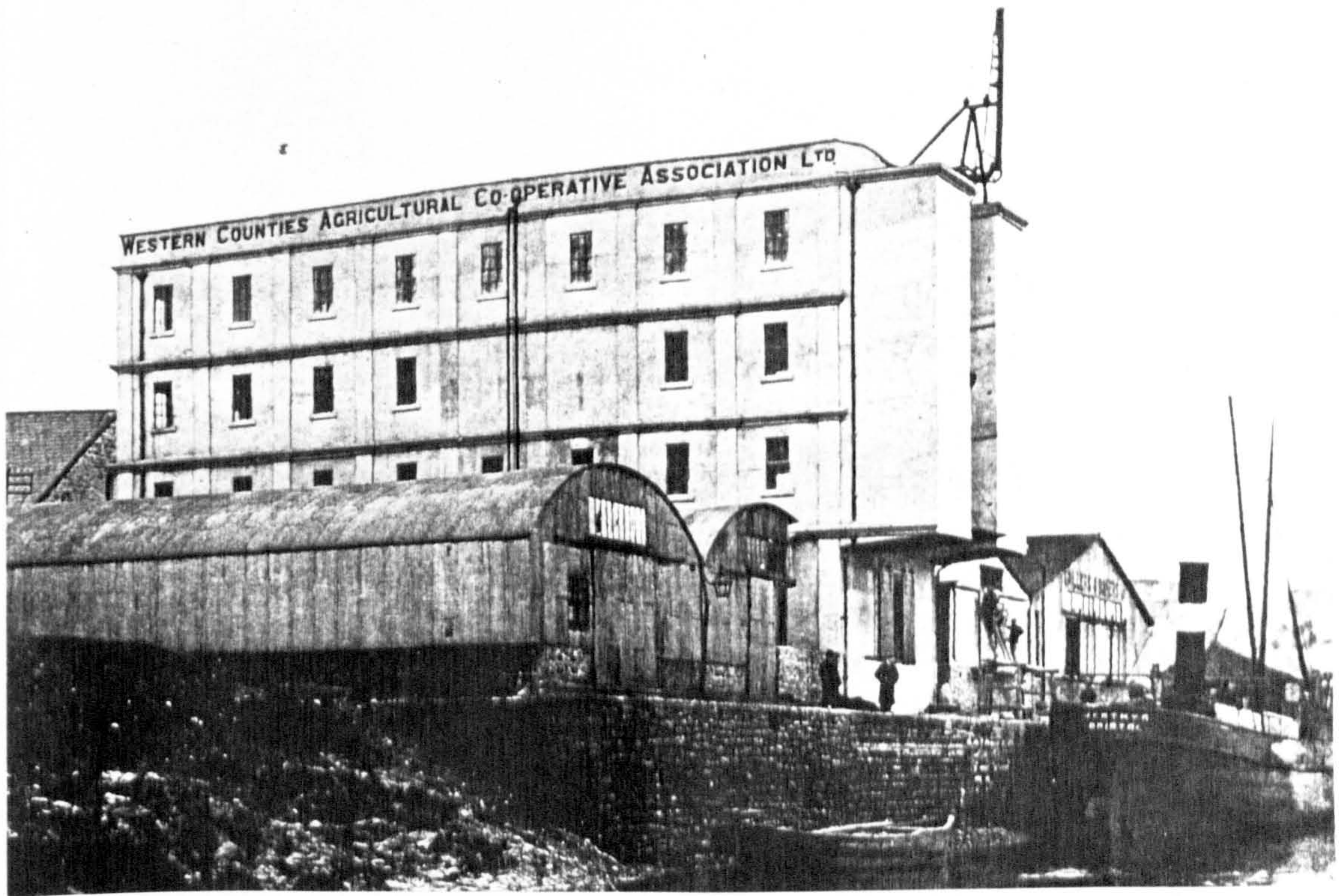


Figure 3: Warehouse Carmarthen.

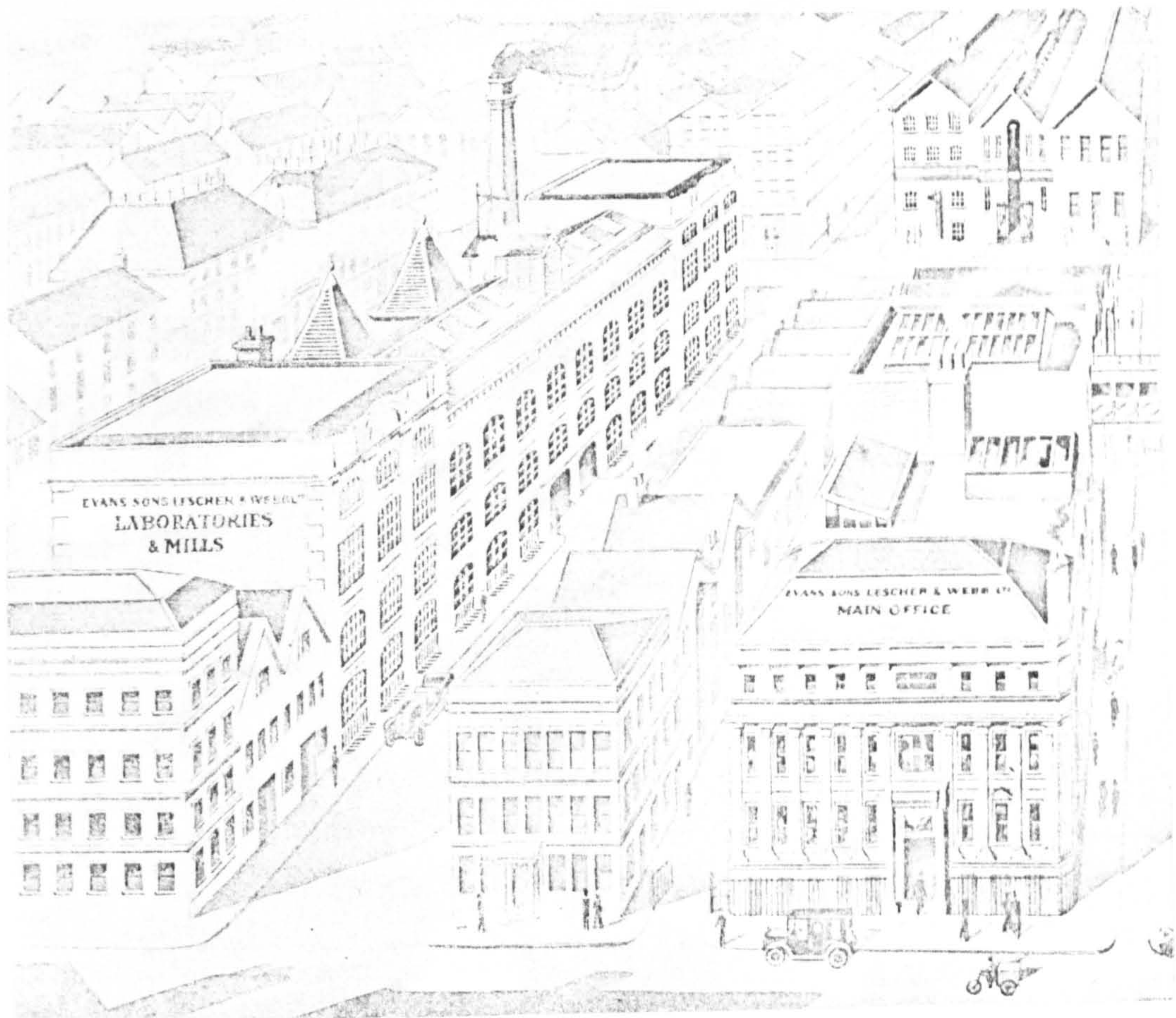


Figure 4: Warehouses and Laboratories of Evans, Sons, Lescher & Webb, Ltd. Liverpool (1927).

Architect: Sir Aston Webb, K.C.V.O., C.B., R.A., F.R.I.B.A.²⁹

Apparently demolished: own visit to site, April, 1978, (which was largely bombed, in 1941³⁰).

Sir Aston Webb, C.B., was a grandson of the founder of Evans, Sons, Lescher & Webb, Ltd., (John Evans of Welshpool, Montgomery), subsequently Evans Medical Supplies Ltd., and had designed another building for the company in Bartholomew Close, London, in 1879.³¹ The factory (1904) in Liverpool has not been positively identified, but it is possible that it was the "Laboratories and Mills" (in Wood Street, Liverpool) illustrated in Figure ⁴ 5.

Acknowledgement: Evans Medical Ltd., Liverpool.

1904 - 1906.³² Water Tower, Newton-le-Willows. (Figure 5).

Construction: entirely reinforced concrete.

Client: The Newton-in-Makerfield Urban District Council.

Engineers: Read & Waring, A.M M.Inst. C.E.

Contractor: Cubitt & Co.

Demolished by owners, The North-West Water Authority, 1978-9 (listed structure).

Largest structure of its kind in the U.K. when built,³³ (capacity, 300,000 gallons³⁴).

29. Mouchel-Hennebique Ferro-Concrete, - List of Works, op.cit. (6).

30. The Story of Evans Medical 1809 - 1959, Published to Commemorate the 150th Anniversary of the Foundation of the Company, Evans Medical Supplies Ltd., Liverpool and London.

31. lb.

32. E.g. Editorial Notes, C. & C.E., vol.1, no.6, Jan.1907, p.404 - recently completed.

33. E.g. E.W.Hollingworth, As.M.Inst.C.E., Reservoir at Newton-le-Willows, in - The I.C.E. and Reinforced Concrete, C. & C.E., vol.5, no.11, November 1910, p.803.

34. E.g. Mouchel-Hennebique Ferro-Concrete - List of Works, op.cit. (6).

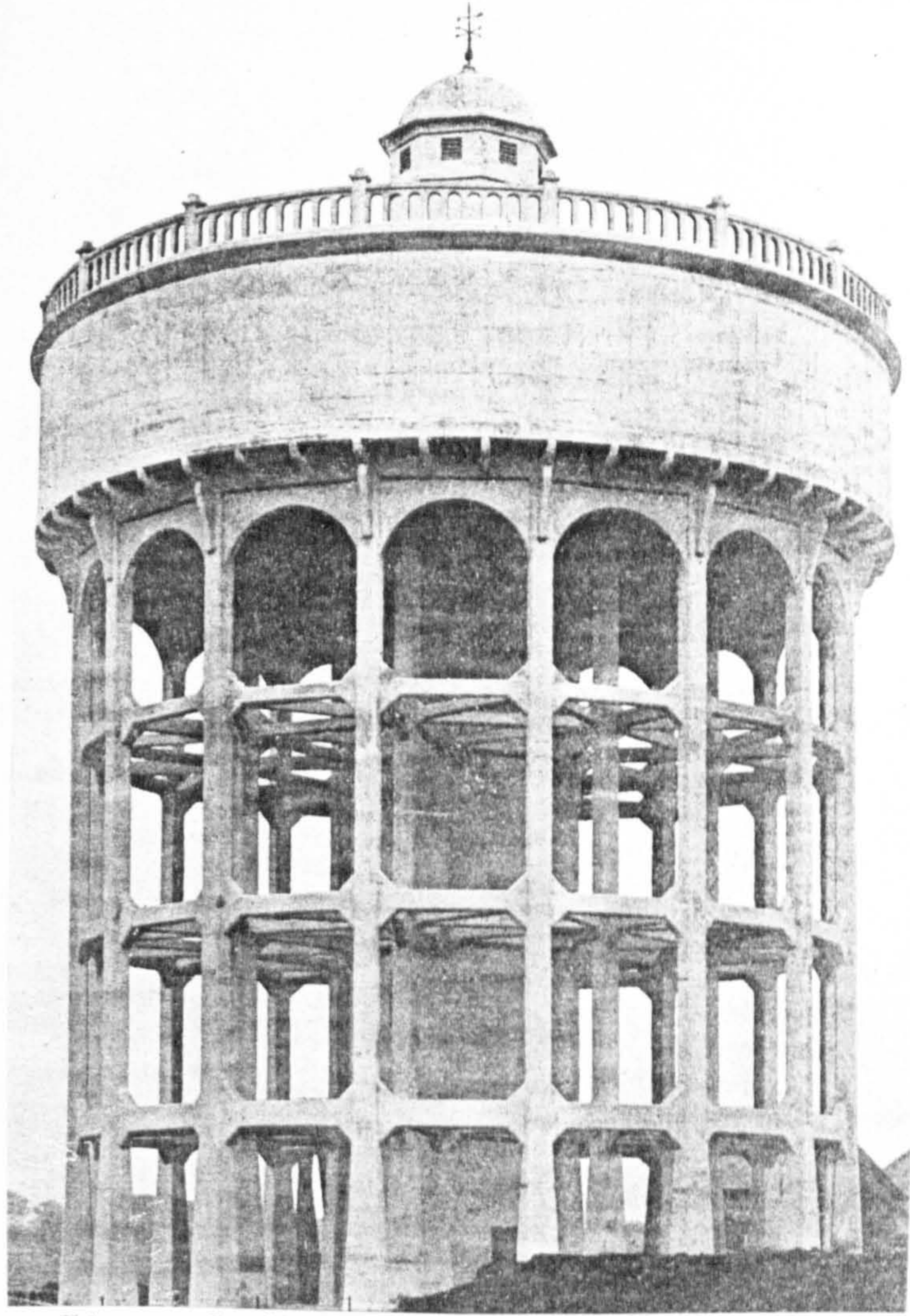


Figure 5: Water Tower Newton-le-Willows.

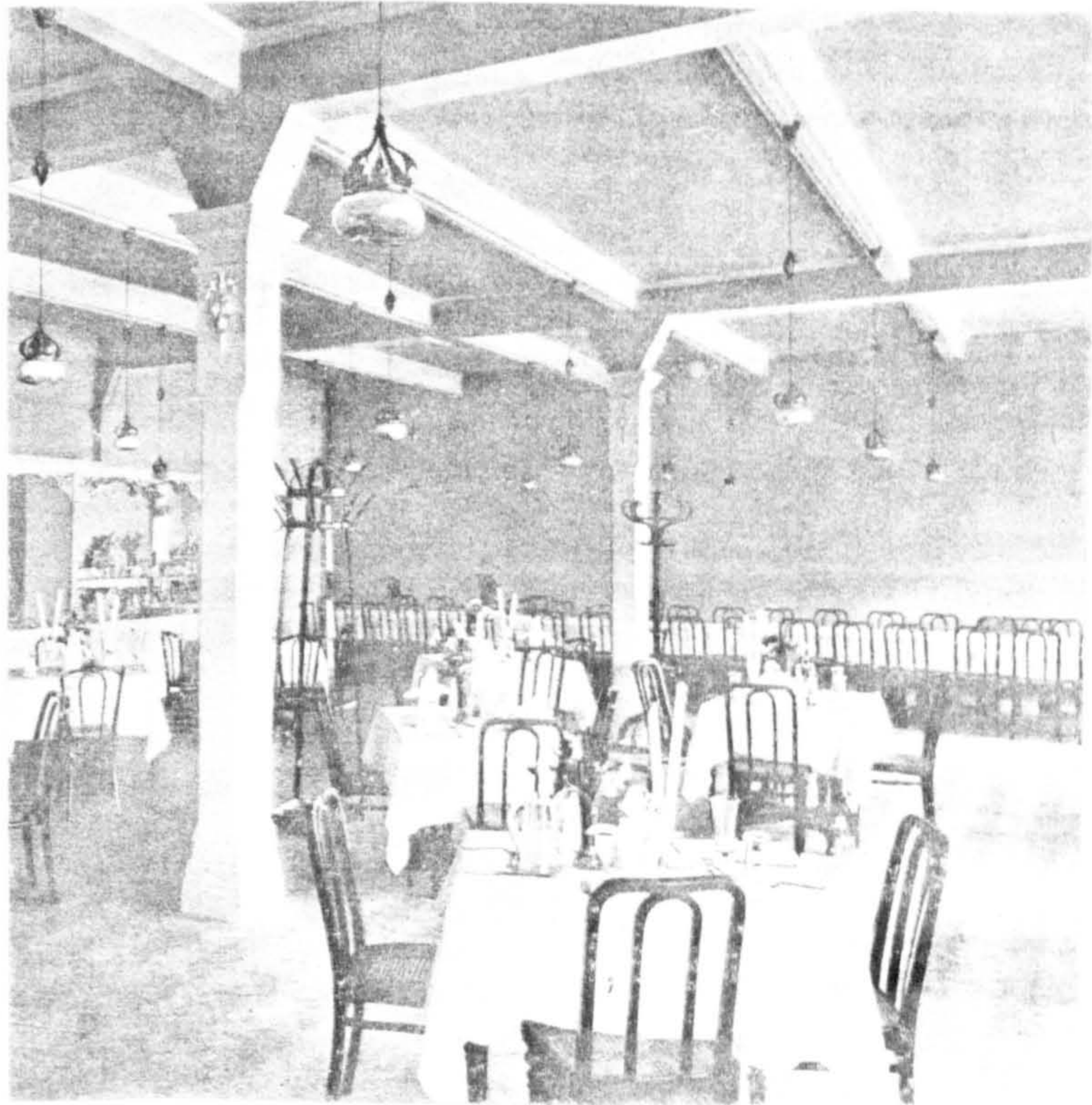


Figure 6: Co-operative Stores Colne: cafe.

Articles: New Works in Concrete - New Water Tower at Newton-le-Willows, C.& C.E., vol.1, no.3, July, 1906, pp.220-2. Reservoir at Newton-le-Willows, report by E. W. Hollingworth, As.M.Inst.C.E. in: The I.C.E. and Reinforced Concrete, C.& C.E., vol.5, no.11, Nov.,1910, pp.803-4.
Historic Concrete, Concrete, Feb., 1975.

Own Photographs: April, 1978.

1904 (April) - 1905. Pattern-Making Shop, Polmadie, Glasgow.

Construction: entirely reinforced concrete; 4 storeys.
 Client: Alley & MacLellan, Ltd., Glasgow.
 Architects: Brand & Lithgow, Glasgow.³⁵
 Extant: vacant and for sale, (August, 1981).
 Illustration: G.F. Thomson, Early Reinforced Concrete Frame Buildings in Glasgow, 1905-1921, B. Arch. dissert., Univ. Strathclyde, 1976, figure 19.
 Acknowledgement: British Electrical Repairs Ltd., Glasgow.

1904 (April) - 1907 (April). The Lion Chambers, 172, Hope Street, Glasgow. (Chapter 11, figures 2, 3, 7, 8, 9).

Construction: entirely reinforced concrete; 8 storeys.
 Client: William George Black, Glasgow.
 Architects: Salmon & Son & Gillespie, Glasgow.
 Contractor: The Yorkshire Hennebique Contracting Company Ltd., Leeds.
 Extant: owned by a Committee, Chairman, Dr. O. A. Franchi, of Franchi, Wright & Co., Solicitors and Notaries, who occupy part of the building. Exterior renovated, May, 1979.

35. Mouchel-Hennebique Ferro-Concrete - List of Works, op.cit. (6), and, Travaux du Mois d'Avril - Bureau de Londres, Le Bét.Armé, May, 1904, p.184, although latter gives "Mr. Kennedy" as architect.
 S.a: Plans of Proposed Building, 172 Hope St., for Wm.Geo.Black, Esq., Messrs. Salmon & Son & Gillespie, Architects, Glasgow, 19.4.1905 : titlepage.

Drawings:

Plans of Proposed Building 172 Hope St. for Wm. Geo. Black, Esq., Messrs. Salmon & Son & Gillespie, Architects, 53 Bothwell St., Glasgow, April 19th, 1905,
 13 drawings, referred to in Dean of Guild Decree of 1.6.1905 in petition on behalf of William George Black³⁶:
 plans of present building, n.d; $\frac{1}{8}$ " scale plans of basement, ground, 1st, 2nd, floors, n.d; plan of 1st floor, (2nd similar), n.d; plan of roof, 12.4.1904; elevations and section, 15.4.1904; $\frac{1}{4}$ " plan of shop floor, 9.3.1905; South elevation, 3.4.1905; plan of 3rd floor (4th similar), 5.4.1905; plan of top (7th) floor, 6.4.1905; plan of 5th floor (6th similar), 7.4.1905; plan of basement floor and block plan, 15.4.1905; West elevation, North elevation, 18.4.1905; $\frac{1}{2}$ " detail of S.W. office, 2nd floor, 19.4.1905.

Building for W. G. Black Esq., Glasgow. Construction in Hennebique's Patent Ferro-Concrete, Head Office, 38, Victoria St., Westminster, S.W., order no. 922: Working Plans,
 e.g. plan no. 26, Hope St. Elevation above 7th floor, 17.1.1905; plan no. 4, modified, columns, 13.9.1905; plan no. 17, modified, South wall, East wall, 12.10.1905; plan no. 15, modified, Hope St. Elevation, Corner oriel, 18.10.1905; plan no. 10, modified, 2nd and 3rd floors, 8.11.1905; plan no. 16, modified, Bath Lane Elevation, 9.12.1905; plan no. 22, modified, roof, 10.1.1906; plan no. 21, modified, roof, 16.1.1906; plan no. 27, Tower roof, 17.1.1906;

Building for W. G. Black, Esq., Glasgow. Construction in Hennebique's Patent Ferro-Concrete, Head Office, 38, Victoria St., Westminster, S.W. order no. 922, plan no. 24, Cupola (not as executed), 7.12.1905.

36. Note (handwritten) on one of the group of drawings, Proposed Building 172 Hope St. for Wm. Geo. Black, Esq. Plan of Basement Floor, Messrs. Salmon & Son & Gillespie, Glasgow, 15.4.1905, and, Dean of Guild Glasgow Register of Plans 2nd Series 1904-10.

- Articles: Novel Methods of Building Construction: The Lion Chambers, Hope St., Glasgow, Build. Inds., vol.17, 16.4.1906, pp.1-2,9.
- Les "Lion Chambers" Hope St., Glasgow, Le Bét.Armé, June, 1906, p.75 (using previous article).
- Les "Lion Chambers" à Glasgow, Le Bét.Armé, Oct, 1906, pp. 140-1.
- A Reinforced Concrete Office Building, B.J., vol.25, C.& S.suppl., 30.1.1907, pp.11-14.
- Lion Chambers, Hope St., Glasgow: Some Interesting Constructive Details, Build. Inds., vol.18, 15.7.1907, p.53, (from: W.N. Twelvetrees, Concrete-Steel Buildings).
- Own Photographs: March, 1977, and, May, 1979 (when Lion Chambers was being renovated).
- Acknowledgements: L. G. Mouchel & Partners, West Byfleet.
City Archivist's Department, Glasgow.
Dr. J. Coia (partly retired from Gillespie, Kidd & Coia, Glasgow).
Dr. O. A. Franchi, Lion Chambers.
- Drawings from: City Archivist, Glasgow and L. G. Mouchel & Partners.

1905-1907 (June). Co-operative Store Buildings, Colne. (Figure 6).

- Construction: reinforced concrete framed (stone outer walls).
3 storeys.
- Client: The Colne Co-operative Society Ltd.
- Architect: R. Worcester, Manchester.
- Contractor: Co-operative Wholesale Society, Ltd. ³⁷
- Extant: present owners, "Princess of Norway"; much of interior refurbished: restaurant and shop open, (April, 1978).
- Drawings: 6 drawings held by Colne Library, 2 signed by R. Worcester, 10.5.1905 and 21.1.1907. ³⁸

37. Souvenir Coming-of-Age and Opening of New Central Premises, The Colne & District Co-operative Society, Ltd., Saturday, June 29th, 1907.

38. Deputy District Librarian, Colne Library, Market St., Colne.

Articles: Souvenir Coming-of-Age and Opening of New Central Premises,
The Colne & District Co-operative Society, Ltd., Sat.
June 29th, 1907.

Colne Co-operative Society: Opening of the New Buildings,
Colne and Nelson Times, 5.7.1907.

Own Photographs: April, 1978.

Acknowledgements: Co-operative Retail Services, Accounts Dept., Burnley.
"Princess of Norway", Colne.
Colne Library.

1905 - 1909.³⁹ General Post Office Extensions - Public Office and Sorting
Office, King Edward VII Street and Newgate Street, London.

Construction: entirely reinforced concrete except granite "curtain"
walls in Public Office, facing King Edward Street, and
Sorting Office, facing Newgate Street, and brick for side
elevation to Public Office; remainder of walls, reinforced
concrete.⁴⁰ 4 storeys.

Client: H. M. Office of Works.

Architect: Sir Henry Tanner, C.B., I.S.O., F.R.I.B.A.

Contractor: Holloway Bros., Ltd., London.

Foundation stone laid by King Edward VII, 1905.⁴²

Articles; e.g: New Works in Concrete: The New G.P.O., C.& C.E.,
vol.2, no.4, Sep., 1907, pp.321-3.

The New G.P.O. Buildings, St. Martin's-le-Grand, London,
C.& C.E., vol.3, no.6, Jan., 1909, pp.436-44.

New G.P.O. Buildings, St. Martin's-le-Grand, London,
C.&C.E., vol.4, no.3, July, 1909, pp.159-62.

Sir Henry Tanner, I.S.O., F.R.I.B.A., The New G.P.O.,
London, pr. to R.I.B.A., 2.1.1911, J.R.I.B.A., vol.18,
7.1.1911, pp.149 - 68.

39. Editorial Notes, C.& C.E., vol.6, no.2, (pp.80-3), p.82, and, New General
Post Office Buildings, London, F.C., vol.1, no.6, Dec.1909, p.115.

40. E.g. Post Office Buildings, London, ib. C.& C.E., vol.3, no.6,
pp.439-42.

41. E.g. Chronicle, JRIBA, vol.16, 8.5.1909, p.483.

42. Sir Henry Tanner, The New G.P.O., London, JRIBA, vol.18, 7.1.1911,
(pp.149-68), p.150.

1906 - 1907 (March). Lynn House: Shop and Office Building, Lynn Street, West Hartlepool. (Chapter 11, figure 4).

Construction: reinforced concrete frame, floors and roof: Coignet System. 3 storeys.

Client: M. Robinson & Sons, Ltd., West Hartlepool.

Architects: Harry Barnes, A.R.I.B.A., Newcastle on Tyne, and Charles F. Burton, West Hartlepool.

Contractor: Watt Bros.

Demolished.⁴³

Article: Advertisement feature, Northern Daily Mail, 20.3.1907.

Illustration: M. T. Cantell, Reinforced Concrete Construction, London, 1912, p.235, figure 242.

Acknowledgement: Reference Librarian, Hartlepool Central Library.

1906 - 1907. Melangeur Block, Cocoa Works, York.

Construction: entirely reinforced concrete. 6 storeys.

Client: Rowntree & Co., Ltd., York.

Architect: W. H. Brown, M.S.A., York.

Contractor: The Yorkshire Hennebique Contracting Co., Leeds.

Article: Loading Tests in a Reinforced Concrete Factory Building, C.& C.E., vol.1, no.5, Nov., 1906, p.382.

1906 (April) - 1908. Circular Silos, Dunston, Newcastle on Tyne. (Chapter 10, figure 13).

Construction: entirely reinforced concrete . 5 storeys.

Client: The Co-operative Wholesale Society, Ltd.

Architect: L. G. Ekins, Lic. R.I.B.A.

Demolished: previously sold by the Society to Spillers-French Ltd., London, (now: Dalgety-Spillers, Ltd., London).

43. Enquiries made by Reference Librarian, Hartlepool Central Library (1979).

Drawings: 2 Architect's drawings - C.W.S. Dunston Flour Mill, Plan of Grain Storage Silos Built in Ferro-Concrete, signed: L.G.Ekins, Architect, C.W.S., West Blandford St., Newcastle upon Tyne, 20.3.1906 (date not quite clear), also signed by two others, perhaps R. Rutherford and M. Lambert, April, 1906.

C.W.S. Dunston Flour Mill New Circular Silos: Part South Elevation, signed: pp. L. G. Ekins, Architect, C.W.S. West Blandford St., Newcastle upon Tyne, March, 1908.

Articles: Ferro-Concrete Granary Building, F.C., vol.2, no.5, Nov., 1910, p.152.

Historic Concrete No.18, Concrete, Feb., 1976, p.28.

Illustration: Dunston-on-Tyne Flour Mills, The Co-operative Wholesale Societies Ltd., Annual, Manchester and Glasgow, 1916, p.123.

Own Photographs: April, 1977.

Acknowledgements: Co-operative Wholesale Society, Ltd., Estate and Property Group, Manchester.

Co-operative Wholesale Society, Ltd., Architects' Dept., Newcastle on Tyne.

Spillers-French Milling Ltd., Old Change House, London.

Drawings from: Co-operative Wholesale Society, Ltd.

1906 (May) - 1908.⁴⁴ Forth Banks Warehouse and Goods Station, Forth Banks, Newcastle on Tyne. (Chapter 10, figure 18).

Construction: entirely reinforced concrete, except for the roof (steel-framed). 3 storeys.

Client: The North Eastern Railway Co,

Architect: William Bell, F.R.I.B.A., York.

Contractor: Howe Bros., West Hartlepool.⁴⁵

Extant: owned by British Railways; occupied by George Blair & Co. (1977); interior recently painted; exterior also being painted (although parts in need of repair), April, 1977.

44. Memoranda, C.& C.E., vol.3, no.4, Sep., 1908, p.343 - almost completed.

45. lb., Hennebique Ferro-Concrete, op.cit. (5).

Drawing and associated sheets: Cellar Accommodation Forth Banks Newcastle,
 Hennebique's Patent Concrete Buildings, 38, Victoria
 St., Westminster, London, S.W., Quantities, 7 sheets,
 (including reference to elevation to Forth Banks,
 with pediment), 31.5.1906;
Forth Banks Warehouse Cellar Accommodation, order no.
1054, notes, mainly in French, referring to
 discrepancies between preliminary plans and
 calculations, 27.7.1906;
Forth Banks Warehouse, note, in English, from (T.J.)
 Gueritte, 20.11.1906;
Forth Banks Warehouse, note, in English from (T.J.)
 Gueritte with reply, in French, appended, referring to
 alterations of plans, and to accord with W. Bell
 (Architect's) plan of April, 1907, 15.5.1907;⁴⁶
N.E.R. Forth Banks Warehouse Cellar Accommodation
Construction in Hennebique's Patent Ferro-Concrete,
 section through new pulley way, 1906.

Illustrations: Hennebique Ferro-Concrete, London, 4th edn., 1921,
 p.130.

Own Photographs: April, 1977.

Acknowledgments: George Blair & Co., Forth Banks, Newcastle on Tyne.
 L. G. Mouchel & Partners, West Byfleet.

Drawing from: L. G. Mouchel & Partners.

47

1906 - 1908 Second Tobacco Warehouse, Cumberland Basin, Bristol.

Construction: entirely reinforced concrete: Coignet System,
 except exterior brick panel walls, and steel-framed
 roof. 9 storeys.

Client: The Bristol Corporation.

Engineer: W. W. Squire, M. Inst. C.E.

Contractor: W. Cowlin & Son, Bristol.

 46. Discussed in Chapter 7.

47. British Patent Rights in Reinforced Concrete Piles, C.& C.E., vol.1,
 no.4, Sep.1906, p.280 - reference to Coignet's reinforced concrete piles
 in works under construction at Bristol would appear to refer to this
 building. S.a: A Bristol Tobacco Warehouse, B.J., vol.27, 22.4.1908,
 (pp.368-70), p.368.

Article : A Bristol Tobacco Warehouse, B.J., vol.27, 22.4.1908, pp.368-70.

Illustration: under construction: M. T. Cantell, Reinforced Concrete Construction, London, 1912, p.225, figure 229.

1907. Chocolate Factory, Portobello, Scotland.

Construction: reinforced concrete frame, floors and roof: Wells System ; brick exterior walls. 3 storeys.

Client: Schulze & Co., Portobello.

Architects: J. & J. Hall, Galashiels.

Contractor: Stuart's Granolithic Co. Ltd.

Article: A Reinforced Concrete Factory in Portobello, Scotland, C. & C.E., vol.2, no.6, Jan.,1908, pp.459 - 66.

1907 (Feb.)- 1907 (Sep.) Perfume Factory, Ivy Lane and Duke's Head Passage, Newgate St., London.

Construction: reinforced concrete frame, floors and roofing: Coignet System; brick external walls. 9 storeys.

Client: Grossmith, Sons & Co.

Architect: H. A. Saul, A.R.I.B.A.

Contractor: Peacock Bros., Brixton.

Article: New Works in Concrete - Reinforced Concrete Factory Work, C. & C.E., vol.2, no.4, Sep.,1907, pp.323-4.

1907 - 1908. Granary, Avonmouth Docks. (Figure 7).

Construction: entirely reinforced concrete. 8 storeys.

Client: The British Corporation.

Engineer: W. W. Squire, M.Inst. C.E.

Contractor: John Aird & Sons.

General external design similar to W. W. Squire's 2nd Tobacco Warehouse (1906 - 8), at Bristol in Coignet's system but brick-faced.

Articles: Reinforced Concrete Sheds and Granary at Avonmouth Docks, C. & C.E., vol.3, no.3, July, 1908, pp.231-8.

Avonmouth Docks Granary, F.C., vol.2, no.4, Oct.,1910, p.123.

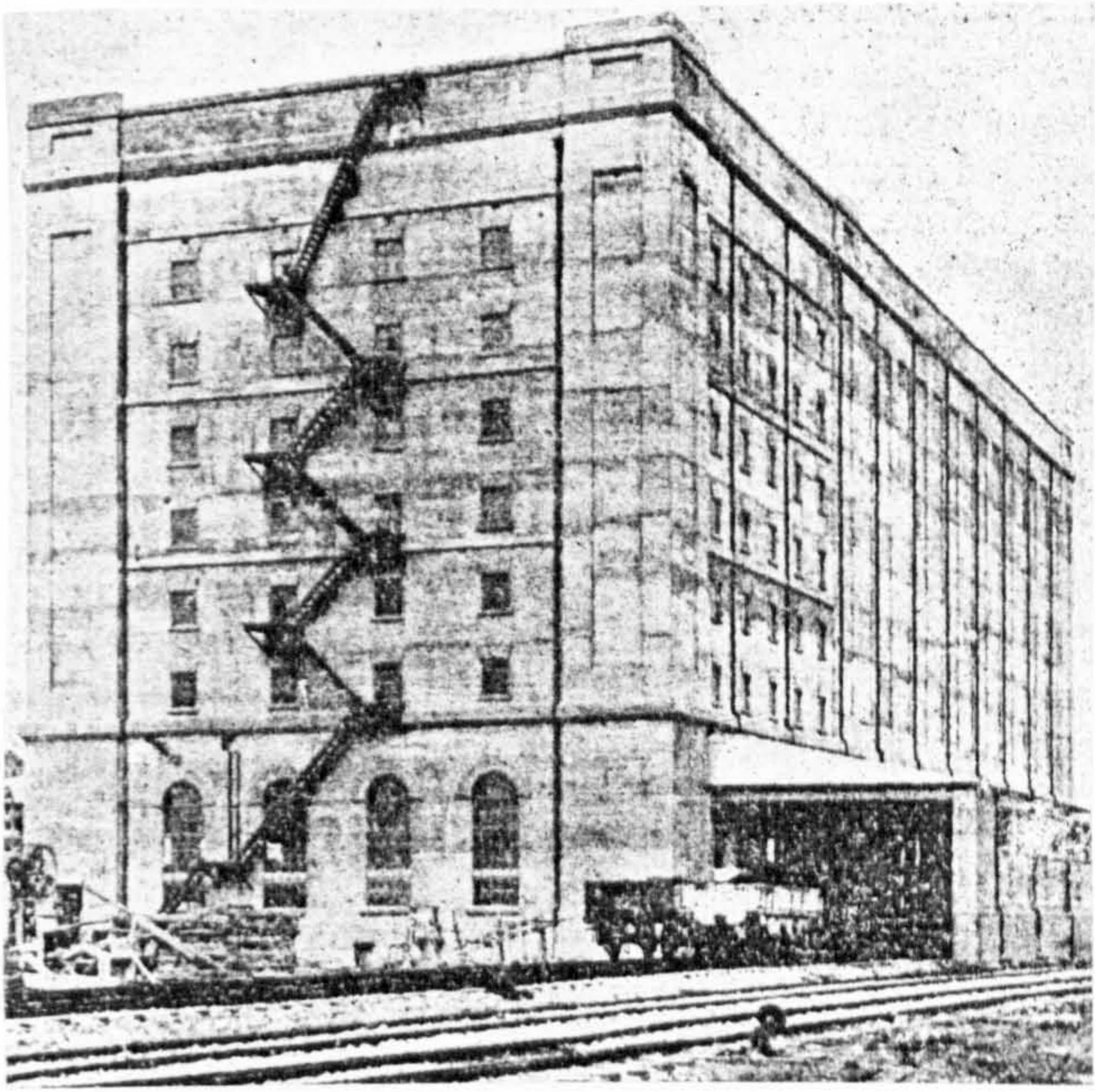


Figure 7: Granary Avonmouth Docks.

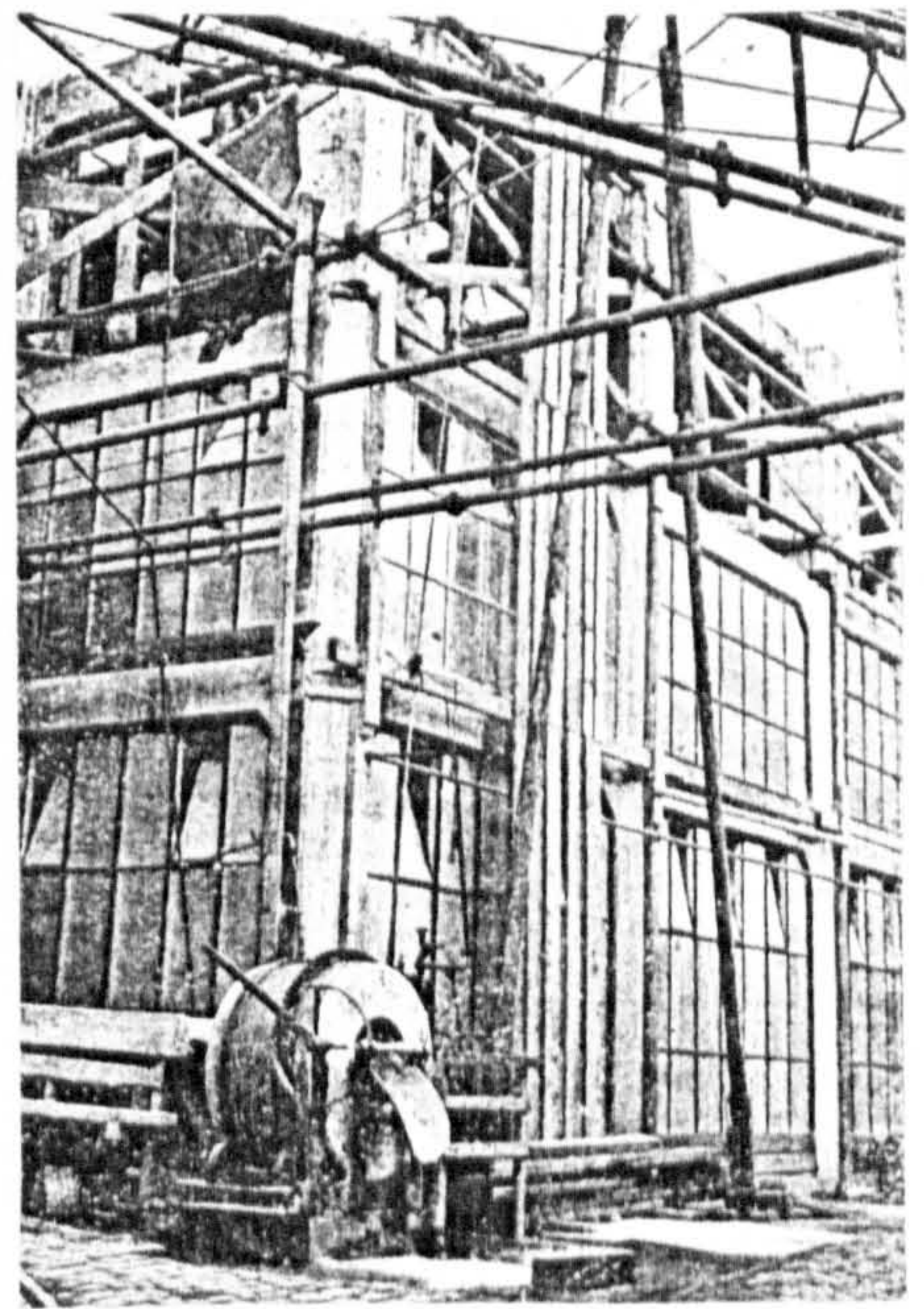


Figure 8: Factory Warrington:
under construction.



Figure 9: Confectionery
Manufactory Glasgow.

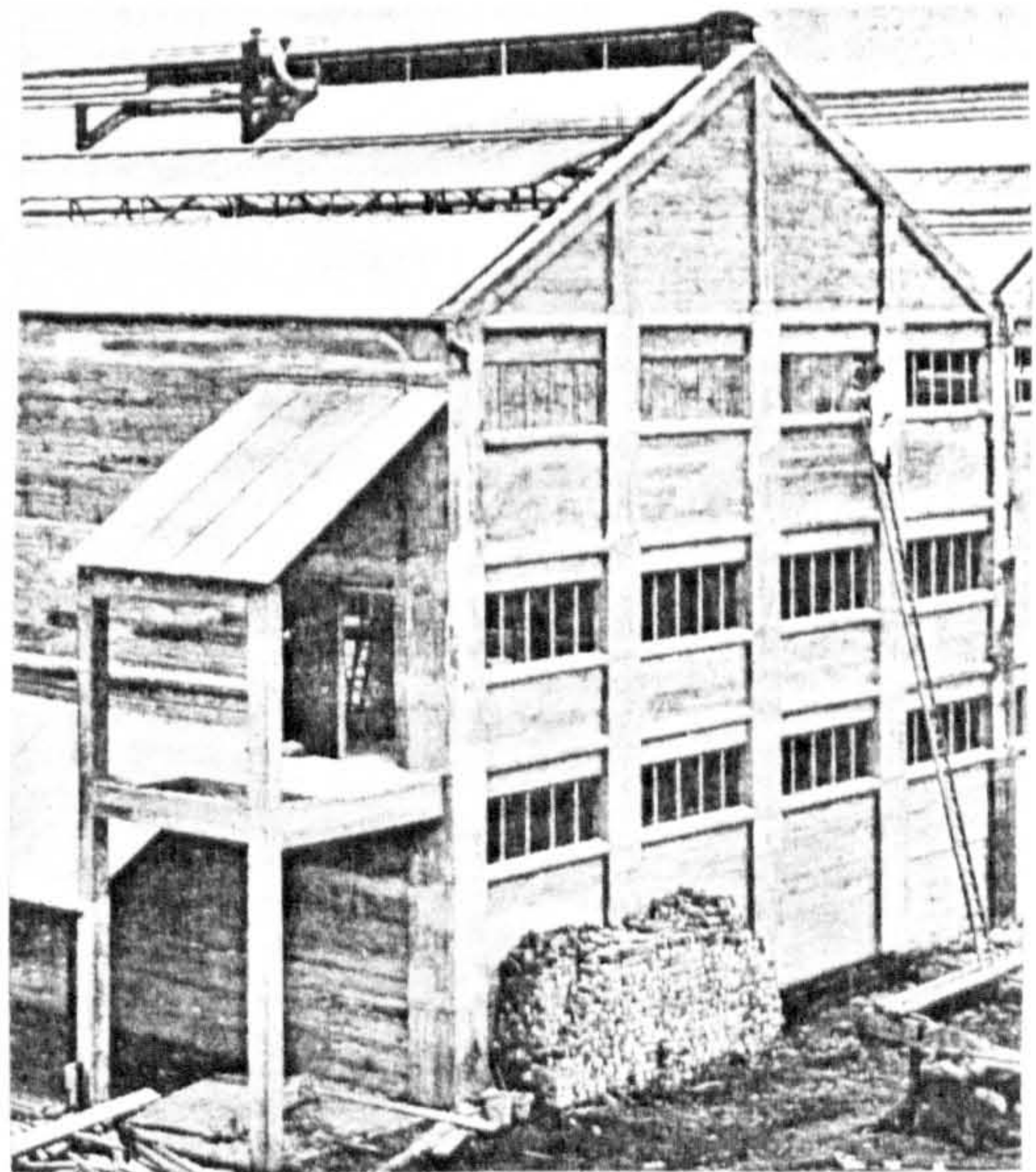


Figure 10: Warehouse Rainham:
under construction.

1907 - 1908. Granary, near Murrayfield Road and sidings near Haymarket Station, Edinburgh. (Chapter 10, figure 24).

Construction: entirely reinforced concrete, except 3 upper floors in mill: wood to facilitate cutting passages for equipment. 7 storeys.

Client: John Herdman & Son, Ltd.

Contractor: Robert Thorburn & Sons, Edinburgh.

Perhaps demolished: a search of the areas near Murrayfield Rd. and along the railway in the vicinity of the Haymarket Goods Depot, proved negative, (May, 1979).

Articles: Grain Silos and Flour Mills, Edinburgh, B.J., vol.29, 6.1.1909, pp.12-13.
Ferro-Concrete Grain Silo Building, Edinburgh, F.C., vol.1, no.4, Oct., 1909, pp.76-81.

1907 - 1908. Factory, Warrington. (Figure 8).

Construction: reinforced concrete framed: Paragon System.
5 storeys.

Client: The Erasmic Co. Ltd., Warrington.

Architects/Engineers: staff of The Erasmic Co. Ltd., Warrington.

Contractor: The Erasmic Co. Ltd., Warrington.

The Paragon system was developed by the British Reinforced Concrete Engineering Co. Ltd., Manchester, which was in business, "in a small way" until 1911, when the company expanded.⁴⁸

Article: New Works in Concrete: Reinforced Concrete Factory at Warrington, C. & C.E., vol.3, no.2, May, 1908, p.169.

48. E.g. Some Methods of Construction, C. & C.E., vol.6, no.11, p.848.
Progress During a Quarter of a Century, C. & C.E., vol.21, 1926,
 (pp.111-49), p.114. S.a: S.B. Hamilton, A Note on The History of Reinforced Concrete in Buildings, N.B.S. Spec. Rep. No.24, London, 1956,
 pp.11, 13.

1907 (May) - 1909 (Feb.)⁴⁹ Soap Factory, Dunston, Newcastle on Tyne.

(Chapter 10, figures 10 - 12).

Construction: entirely reinforced concrete. 3 - 4 storeys.
 Client: The Co-operative Wholesale Society, Ltd.
 Architect: L. G. Ekins, Lic. R.I.B.A.
 Extant: still owned by the Society. Extended between 1911 - 1916, with L.G. Ekins as architect, including a glycerine department and an additional storey to part of the building. Production ceased in the mid-1960s and the factory is now largely vacant except for part occupied as a hide and skin depot.

Drawings: Ferro-Concrete Construction (Hennebique System)
Order No. 1810, plan no. 2, 1st floor (original, coloured drawing), 24.5.1907; plan no. 3, pan room and roof plans, (original, coloured drawing), 24.5.1907; plan no. 5, foundations plan (original, coloured drawing), 24.5.1907.

Article: The C. W. S. Soap Works at Dunston, The Wheatsheaf (C.W.S.publication), pp.24-7.

Own Photographs: April, 1977.

Acknowledgements: The Co-operative Wholesale Society, Ltd., Estate and Property Group, Manchester.
 The Co-operative Union Ltd., Library, Manchester.
 The Co-operative Wholesale Society, Ltd., Architects' Department, Newcastle on Tyne.

Drawings from: The Co-operative Wholesale Society, Ltd.

1907 (June) - 1908. Confectionery Manufactory, Maitland Street, Glasgow.
(Figure 9).

Construction: entirely reinforced concrete. 5 storeys.
 Client: J. Buchanan & Bros. Ltd., Glasgow.
 Engineers: Wyllie & Blake, A.M M.Inst.C.E., Glasgow.
 Contractor: W. T. Weir, Newcastle on Tyne.

49. Opened, 15.2.1909: Percy Redfern, The Story of the C.W.S., Manch., 1913, p.429.

- Apparently demolished: own visit to area of site, now altered, partly rebuilt with motorway, partly derelict.
- Drawings: Messrs. John Buchanan & Bros. Ltd. Proposed Ferro-Concrete Warehouse on the Hennebique System of Construction, Maitland Street, showing existing buildings, signed: Wyllie & Blake, C.E., Architects, Glasgow, 18.6.1907: a note on the drawing states that it and an accompanying plan are referred to, in the Dean of Guild Decree, in the petition of John Buchanan & Bros. Ltd. - decree, Glasgow, 11.7.1907; Proposed Building of Ferro-Concrete, Elevation to Maitland Street, End Elevation, plans, sections, signed: Wyllie & Blake, C.E., Architects, Glasgow, 18.6.1907.
- Article: Ferro-Concrete Warehouse, Glasgow, F.C., vol.1, no. 5, Nov., 1909, pp.105-7.
- Acknowledgement: City Archivist's Dept., Glasgow.
- Drawings from: City Archivist's Dept., Glasgow.
- 1907 (June) - 1911. Royal Liver Office Building, Pierhead, Liverpool.
(Chapter 10, figure 5).
- Construction: reinforced concrete frame, floors (hollow), terrace roof and domes; 14" granite walls supported by frame. 11 storeys and 6 in towers.
- Client: The Royal Liver Friendly Society.
- Architect and Engineer: W. Aubrey Thomas, Architect, assisted by his engineer, A. Edwin Culley, Liverpool.
- Contractor: Edmund Nuttall & Co., Manchester.
- Extant: still occupied by The Royal Liver Friendly Society.
- Drawings: The Royal Liver Friendly Society holds original drawings for the building.
- Articles: e.g. Royal Liver Building, Liverpool, B.J., vol.25, 5.6.1907, p.286;
Royal Liver Building, Liverpool, Articles I - IV, F.C., vol.1, no.5, Nov., 1909, pp.91-4; vol.1, no.7, Jan., 1910, pp.150-3; vol.1, no.8, Feb., 1910, pp.172 - 7; vol.1, no.10, April, 1910, pp.210-4.
Albert Lakeman, The Royal Liver Building, Liverpool,

C. & C.E., vol.6, no.10, Oct.,1911, pp.727 - 35.

Own Photographs:

April, 1978.

Acknowledgement:

The Royal Liver Friendly Society, Liverpool.

1908. Warehouse, Rainham, Essex. (Figure 10).

Construction: entirely reinforced concrete: Coignet System,
except roof (steelwork). 3 storeys.

Client: J. C. & J. Field, Ltd.

Architects: Scott, Hanson & Fraser, London.

Contractor: W. King & Son, London.⁵⁰

1908. Grain Silos, Silvertown, London. (Figure 11).

Construction: entirely reinforced concrete.

Client: The Co-operative Wholesale Society, Ltd.

Architect: F.E.L. Harris, A.R.I.B.A.

Contractor: A. Jackaman & Son, Slough.

Apparently demolished: visit to expected site, Silvertown, July, 1977.

Articles: Reinforced Concrete Grain Silos at Silvertown,
C. & C.E., vol.5, no.11, Nov.,1910, pp.791-7.
F.E.L. Harris, A.R.I.B.A, Grain Silos at Silvertown,
F.C., vol.2, no.8, Feb.,1911, pp.240 - 3.

1908. Office Building and Pattern Shop, West Gorton, Manchester.

(Chapter 10, figure 23).

Construction: reinforced concrete frame, floors and terrace
roof; 9" brick exterior walls. 3 storeys.

Client: The Unbreakable Pulley & Mill Gearing Co. Ltd.

Contractor: The Yorkshire Hennebique Contracting Co. Ltd., Leeds.

Extant: presently occupied by Lex Motor Co., D.I.Y. Centre;
exterior of building not substantially altered, but
windows replaced and one corner window blocked,
new door and brickwork of upper storeys painted.

50. New Works in Concrete, C.& C.E., vol.3, no.1, March, 1908, p.82.

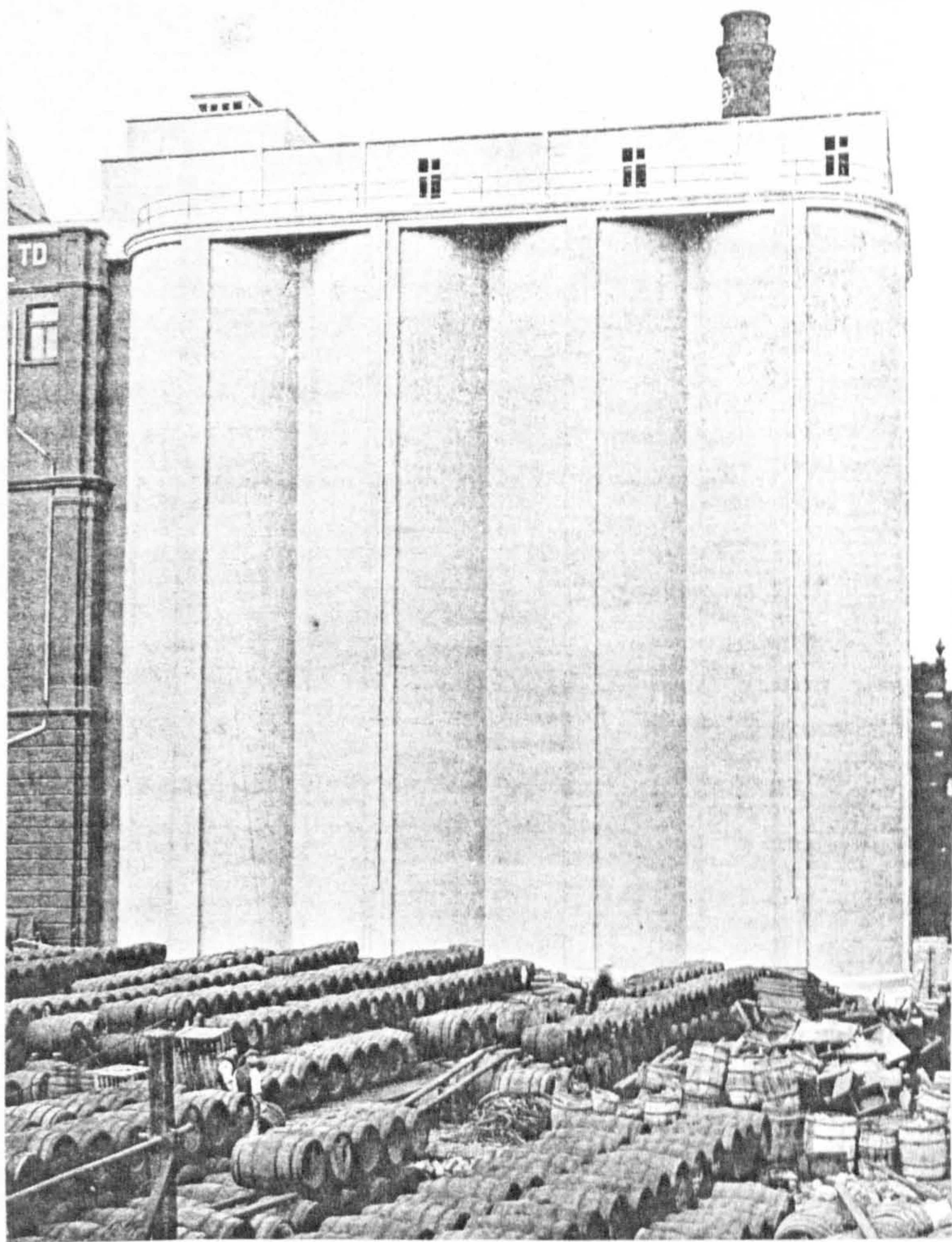


Figure 11: Grain silos London.

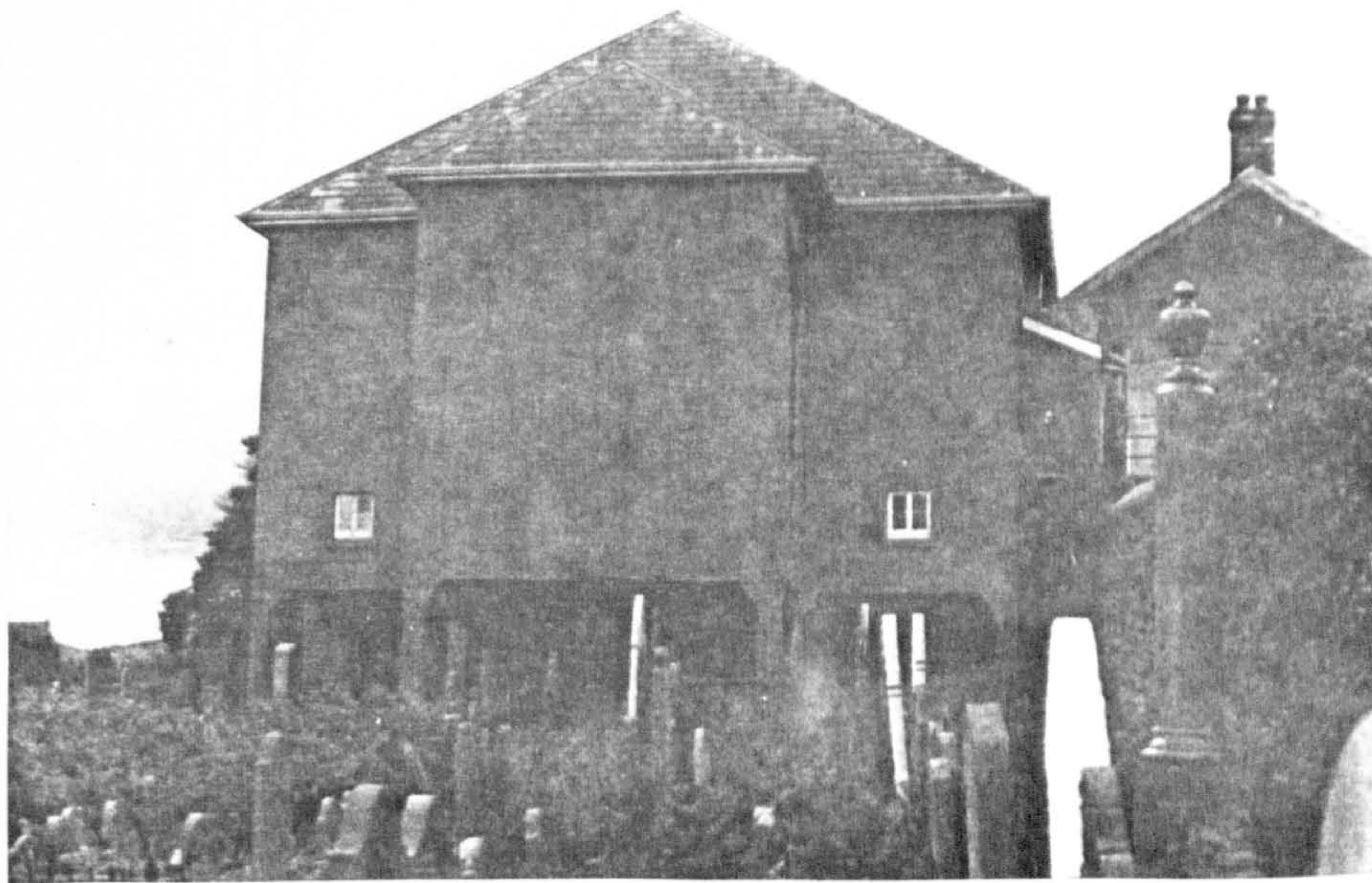


Figure 12: Organ Chamber Pontardawe.

Own Photographs: April, 1978.
 Acknowledgement: Lex Motor Co., West Gorton.

1908. Viaduct Works, Kirkstall Road, Leeds.

Construction: partly, perhaps entirely reinforced concrete.
 Client: The Yorkshire Hennebique Contracting Co. Ltd.
 Apparently demolished: search in area of Kirkstall Road, April, 1978.
 Illustration: The Yorkshire Hennebique Contracting Co. Ltd., Leeds, illustrated booklet, n.d., cover illustration possibly depicts part of exterior

1908 - 1911 (May). Y.M.C.A. Premises, Manchester. (Chapter 10, figure 21).

Construction: entirely reinforced concrete: Kahn System;
 external walls faced with terra-cotta.
 Client: The Young Men's Christian Association.
 Architects: Woodhouse, Corbett & Dean, Manchester.
 Extant: still occupied by the Y.M.C.A.; external terra-cotta surface recently cleaned.⁵¹
 Drawings: 2 elevations, Aug., 1941, by Harry S. Fairhurst & Son, F.F.R.I.B.A., Architects, Manchester, to Museum Street, and Peter Street.
 Articles: e.g. The New Y.M.C.A. Manchester Building Opened, Manchester Guardian, 23.5.1911.
The Y.M.C.A. Building, Manchester, C. & C.E., vol.6, no.5, May, 1911, pp.368-77.
 Alfred E. Corbett, F.R.I.B.A., M.C.I., The Y.M.C.A. Building, Manchester. pr. to C.I., 8.6.1911, C.I.Trans., vol.3, pp.282-318.
The Manchester Y.M.C.A. in Pictures, and, Woodhouse, Corbett & Dean, The Y.M.C.A. from the Architect's Point of View, The Manchester Y.M.C.A. News, July, 1911.

51. Mr. R. Jarman, General Secretary, Y.M.C.A., Manchester, April, 1978.

Own Photographs: April, 1978.
 Acknowledgement: Mr. R. Jarman, General Secretary, Y.M.C.A., Manchester.
 Drawings from: Mr. R. Jarman.

1909. Organ Chamber, Alltwen, Pontardawe.. (Figure 12).

Construction: entirely reinforced concrete (except possibly, the roof); panel walls, with cavity (in situ).
 Client: The Alltwen Congregational Church Trustees.
 Architect: W. Beddoe Rees, Cardiff.
 Contractor: W. Thomas & Co., Cardiff.
 Extant: still in use (1976).
 Article: Organ Chamber, Pontardawe, F.C., vol.1, no.4, Oct.,1909, p.84.
 Own Photographs: August, 1976.

1909. St. Lawrence Wire Rope Works, St. Lawrence Road, Newcastle on Tyne.
(Figure 13).

Construction: entirely reinforced concrete .double storey height.
 Client: J. W. Smith & Co. Ltd.
 Engineer: Lieut.-Col. J. Mitchell-Moncrieff, C.B.E., R.E., M.Inst.C.E.
 Extant: now occupied by John Porter (Newcastle) Ltd., joinery manufacturers, (1977).
 An example of king-post trusses in reinforced concrete.
 Drawing: Premises of John Porter (Newcastle) Ltd., current plan, n.d.
 Own Photographs: April, 1977.
 Acknowledgement: John Porter (Newcastle) Ltd.
 Drawing from: John Porter (Newcastle) Ltd.

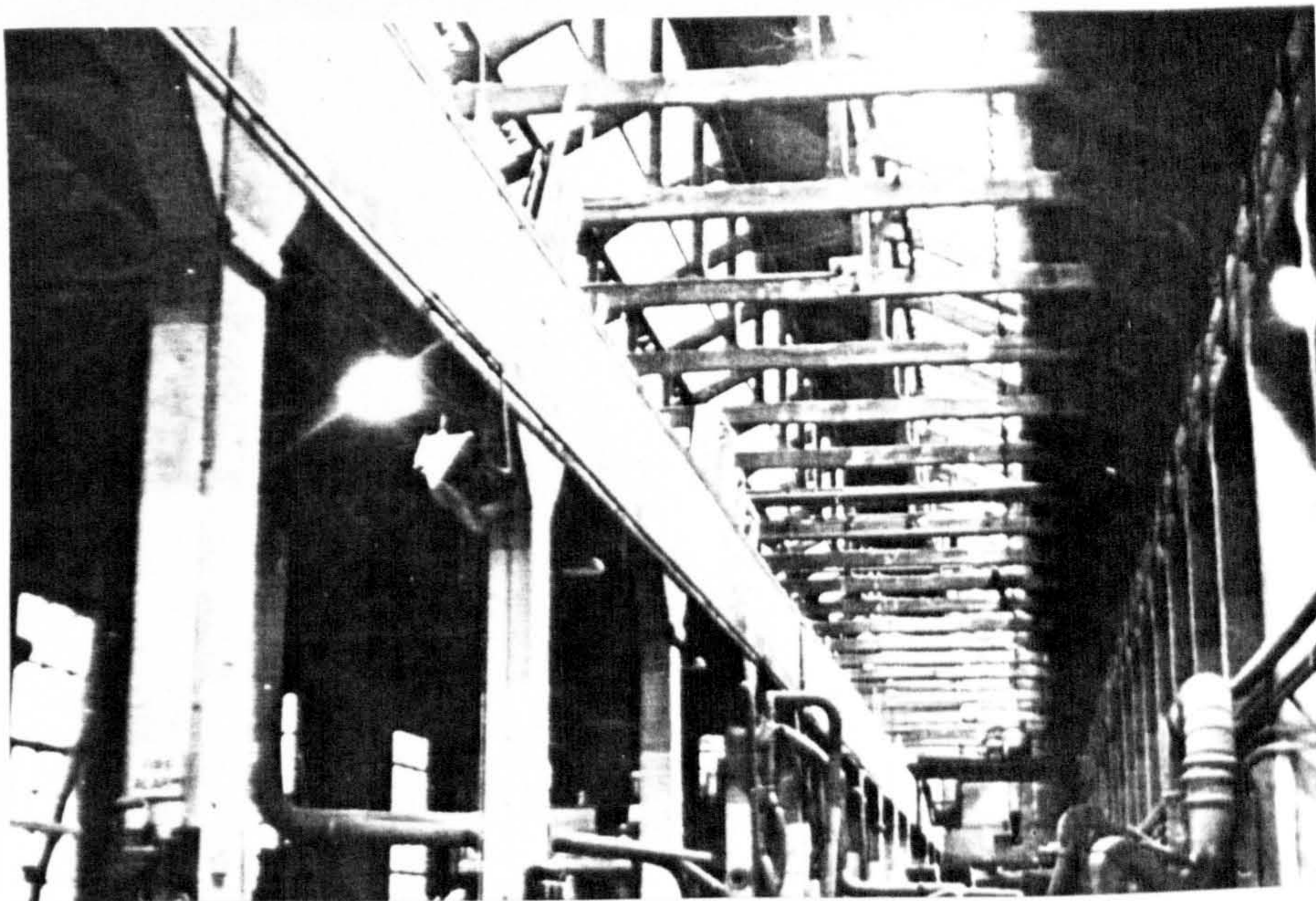


Figure 13: St. Lawrence Wire Rope Works
Newcastle on Tyne.



Figure 14: Keir Chapel Dunblane: interior:
half-dome.

1909. Central Hall in "Spanish City", Whitley Bay.

Construction: dome and gallery in reinforced concrete.
 Client: The Whitley Bay Amusements Ltd.
 Architects: J. T. Cackett & R. Burns Dick, F F.R.I.B.A.
 Extant: Spanish City still in use as an amusements centre.
 Article: Spanish City - Whitley Bay, F.C., vol.2, no.6,
 pp.168-75.

1910. Keir Chapel, Keir House, Dunblane. (Figure 14).

Construction: roof in reinforced concrete, with half-dome.
 Client: Captain Stirling.
 Architects: Sir Rowand Anderson & Paul, F F.R.I.B.A., Edinburgh.
 Contractor: Gray's Ferro-Concrete Contracting Co., Glasgow.⁵²
 Extant (1977).
 Own Photographs: January, 1977.

1910 - 1912. Shop Premises, The Corner, Middlesbrough.

Construction: reinforced concrete frame, except for perimeter columns,
 ground floor level: circular cast iron; external
 walls: faience tiling, over brick or possibly reinforced
 concrete. Considère System. 3 storeys.
 Client: J. Newhouse & Co., Ltd.
 Architect: A. Forrester.
 Contractor: The Considère Construction Co., Ltd.⁵³
 Extant: currently occupied by Debenham's Departmental Stores
 (1981). Extended, 1937, 1954 and further work in
 progress (1981).
 Acknowledgements: Archives Dept., Cleveland County Libraries, Middlesbrough;
 Debenhams, Middlesbrough.
 Ketley Goold Associates, Architects. Leeds.

52. Mouchel-Hennebique Ferro-Concrete: List of Works, op.cit.(6), and, New Works in Ferro-Concrete, F.C., vol.2, no.9, March, 1911, p.320.

53. Reference List of Work carried out to Considère Designs, 1908 - 1923; Plans Index, Middlesbrough; Surveyors' Report Book, No.6, Middlesbrough, 20.12.1911, pp.74-7; J. Newhouse Ltd., Illustrated Brochure, 1957.

Ketley Goold Associates, Architects, Leeds, for additional comments on the construction.

1911. House, Fyling Hall, near Robin Hood's Bay. (Figure 15).

Construction: entirely reinforced concrete: walls cast flat;
structural design probably by W. J. Swain.

Client: Mr. Seebohm Rowntree.

Contractor: Rowntree & Co. Ltd., building staff.⁵⁴

Acknowledgement: Rowntree Mackintosh Ltd., Public Relations Dept., York.

1911 - 1912. H.M. Stationery Office Warehouse, Stamford Street, London.
(Figure 16).

Construction: entirely reinforced concrete. 6 storeys, joined by
3-storey bridge to office building, fronting Waterloo
Bridge Street and faced with Portland stone.

Client: H. M. Office of Works.

Architect: R. J. Allison, O.B.E., F.R.I. B. A.

Contractor: Perry & Co. (Bow) Ltd., London.

Extant: still occupied by H.M.S.O. (1977); present roof may
not be original: there was some war damage (1945),
with upper storey of warehouse or office block partly
rebuilt.⁵⁵

Drawing: H.M. New Stationery Office and H.M.O.W. Stores, Second
Contract, no. 9, sections, Engineering Division, H.M.
Office of Works, 30.10.1911.

Article: Visits: H.M. New Stationery Office and H.M. Office
of Works Stores, C.I., Trans., vol.4, pt.3, Dec., 1912,
xxxvii - xxxix.

Illustrations: under construction: Bernard E. Jones. ed., Reinforced Concrete,
London, 1913, p.174, figure 241;
Portland Cement and Concrete, Wouldham Cement Co. Ltd.,
London, 1914, xxiii.

Own Photographs: July, 1977.

54. W.J.Swain, Ferro-Concrete Buildings, "The C.W.M.," Rowntree & Co. Ltd.,
York, Sep. 1911, pp.1147 - 50.

55. Own visit and Photographs, and see Hamilton, op.cit. (5), Table 1.

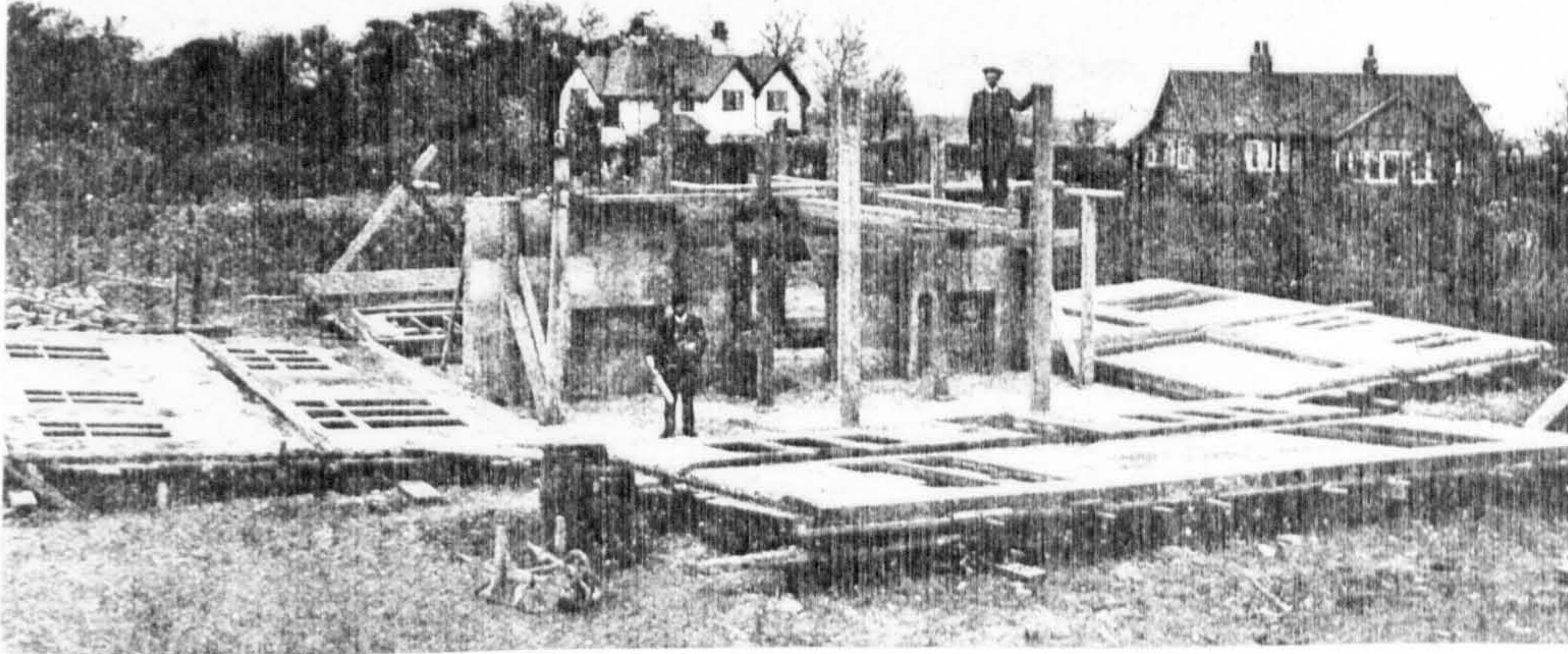


Figure 15: House Fyling Hall: under construction and completed.



Figure 16: H.M.S.O. Warehouse London.

Acknowledgement: H. M. Stationery Office, Norwich (Personnel Services),
and London.

Drawing from: H. M. Stationery Office, London.

1911 - 1912. 6 Dock Warehouses, Kingston-on-Hull. (Figure 17).

Construction: entirely reinforced concrete: Considère System.
2 storeys.

Client: Hull Joint Dock Committee.⁵⁶

Extant: owned by British Transport, Docks Board, Hull. (1978).

Drawings: Hull Joint Dock, Sheets nos.1, 2, 3,4: Ferro-Concrete
Warehouses: Site Plan; Warehouses on No.1 Quay,
elevation and cross-section; No.3 Quay, same; end walls,
1911.

Own Photographs: April, 1978.

Acknowledgement : British Transport, Docks Board, Hull.

1911 (June) - 1912. Spanish Villa, Tillycorthie, Aberdeenshire.

(Chapter 11, figure 6).

Construction: entirely reinforced concrete, except roofing (timber).
2 storeys.

Client: James Duncan.

Architect: John Cameron, Aberdeen.

Contractor: James Scott & Son, Aberdeen.

Extant: now owned (since 1953⁵⁷) by University of Aberdeen and
in grounds of Farm Estate of Dept. of Agriculture: unoccupied and becoming
dilapidated (1979). Probably first large house or mansion, in Britain,
constructed almost wholly in reinforced concrete.

Drawings: Ferro-Concrete Construction (Hennebique System) Order No.
5129, Newcastle No. 1180, L. G. Mouchel & Partners, Ltd.,
Civil Engineers, 18 Victoria Square, Newcastle on Tyne:

56. Reference List of Work carried out to Considère Designs, op.cit. (53).

57. Aberdeen Press & Journal, 21.9.1953.

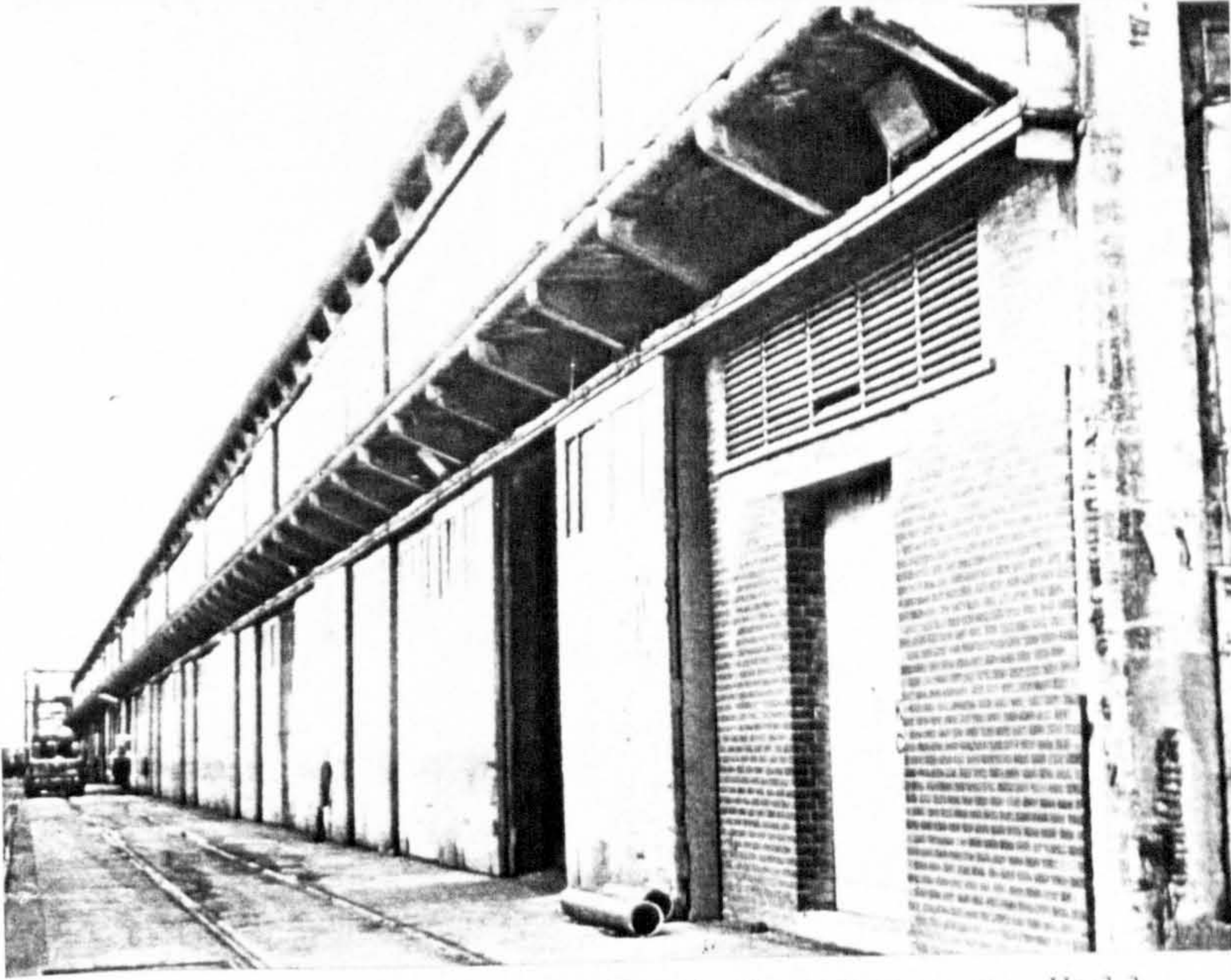


Figure 17: Dock Warehouses Hull.

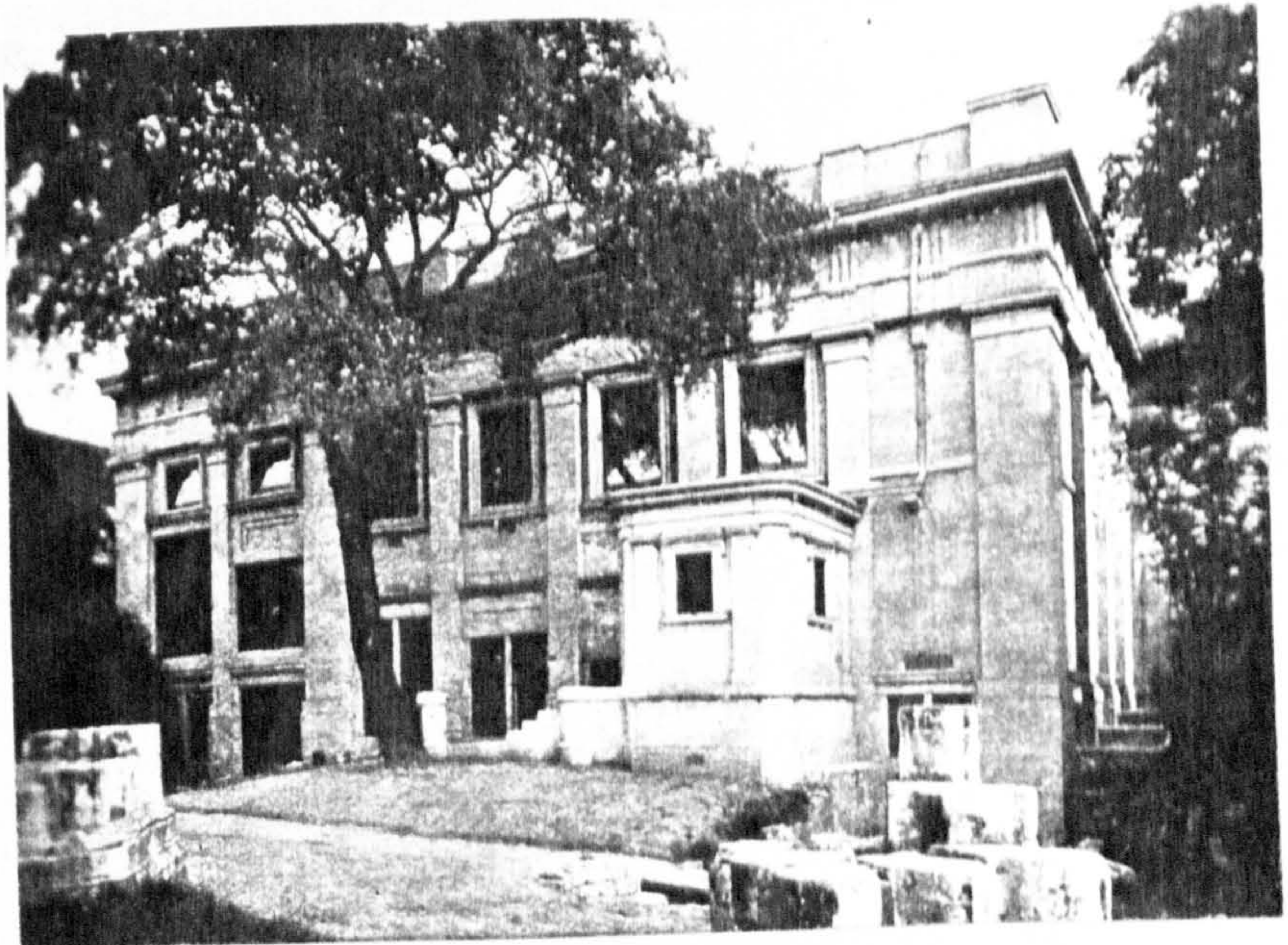


Figure 18: Lecture Theatre, Museum York.

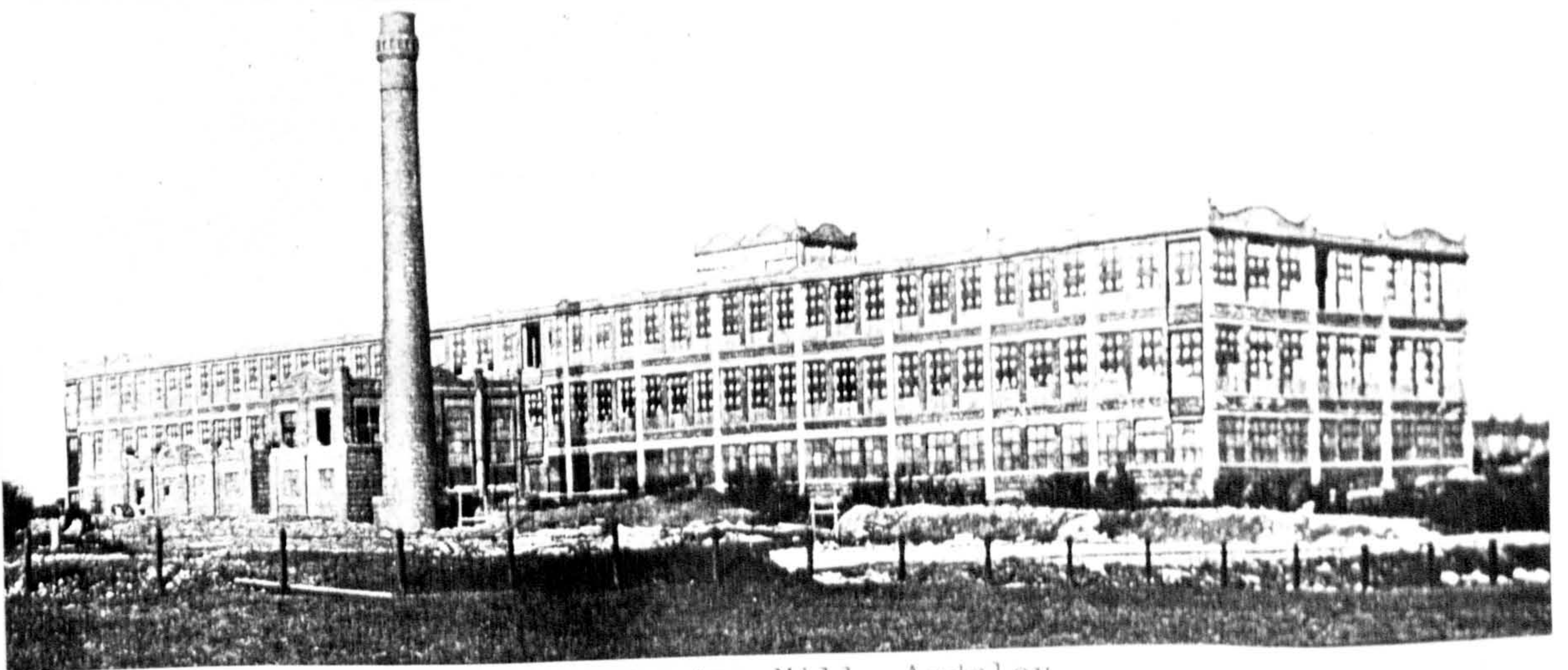


Figure 19: Atlas Spinning Mill Ardsley.

plans nos. 1, 2 : elevations : 10.6.1911 ;
Spanish Villa, Tillycorthie, Ferro-Concrete Construction
Hennebique System Order no. 5129. L. G. Mouchel & Partners,
 Civil Engineers. 38 Victoria Street, Westminster:
Working Plans, plan no.12, amended elevations, sections,
 details, 3.8.1911; plan no. 15, details of corbels, 11.8.1911;
 no. 17, 1st floor, 24.8.1911; no.20, elevation (stepped
 gables in reinforced concrete), 21.9.1911; no. 21, elevations,
 21.9.1911; no 23^a, details of oriel window in tower,
 26.10.1911; no. 25, details of tower, 13.1.1912.
 Perspective drawing of front of building for reproduction,
 unsigned, n.d.

Articles: Tillycorthie House Progress of the Work, Aberdeen Daily
 Journal, 10.1.1912.
Spanish Villa, Tillycorthie, The First Ferro-Concrete
Mansion in Great Britain, F.C., vol.4, 1912-13, pp.123-4.

Own Photographs: June, 1979.

Acknowledgements: L. G. Mouchel & Partners, West Byfleet.
 Udney Post Office, Udney, Aberdeenshire.
 Aberdeen University, Dept. of Agriculture.
 Central Library, Aberdeen.
 City of Aberdeen, Dept. of Planning and Building Control.

Drawings from: L. G. Mouchel & Partners.

1911 - 1912. Lecture Theatre: Extension to the Yorkshire Philosophical
Society's Museum, York. (Figure 18).

Construction: entirely reinforced concrete: Kahn System. 2 storeys.
 Client: The Yorkshire Philosophical Society.
 Architect: E. Ridsdale Tate, York.
 Contractor: J. & T. Biscomb & Sons, York.
 Extant: (1978).

No treatment or cover to the external surfaces of the building except
 cleaning, after removal of the forms.

Articles: Test of a Kahn Building at York, B.J., 1.5.1912, p.450.
New Lecture Theatre, York, B.J., 17.7.1912, pp.75-6.
The Tempest Anderson Hall Extension to York Museum (1912), in:
 Professor E. Heinle and Professor Max Bächer, Building
in Visual Concrete, Stuttgart, 1966, adapted in English by
 the Technical Press, London, 1971, pp.158-9.

Own Photographs: April, 1978.
 Acknowledgement : R. B. Colman, Birkett, Stevens Colman Partnership,
 Smeaton House, Leeds.

1912. Atlas Spinning Mill, Ardsley, Wakefield. (Figure 19).

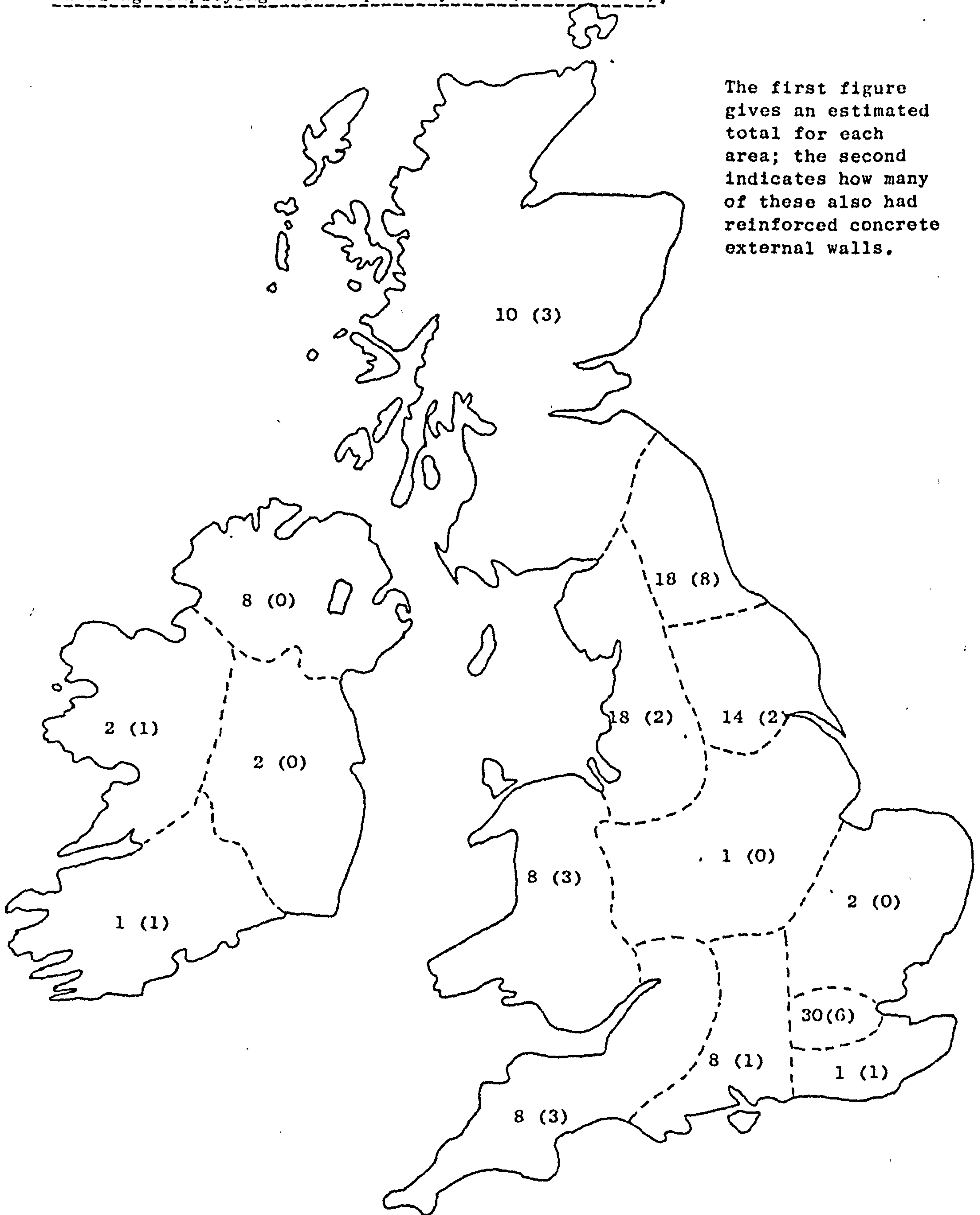
Construction: reinforced concrete frame, floors and roof.
 3 storeys.
 Client: Thomas Ambler & Sons, Ltd.
 Architect: W. E. Putman.
 Contractor: The Yorkshire Hennebique Contracting Co. Ltd.,
 Leeds.⁵⁸
 Illustration of interior: The Yorkshire Hennebique Contracting Co.Ltd.,
Leeds, illustrated booklet, n.d.

: : : : : : : : : : :

58. Mouchel-Hennebique Ferro-Concrete.List of Works, op.cit. (6), and,
Ferro-Concrete Works Under Construction or Recently Completed, F.C.,
vol.3, no.11, May, 1912, p.356, and, The Yorkshire Hennebique
Contracting Co. Ltd., Leeds, illustrated booklet, n.d.

A P P E N D I X I I .

Geographical Distribution in Britain of Reinforced Concrete Framed Buildings Employing Hennebique's System (1897 - 1908)!



1. Based on: Mouchel-Hennebique Ferro-Concrete: List of Works Executed in the U.K. 1897-1919, London, and individual studies of many buildings: see, e.g. Appendix I.

B I B L I O G R A P H Y.

The bibliography is divided into two main parts:

A. Relevant sources consulted dated from the early nineteenth century until 1908 but with chief reference to the period: 1897 - 1908.

B. Relevant sources consulted dated from 1909 to the present.

These are subdivided as follows:

A. Nineteenth Century and until 1908, particularly: 1897 - 1908:

1. Manuscripts (including signed documents) and Drawings;

Photographs:

- 1.1. Drawings and associated sheets: see also Appendix I.
- 1.2. Correspondence: excluding communications relating to individual buildings and included in Appendix I.
- 1.3. Project Records; Buildings Registers; Contracts and Agreements.
- 1.4. Photographs.

2. Printed Sources:

- 2.1. Patents; Reports.
- 2.2. Lists of Works; Company Brochures and Magazines.
- 2.3. Transactions and Journals.
- 2.4. Newspapers and Directories.
- 2.5. Books on Concrete and Reinforced Concrete.
- 2.6. Local and Company Books.
- 2.7. General Books.

B. 1909 - Present:

3. Manuscripts (including signed documents) and Drawings;

Photographs:

- 3.1. Drawings - see Appendix I.
- 3.2. Correspondence and Notes.
- 3.3. Estimates, Contracts and Inventories.
- 3.4. Photographs.

4. Printed Sources:

- 4.1. Lists of Works; Company Brochures and Magazines.

- 4.2. Transactions and Journals.
- 4.3. Newspapers and Directories.
- 4.4. Books and Dissertations on Concrete and Reinforced Concrete.
- 4.5. Local Books and Dissertations and Company Books.
- 4.6. Other Books and Dissertations.

: : : : : : : : : : :

Sources of material are given except for: Transactions, Journals, Newspapers, Directories and Books and constitute a further subdivision within the relevant sections.

: : : : : : : : : : :

A. Nineteenth Century and until 1908, particularly: 1897 - 1908:

1. Manuscripts (including signed documents) and Drawings; Photographs:

1.1. Drawings and associated sheets: see also: Appendix I:

Note: Details of drawings, including original, water-coloured, examples, and associated sheets, (e.g., quantities, jottings), relating to many individual, executed, buildings are given in Appendix I, together with their sources, mainly:

L. G. Mouchel & Partners, Ltd., (now, Mouchel Associates, Ltd.) West Byfleet, and Newcastle on Tyne.

The Regional Architect, British Railways Board, York.

The City Archivist's Department, Glasgow.

The Record Office, Hull.

The Co-operative Wholesale Society, Ltd., Manchester, and Newcastle on Tyne.

The Manchester Ship Canal Co. Ltd., Manchester.

Additional drawings, and associated sheets, for unexecuted projects:

1.1.1. L. G. Mouchel & Partners, Ltd., West Byfleet:

Spillers & Bakers Co., Ltd., Proposed Warehouse and Bakery, Newcastle, order no. 89, plan no.2, 17.10.1899.

1.1.2. The Record Office, Hull:

Messrs. Brown & Polson, Silos, Paisley, order no. 213, 1st Project, plan no. 1, 7.6.1901; 2nd Project, n.d.

Floors in Mr. Robson's Oil Mill, order no. 246, sketches, nos. 1 and 2, and quantities, 38, Victoria Street, Westminster, 30.10.1901.

Silos, Wincolmllee, Hull, order no. S46, quantities, 38,
Victoria Street, Westminster, 26.10.1904.

Tender for ferro-concrete work (executed):

The British Concrete Steel Co., J. T. Levitt, Hull, contractor,
for ferro-concrete work, Cattle Market, Hull, to: the Municipal
Corporation, Hull, November, 1908: original completed Form of
Tender.

Example of Hennebique's System:

Example of Floor, Beam and Column, Hennebique's Patent Ferro-
Concrete, figures 1 - 5, Francis Eliet (sic), C.E., Grosvenor
Chambers, 16 Deansgate, Manchester, n.d., c.1901: blueprint.

1.2. Correspondence, excluding communications relating to individual
buildings, included in Appendix I :

1.2.1. L. G. Mouchel & Partners, Ltd., West Byfleet:

L. G. Mouchel, G.W.R. Buildings, 124, Holborn, London, E.C.,
general letter: change of office address, 19.2.1901: original
printed letter, amended by hand.

T.O. Dixon, Maritime Chambers, Hennebique's Patents: Southampton
Office, to: L. G. Mouchel, London, 24.7.1901: signed, T.O.Dixon.

T.O. Dixon to: L. G. Mouchel, 16.9.1902, handwritten copy
probably of same date.

A. Jackaman & Son, Contractors, Slough, to: L. G. Mouchel, 15.6.1903,
handwritten, original.

T. J. Gueritte, Northern District Office, 18, Victoria Square,
Newcastle on Tyne, to: contractor, 27.11.1905: signed, T.J.Gueritte.

L. G. Mouchel, 38, Victoria Street, Westminster, to: W. F. Howard,
37, St. Paul's Road, Camden Square, 1.9.1906: original postcard.

Charles H. Mounsey, County Surveyor, Carmarthenshire, to: The
Yorkshire Hennebique Contracting Co. Ltd., East Parade, Leeds,
30.10.1906.

J.S.E. de Vesian and T. J. Gueritte, obituary letter for L. G.
Mouchel, May, 1908: signed by J.S.E. de Vesian and T.J. Gueritte.

1.2.2. The Record Office, Hull:

L. G. Mouchel to: Messrs. Brown & Polson, 11.6.1901, 3 pp:
1st missing: copy.

Alex Murdoch, Glasgow, to: Brown & Polson, Paisley, June, 1901:
handwritten, original.

W. K. Renwick & Co., Glasgow, to: Brown & Polson, Paisley, June,
1901: handwritten, original.

London and South Western Railway, Cold Storage Office,
Southampton, to: Messrs. Rose, Downs & Thompson, Hull,
21.8.1901: handwritten with illegible signature.

L. G. Mouchel, 38, Victoria Street, Westminster, to: Messrs.
Rose, Downs & Thompson, Hull, 30.10.1901: signed by L. G.
Mouchel.

L. G. Mouchel, 38, Victoria Street, Westminster, to: Messrs.
Rose, Downs & Thompson, Hull, 1.11.1904: signed by L. G. Mouchel.

- 1.2.3. The Manchester Ship Canal Co. Ltd., Manchester :
L. G. Mouchel, 38, Victoria Street, Westminster, to: W. Henry
Hunter, 5.9.1902: 12 pp.; handwritten and signed, by L. G. Mouchel.
- 1.2.4. The Clerical, Medical & General Life Assurance Society, London,
from Bristol offices:
W. Dunn & R. Watson, 35, Lincoln's Inn Fields, London, W.C.,
to The Clerical, Medical & General Life Assurance Society,
15, St. James's Square, London, 4.9.1903: copy.

1.3. Project Records and Buildings Registers; Contracts and Agreements:

- Project Records and Buildings Registers:
- 1.3.1. L.G.Mouchel & Partners, Ltd., West Byfleet:
Project Record No.1. Nos. 1 - 8750 (1897 - 1917), L. G. Mouchel
& Partners, Ltd., 38, Victoria Street, Westminster.
Project Locality Index No.1, L. G. Mouchel & Partners, Ltd., 38,
Victoria Street, Westminster.
- 1.3.2. The Record Office, Hull:
Buildings Registers (Miscellaneous Buildings), Hull: Vol.7:
October, 1893 - January, 1900; Vol.8: January, 1900 - September,
1906; Vol.9: September, 1906 - April, 1913.
- 1.3.3. The City Archivist's Department, Glasgow.
Register of Plans: First Series, 1885 - 1903, Dean of Guild,
Glasgow, and,
Register of Plans: Second Series, 1904 - 1910, Dean of Guild,
Glasgow.

Dean of Guild Court Proceedings, (49 vols: Jan, 1862 - 1964 -),
No. 21 .Arranged by Street and Petitioner.

- 1.3.4. The Archives Department, Cleveland County Libraries, Middlesbrough:
The Plans Index.
The Surveyors' Report Books.

Contracts and Agreements:

- 1.3.5. L. G. Mouchel & Partners, Ltd., West Byfleet; from: Album,
L. G. Mouchel & Partners, Ltd., 38, Victoria Street, Westminster:
Indenture between L. G. Mouchel and the Manchester Dock and
Warehouse Extension Co. Ltd., for the erection of 5 Transit Sheds,
18.3.1903: original document.

Memorandum of Agreement, between David Jones, Leeds and Louis
Gustave Mouchel, Westminster, 16.3.1904: original document.

Memorandum of Agreement, Duplicate or Counterpart, agreement
between L. G. Mouchel and the Colonial Ferro-Concrete Syndicate
Ltd. of London, 19.9.1906: original document.

- 1.3.6. H. Portsmouth, Architect, Swansea:
Contract for Provender Mill, Swansea, between Joseph Hall for
Weaver and Co., François Hennebique (signed by E. le Brun) and
E. le Brun, 20.10.1897.

- 1.3.7. The Record Office, Hull:
Contract for Ferro-Concrete Construction: Bridge for New Street
Witham to Cleveland Street, Hull, between: Messrs. Rose, Downs
and Thompson, Ltd., and their Sureties and The Mayor, Aldermen
and Citizens of the City and County of Kingston upon Hull,
21.11.1902.

1.4. Photographs:

- 1.4.1. L. G. Mouchel & Partners, Ltd., Manchester:
Provender Mill, Victoria Wharf, Swansea, for Weaver & Co. Ltd.,
under construction, November, 1897-early, 1898; under
construction, c.early 1898.
Provender Mill and Granary, Victoria Wharf, Swansea, for
Weaver & Co., Ltd., both completed, c.1900 - 1908.
Grain Silos and Grain Cleaning House, Dunston, Newcastle on
Tyne, for The Co-operative Wholesale Society, Ltd., c.1902.

Bridge, New Street, Witham to Cleveland Street, Hull, for the City Corporation, Opening Ceremony, 1902.

Collapsed Test Floor, c.1900 - 1905, probably: in Manchester: test for The Manchester Ship Canal Co. Ltd., September, 1902.

Soap Factory, Dunston, Newcastle on Tyne, for The Co-operative Wholesale Society, Ltd., c.1908 - 1909.

The Royal Liver Building, Liverpool, for The Royal Liver Friendly Society, under construction: c.1908 - 1909; under construction, (interior), c.1908 - 1911.

1.4.2. The Record Office, Hull:

Grain Warehouse, Plymouth, for the Great Western Railway Co., c. 1899 - 1900.

2. Printed Sources:

2.1. Patents; Reports:

Patents (British):

2.1.1. The Patent Office:

Ralph Dodd, Flooring for Bridges, Fireproof Roofings, etc., No. 3141, December, 1808.

William Boutland Wilkinson, Construction of Fireproof Buildings, etc., No. 2293, provisional specification, 27.10.1854; specification, 26.4.1855.

Thomas Frederick Tyerman, Preparation of Hoop Iron, etc., used for Bondings in Building, No. 2310, provisional specification, 31.10.1854; specification, 30.4.1855.

Henry Robins, Sheathing Iron Ships, etc., No. 2283, provisional specification, 5.9.1866; specification, 5.3.1867.

Henry Young Darracott Scott, Floors and Roofs, No. 452, provisional specification, 19.2.1867; specification, 19.8.1867.

George Middleton Edwards, on behalf of: Thaddeus Hyatt, Tie and Core Metal, etc., No. 4070, provisional specification, 7.10.1880; specification, 7.4.1881.

Peter Stuart, Manufacture of Paving, Floors, etc., No. 610, provisional specification, 12.2.1881; specification, 11.8.1881.

- David Wilson, Improvements in the Manufacture of Telegraph Poles, etc., No.5990, provisional specification, 15.5.1885; specification, 13.2.1886.
- Robert Bristow Lee and James Hodgson, Improvements in the Manufacture of Concrete Fire-Proof Building Materials, etc., No.14,726, provisional specification, 30.11.1885; specification, 10.6.1886.
- Frederick George Edwards, Improvements in Concrete-and-iron Beams, No.1415, provisional specification, 23.1.1892; specification, 6.4.1892.
- Matthias Koenen and Gustav Adolf Wayss, Improvements in or relating to Structures adapted to Resist Certain Strains, No.1741, provisional specification, 28.1.1892; specification, 27.10.1892.
- William Phillips Thompson, on behalf of: François Hennebique, Improvements in the Manufacture or Construction of Joists, etc., No. 14,530, provisional specification, 10.8.1892; specification, 3.5.1893.
- Joseph Augustus London and Philip Hobbs, Improvements in or connected with the Paving of Roads, etc., No.11,310, provisional specification, 8.6.1895; specification, 9.3.1896.
- François Hennebique, Improvements in the Construction of Joists, etc., No.30,143, specification, 18.12.1897.
- Gustave Louis Mouchel, Improvements in and relating to Piles, Columns, etc., No.4548, provisional specification, 9.3.1900; specification, . 8.1.1901.
- Gustave Louis Mouchel, Improvements in and relating to Walls, etc., No.15,446, provisional specification, 30.8.1900; specification, 30.5.1901.
- Gustave Louis Mouchel, Improvements in and relating to Concrete Piles, No.15,932, provisional specification, 7.9.1900; specification, 7.6.1901.
- Armand Gabriel Considère, Improvements relating to the Construction of Buildings, etc., No.14,871, specification (amended), 3.7.1902.
- Edmond Coignet, Improvements in and connected with Reinforced or Armoured Concrete Construction, No.24,371, specification (amended), 10.11.1904.
- Gustave Louis Mouchel, Improvements in and relating to Reinforced Concrete Structures, No.13,671, specification, 3.7.1905.

Reports:

- 2.1.2. L.G.Mouchel & Partners, Ltd., West Byfleet:
Official Report of Commander Welsch, Ghent Fire Brigade, 29.9.1899.
 W.J.Taylor, County Surveyor, Southampton, testimonial to new

work, Hennebique System, to: L. G. Mouchel, 7.5.1900.

2.1.3. The Record Office, Northumberland County:

Report of the County Surveyor, 10.4.1905, Northumberland County Council Property and Sanitation Committee Minute Book, 1904 -1907.
Reports of the County Surveyor, Northumberland County Council Minute Book, vol.17, 1905 - 1906.

2.1.4. The Record Office, Hull:

Tests of Floors, Iron girders and jack arches compared with Hennebique's Patent Ferro-Concrete, Orleans Railway Co., Station, Rue de Lille, Paris, n.d., c.1901.
A. E. White, M. Inst. C.E., City Engineer, Hull, Description of Works, for Cattle Market, Hull, 18.2.1908 .

2.2. Lists of Works, Company Brochures and Magazines:

2.2.1. L. G. Mouchel & Partners, Ltd., West Byfleet:

Relevés de Travaux Executés, Bétons Armés Système Hennebique, Paris, 1895 - 1909.
Hennebique's Patent Buildings in Strengthened Concrete: Work Executed in the United Kingdom, n.d., c.1904.

2.2.2. The National Monuments Record Office, Edinburgh:

Stuart's Granolithic Souvenir, Stuart's Granolithic Stone Co. Ltd., Glengall Road, Millwall Dock, London, 2nd Issue, 1901.

2.2.3. Colne Library, Colne:

Souvenir: Coming-of-Age and Opening of New Central Premises, The Colne and District Co-operative Society, Ltd., Saturday, 29.6.1907.

2.2.4. Co-operative Retail Services, Accounts Department, Burnley:

85th Report and Balance Sheet, Colne and District Co-operative Society, Ltd., 8.6.1907.

2.2.5. The Co-operative Union Ltd., Library, Manchester.
The Wheatsheaf, The Co-operative Wholesale Society, Ltd.,
 Manchester, 1907 - 1909.

2.2.6. Rowntree Mackintosh Ltd., York:
The C.W.M. (Cocoa Works Magazine), Rowntree & Co. Ltd., York,
 1908.

2.3. Transactions and Journals:

Note: The following have been consulted primarily for the period,
 1897 - 1908 (and a number of the journals originated only shortly before,
 or during, this period): those found most useful, overall, were:

Le Béton Armé; Concrete and Constructional Engineering; The Builders' Journal and the R.I.B.A. Journal. Transactions and journals also useful for the earlier nineteenth century history of concrete and reinforced concrete in Britain include, notably, The I.B.A. and R.I.B.A. Transactions, The Building News and The Builder.

The American Architect and Building News.

The Architect and Contract Reporter, London.

The Architectural Record, New York.

The Architectural Review, London.

Le Béton Armé, Paris.

The British Architect, Manchester.

The Builder, London.

The Builders' Journal, London.

The Builders' Merchant, London.

Building Industries, Glasgow.

The Building News, London.

Le Ciment, Paris.

Concrete and Constructional Engineering, London.

La Construction Moderne, Paris.

The Edinburgh Architectural Association, Transactions, Edinburgh.

The Engineer, London.

Engineering News, New York.

The Engineering Record, New York.

The Incorporated Association of Municipal and County Engineers, Proceedings,
 London.

The Institution of Civil Engineers, Minutes of Proceedings, London.

The Institution of Mining Engineers, Transactions, London.

International Congress of Architects, London, July, 1906, Transactions,
London, 1908.

Modern British Domestic Architecture and Decoration, London.

Le Moniteur des Architectes, Paris.

The (Royal) Institute of British Architects, Transactions, London.

The Royal Institute of British Architects, Journal, London.

The (Royal) Society of Arts, Journal, London.

Scientific American.

The Stone Trades Journal, London.

The Strand Magazine, London.

Trade and Industry, Manchester.

2.4. Newspapers and Directories: chiefly: 1897 - 1908:

Newspapers:

The Cambrian.

Colne and Nelson Times.

The Glasgow Advertiser and Property Circular.

The Glasgow Herald.

Newcastle Daily Journal.

The Northern Daily Mail.

The Swansea and South Walian.

Directories:

The Charitable 10,000, London, 2 vols., 1896, 1903.

The Chemical Manufacturers' Directory of England, London.

Edwards' Manchester and Salford Professional and Trades Directory.

Gore's Directory of Liverpool, Liverpool.

Gore's Street and Official Guide, Liverpool and Birkenhead, Liverpool.

W. F. Howe, e d., An Edited Classified Directory to Metropolitan Charities,
London.

Kelly's Directories of: Bradford and Suburbs; Hull; Lancaster;
Leeds; Leeds and Bradford; Liverpool; all: London.

Kelly's Directory of Chemists and Druggists, London.

The Liverpool Commercial List, London.

The Manchester Cotton District and General Lancs. Commercial List, London.

The Post Office Aberdeen Directory, Aberdeen.

The Post Office Bradford Directory, Bradford.

Robinson's Business Directory for the City of Leeds, Leeds.

Robinson's Leeds Directory, Leeds.

Slater's Royal National Commercial Directory, Manchester.

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 London, 20.4.1911: handwritten: original or contemporary copy.
 T.O. Dixon, L.G.Mouchel & Partners, Ltd., 26 Albion Crescent,
 Glasgow, to: L.G.Mouchel & Partners, Ltd., Newcastle on Tyne,
 9.6.1911: signed: T.O. Dixon.
 D. J. Rees, Organist, Alltwen Congregational Church, to: L. G.
 Mouchel & Partners, Ltd., 30.9.1913: handwritten: copy of
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 C. Roch, Marseilles, to: C.R.J. Wood, 5.6.1958: transl., 18 pp.
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 6.12.1977.
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 L. G. Mouchel & Partners, Ltd., 36-38, Victoria Street, Westminster,
 London, to: The Yorkshire Hennebique Contracting Co., Leeds,
 6.2.1919: signed: T. J. Gueritte.
 L.G.Mouchel & Partners, 36-38, Victoria Street, Westminster, London,
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 signed: J.S.E. de Vesian.
 Notes:
- 3.2.3. L. G. Mouchel & Partners, Ltd., West Byfleet:
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L. G. Mouchel & Partners, c.1909.

3.4.2. L. G. Mouchel & Partners, Ltd., Manchester:

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3.4.3. Douglas R. P. Ferriday, A.I.I.P., F.R.S.A., Hartlepool:

Lynn House, Lynn Street, West Hartlepool: c.1920; October, 1966.

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