#### DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

# BUILDING RESEARCHS

SPECIAL REPORT No. 20

Dhananjayarao Gadgil Library

GIPE-PUNE-044982

# ECONOMIC AND MANUFACTURING ASPECTS OF THE BUILDING BRICK INDUSTRIES

BY

A. ZAIMAN, B.A., F.S.S.

AND

W. A. MACINTYRE, B.Sc., A.R.C.Sc.

Crown Copyright Reserved

LONDON
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
1933

## BRICK MAKING INQUIRY COMMITTEE

Chairman: Sir William Cecil Dampier, F.R.S., Sc.D.

G. MOWLEM BURT, Esq., F.I.O.B.

Professor P. SARGANT FLORENCE, M.A.

A. W. Flux, Esq., C.B.

#### PREFACE

NE of the major functions of the Building Research Station of the Department of Scientific and Industrial Research is to provide a scientific service to the Building Industry. Part of its programme of work is concerned with research on materials, including heavy clay products. From time to time certain special problems in relation to these products have been referred to the Station, and specific investigations have been undertaken, for example, into the durability of terra cotta, the weathering of clay wares, efflorescence, the strength of brickwork, etc. But it has been realised that to deal effectively with such important and widely-used building materials as heavy clay products, it is necessary, as and when occasion permits, to carry out a comprehensive scheme of work. Such a scheme must cover matters which appeal directly to the industry, and on which scientific research in co-operation with the industry is likely to be fruitful. A scheme of these dimensions cannot be embarked upon lightly.

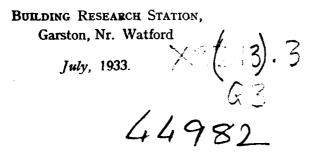
Impressed with these considerations, the Department decided that a survey should be made of the brick-making industries. This survey, it was contemplated, should comprise the study of all the available literature and statistics, and a first-hand inspection of typical manufactories, both at home and abroad. Attention should also be paid to research and educational institutions. In this way it was hoped to secure the necessary background to enable the formulation of a rational programme of research work into bricks and brickmaking.

A small Committee, the membership of which is given on p. ii, was set up to advise on the conduct of the survey. The detailed investigation itself was entrusted to Mr. A. Zaiman, B.A., F.S.S. and Mr. W. A. MacIntyre, B.Sc., A.R.C.Sc. The collection of lata proceeded during 1930, and on its completion early in 1931, it was planned to publish a report in six parts, viz.: I. Economic

Aspects; II. Processes of Manufacture; III. Outstanding Technical Problems; IV. Research and Technical Education; V. Properties of Bricks and Brickwork; VI. Programme of Research. Unfortunately, the preparation of the Report was held up by the untimely death, in May, 1931, of Mr. MacIntyre. It was then decided to issue parts I and II, which were nearly ready, as a separate publication. The actual issue of this publication has been further delayed by the decision to await the Final Report of the Census of Production of 1924 and the Preliminary Report for 1930 (both) published in 1932). The statistics quoted in this Report refer mainly to 1930. In view of the catastrophic industrial conditions of 1931 and 1932, it has not been thought worth while to bring the figures up to date, as the features of industry in these years can hardly be regarded as representative.

Acknowledgments are due to the many firms who granted facilities for visits to their works, to the representatives of trade associations who freely gave information, to the members of Government Departments and Consular Officers who rendered assistance, and to Mr. A. E. Brown, B.Sc., who was kind enough to check the proofs and make valuable suggestions.

# WILLIAM CECIL DAMPIER, Chairman, Brick-Making Inquiry Committee.



#### CONTENTS

#### Part I.—Economic Aspects of the Building Brick Industries

1.	Rpicks-	-Their History and Place in Building	PAGE 1
2.		BRICK IN USE—	•
	21120 01		6
		Classification and descriptions	9
		Texture and colour	11
			13
		n: °	13
			16
		Effect of housing schemes	18
			20
			21
			23
		Imports and exports in other countries	20
		lime bricks; lime-slag bricks; hollow blocks; terra-	
		11 1 1	24
	•	** * * * * * * * * * * * * * * * * * * *	26
		Tendencies in brick development	40
3.	MANUFAC		00
		Sizes of works	28
		Trade associations	32
		National Federation of Clay Industries	33
		Ceramic Society	34
		National Joint Industrial Council for the Clay	
		Industries	34
		Institute of Clayworkers	34
		National Association of Clayworks Managers	35
		Continental associations	35
		American associations	35
		Selling arrangements and publicity	36
4.	FACTORS	IN COSTS OF PRODUCTION—	
		Materials	38
		Utilisation of waste	40
		Salaries	41
		Wages	41
		Rate of output	43
		Internal transport and layout	44
		Power, light and water	45
		Depreciation and maintenance	47
		Local rates	48
		Social service charges	48
		National taxation	49
		Transport charges	50
		Selling costs	50
		Capital and profits	50
		Budgeting and costing systems	50 51
		Summary	91

_	Thursday	m.m								Dian
5.	TRANSPO									PAGE
		Railways	• •	• •	• •	• •	• •	• •	• •	53
		Roads	• •	• •	• •	• •	• •		• •	56
		Rivers and	canals		• •	• •			• • •	57
_	<b>-</b>	0								
6,	LABOUR	CONDITIONS-	_							
		Numbers			• •				• •	57
		Earnings								58
		Hours								59
		Trade Unio		•••	••	• •	• •	• •	• •	59
	*.	Recruitmen					••		• •	60
		Welfare con		••	• •	• •	• •	• •	• •	60
	•	Wenare con	dition	s	• •	• •	• •	• .	• •	60
		Part II-	Canar	al Dr	~~~~~	of N	lanııfa	ctura		j
		I all II-	Gener	a1 1 1	uccaaca	01 14	LAILUIA	cture		
1.	RAW MA	TERIALS .	•							63
-•			•			•	• •	• -	• •	
2.	EXCAVAT	TION							• •	68
_										
3.	WEATHE									
		Sumping	• •		• •					71
	D									
4.	Prepara									
		Grinding								
		(a) We			• •		• •			73
	•	(b) Dry	grind	ling						73
		Screening	_							76
		Tempering	• •			• •			• •	77
		Souring			•••		• • •	• •	• •	78
		Mechanical	and in			atrol	• •	• •	• •	79
_	_		and m	sti ume	ii tai Cui	ıuoı	• •	• •	• •	19
5.	FORMING									
		Slop mouldi	ng, ful	l-plast	ic proce	SS	• •		• •	80
		Soft-mud pr	ocess							81
		Plastic, wire	-cut o	r stiff-	mud pro	ocess				82 <
		Stiff-plastic					• •			83
		Semi-dry an					• •	•••	••	84
^	D-44	bonn dry di	<u></u>	aust p		• • •	• •	••	• •	0.1
6.	DRYING-	-								
		Natural dry	nng	• •	• •	• •	• •	• •	• •	85
		Artificial dr								
		Hot flo	w drye	ers	• •		·			87
		Room o	lryers						٠.	87
		Intermi	ttent	chamb	er drye	rs				88
					el dryers		• •			88
		Instrun				• • •				88
_	D		.icii cai		·- · ·	••	• •	• •	• •	00
7.	BURNING									
		Water-smok			• •	• •	• •	• •	• •	90
		Pre-heating	• •	• •	• •	• •	• •	• •	• •	90
		Full-firing		• •	• •		• •		• •	91
		Brick kilns-	_							
		Clamp	and sc	ove ki	lns					92
		Periodi								93
		Continu		-	••	••	• •	• •	••	95
		Tunnel			• .•	••	• •	• •	• •	97 4
				· · ·	1	• •	• •	• •	• •	7/
		Kiln operati			101					00
		Draugh			• •	• •	• •		• •	98
		Firing o			. ••	• •	• •	• •	• •	99
		Air sup	ply an	d regu	lation	• •		• •	• •	101
		Stoking	<b>.</b>	• •	• •	٠.		• 1	• •	103
T			-					,		105
INT	DEX									105

# LIST OF TABLES

Тав	LE	PAGE
1.	Sizes of modern bricks in various countries	12
2.	Prices of bricks, pre-war and in 1920	13
3.	Number of houses built in England and Wales with and without State assistance, 1920-1930	18
4.	Production of building bricks in Great Britain in 1930 and 1924	19
5.	Exports from the United Kingdom of bricks made of brick earth or clay	20
6.	Imports into the United Kingdom of bricks made of brick earth or clay	22
7.	Price of coal per ton—1914 and 1920	38
8.	Market quotations of certain kinds of coal and average pit head prices in chief coal-mining districts of the United Kingdom, 1913 and 1924-30	39
9.	Weekly earnings in foreign countries	42
10.	Power used in the brick and fireclay factories, 1930	45
11.	Electrification in brick and clay products industries	46
12.	Cost analysis of common brickworks in U.S.A. for May, 1929	52
13.	Brick traffic on railways, 1928	54
14.	Census of occupations in England and Wales, 1921, manufacture of bricks and tiles, etc	57
15.	Persons employed in brick and fireclay trades, United Kingdom, 1930	58
	LIST OF FIGURES	
_		PAGE
1.	Movements of brick prices	15
2.	Imports of bricks into the United Kingdom	21
3.	Distribution of brickworks in England and Wales	29
4.	Railroad transport of bricks in Great Britain	55
5.	Section of intermittent down draught kiln	94
6.	Plan of continuous kiln (Hoffmann type)	96
7.	Plan of chamber kiln (grate-fired)	96
8.	Plan of continuous zig-zag kiln	96
9.	Plan of operation of tunnel kiln	96

### INDEX

Accringtons, 8	Board of Trade, 14, 16, 18, 21, 27, 51, 58
American brick-trade associations, 5,	"Body bricks," 6
<b>3</b> 5	Bohnsack Company, 32
American Ceramic Society, 35	Breeze, addition to brick, 65
American Face Brick Association, 35	blocks, 24, 25
American Radiator Building, 11	British Sanitary Fireclay Association,
American Society for Testing	34
Materials, 6	Brunel, M. I., 27
Antwerp, drying sheds, 86	"Bubbled" clay bricks, 5
Apprenticeship, 60	Buckinghamshire, 30
Architects Samples Corporation, New	Budgeting and costing systems, 50
York, 37	Building Centre, 37
Architectural Association, 37	Building Material Bureau, 37
Ashlar bricks, 7	Building Trades Exhibition, 37
Auger machine, 82	Bureau of Labour Statistics, 43
Austria, 12	Bureau of Standards, 36
	Burning, 67, 89-103. (See also Firing)
Balfour Committee, 48	" Burrs," 7
Ball clay, 63	Butty system, 41
Barium carbonate, 66, 78	
Belgium, Boom area, 30	Calcium sulphate, 64
carved brick, 5, 26	Cambrian shale, 66
clay overburden used for bricks, 67	Canada, 9
control of works by English com-	Ceramic Society, 36
panies, 24	exports to U.S.A., 24
drying sheds, 86	National Clay Products Associa-
earnings of workers, 42	tion, 36
exchange, effect on exports, 23	production, 19
exports, 22, 23, 24	sizes, 12, 13
family allowances, 60	types, 9
female labour, 42, 43	works, capacity, 31
hours of work, 42	Canal transport, 57
import of English bricks, 20	Capital, 50
juvenile labour, 60	Carbon dioxide, 102
output per man-hour, 43	Carved brick, 5, 26
perforated brick, 8	Cast concrete blocks, 24
prices, 16	Cellular brick, 8
production, 19	Central Union Switzerland, 30
seasonal occupation, 61	Ceramic Society, 34
sizes, 12	Ceramic Society of Canada, 36
trade associations, 35	Chalk block structures, 4
trade unions, 60	Charleroi, 30
transport, 56	"Cherry" bricks, 6
Berlin, 16, 37	Chicago, 31, 37, 60
"Black core," 65, 91	Chinese labour, 60
"Blaes," 8	Clamp-burning, 67, 92
Blasting, clay winning by, 69	Clay, constitution, 64
Blending, 63, 76, 79 "Bloating," 91	contraction on firing, 63
Blue bricks, 7, 94	grinding, 71 hand picking, 69
"Blue Staffords," 8	impurities, 64
Did Diamoras, U	harreso, or

Drying—contd.
intermittent chamber, 86, 88
moisture measurement, 89
room, 86, 87
shed, 86
thermostatic control, 89
tunnel dryer, 88
ventilation control, 89
waste heat, 88, 89
"Du brick," 27
"Dutch antique" brick, 10
Dutch East India Company, 3
Duty on imported bricks, 23
Earnings, 42
Efflorescence, 64, 65
Electrification, 46
Electro-plated bricks, 10
Empire State Building, 5
Enamel Association, 34
Enamelled bricks, 5, 7, 54
Engineering bricks, 6, 8, 13, 16, 94
England, clamp kiln practice, 92
clay deposits, 66
grinding machinery, 73
hand excavation, 69
hollow clay blocks, 26
size of modern bricks, 3, 12
Essex, 30
Europe (see Continent)
Excavation, 68, 69
Exports from the United Kingdom,
20
•
Facing brick, 6
colour, 26, 66, 69
hand moulded, 8
mechanical texturing devices, 82
price, 16
production, 9, 20, 31
semi-dry process, 85
size, 12
weight, 13
Factory Acts, 60
Family allowances, 60
"Fancy" bricks, 7
"Feather edge" bricks, 7
Fédération des Fabricants de Briques
et Matériaux de Construction de
la Région du Nord de la France,
35
Feeder, automatic, 79
Ferrous salts, 91
Finance, 53
Firebrick, 85

#### INDEX

Firing, chemical reactions, 100	Germany—contd.
control, 100	production, 19
pre-heating, 97	repairs allowance, 48
progress tests, 101	sand-lime brick, 25
schedule, 90, 94, 98, 101	sizes, 12
shrinkage, 91	slag-lime brick, 26
sintering, 91	social insurance system, 60
temperature, 100	trade associations, 32
"Firsts," 6	transport, 56
Flettons, 8, 13, 16, 18, 26, 30, 38	Glazed brick, 1, 7, 11
"Floating" bricks, 7	colours, 10, 11
Flooring, hollow block, 26	dry-dust process, 84
Flue gases, 102	duty in U.S.A., 23
France, brick-making on building site,	firing, 94
28	price, 16
clamp-burning, 67, 92	production, 18
earnings of workers, 42	semi-dry process, 85
exports to United Kingdom, 22	transport rating, 54
family allowances, 60	Gravel works washings, 67
foreign labour, 60	Great Britain, hours of work, 42
hours of work, 42	production, 18, 19 Great Fire of London, 2, 3
imports, from Belgium, 24 from England, 20	Grinding, 46, 59, 72
perforated bricks, 8	dry, 73
prices, 16	dust collection, 76
production, 19	wet, 73
sizes, 12	"Grizzles," 7
slag-lime brick, 26	Grog, 66
sumping, 71	Gypsum, 64
transport, 56	Gyratory crusher, 76
trusts, 35	- <b>,</b>
unemployment, 60	
works, capacity, 31	Hampton Court, 2
Freight costs, 54	Hand-made brick, 6, 8, 10, 72
Fremantle, F. E., 4	"Hard" brick, 6
French-Swiss Syndicate, 31	Hard stocks, 7
Fritted glaze, 11	"Haydite." 5
" Frog," 8	Health insurance, 60
Frohn, K., 51	"Hightex" bricks, 7
Fuel, 38, 40, 94, 95, 102, 103	Hoffmann kiln, 95
Full-plastic process, 72, 80	Holland, brick-making on building site, 28
	exports to United Kingdom, 22
Gas, 95, 102	imports, from Belgium, 24
General Workers' Union, 59	from England, 20
Germany, 8, 26	mediæval brickwork, 3
brick exhibitions, 37	overburden, 69
concrete and glass and other forms	preponderance of brick buildings, 4
of construction, 4	prices, 16
depreciation allowance, 48	sizes, 12
earnings of workers, 42	transport, 56
exports, 24	works, capacity, 31
hours of work, 42	Hollow block, 26 Hollow bricks, 54
import of English bricks, 20 mediæval brickwork, 3	Hollow clay blocks, 24
overburden depths, 69	Horizontal pug mill, 82
plant capacity, 31	Hours, 42, 59
price of bricks, 16	Housing, 14, 16, 19
price or briene, 10	

108 INDEX

Hudson River area, 31 Humidity drying, 86	Lancashire and District Fireclay Manufacturers' Association, 34
	Landscape gardening, 5 Layout, 44
Illinois, 31	Leicester reds, 8
Illinois Brick Company, 31	Leicestershire Brick Manufacturers'
Import Duty Act, (1932), 23	Association, 34
Imports, 20, 21, 22, 23	Light, 45
Impurities in clay, 64	Light-weight products, 5, 26
India, 27	Lime, 64, 75
Indiana, 31	Lime-slag brick, 25
Institute of Clayworkers, 34	Liquidometer, 79
Insulating bricks, 7	Little Wenham Hall, 2
Interdepartmental Committee on	Location of brickworks, 28
Prices, 14, 17	London Brick Company & Forders
Interim Reconstruction Committee	Ltd., 30, 50
for the Clay Industries, 42, 59	London clays, 63, 67
Iowa, 31	London County Council, 14
Iron, 65, 67	London stock bricks, 8
Ironstone waste, 66	areas of manufacture, 8, 30
Italian labour, 60	developments, 27
Italy, import of English bricks, 20	fuel, 38, 65
mediæval brickwork, 3	manufacture, 8, 81
production, 19	price, 16
sizes, 12	weight, 13
	Luton greys, 8, 81
Japan, import of English bricks, 20	
reinforced brickwork, 5, 27	Manadam word awarings CE
sizes, 12	Macadam road sweepings, 65
Jugo-Slavia, 60	Magnesium, 64
Juvenile labour, 60	Maintenance, 47
<b>J</b>	"Malms," 7
	Management, 40
Kaolin, 64	Manganese, 60, 67 Manhattan Island, 3
Kent, 30	Manufacturing processes, 63-103
Kibbler, 76	Marking of foreign bricks, 23
Kiln, chamber, 96	Marl, 63
clamp, 67, 92	Masonry, 5
continuous, 90, 95-97, 103	Mass production, 29
control, 98	Mediæval brickwork, 3, 10
drawing and setting, 44, 90	" Medium " brick, 6
muffle radiation heating, 94	Mellon Institute, 36
operation, 98	Metal spray, 10
periodic, 93-95, 99, 103	Metallic colourings, 10, 67
Scotch, 92	Metropolitan Life Insurance Co.,
scove, 92	Policy Holders' Service Bureau,
stoking, 98	U.S.A., 51
temperature measurement, 100	Midland Brick Association, 34
variations, 91	Midland Pipe Association, 34
tunnel, 91, 97, 98	Ministry of Health, 14
zig-zag, 95	Ministry of Labour, 42, 58
"Klinker" brick, 4, 8, 16, 67, 71	Misshapen bricks, 11
	Moisture content, 89
<b>.</b>	Mortar joints, 11
Labour conditions, 57, 60	Moulded bricks, 7
costs, 41	Moulding, 80
Lamination, 83	Multi-coloured brick, 9, 26

National Association of Clayworks Managers, 35 National Association of Roofing Tile Manufacturers, 34 National Brick Manufacturers' Association, 35 National Clay Products Association, Canada, 36 National Federation Clay of Industries, 33, 34 National Joint Industrial Council for the Clay Industries, 34, 42, 59 Negro labour, 60 New York, 31 Architects' Sample Corporation, 37 brick market, 4 increase of size of plant units, 32 Night work, 46, 59, 76 Normandy, 19 Normans, 2 North Warwickshire Brick Association, Ltd., 34 Northern District Federation of the Building and Engineering Brick Trade of England and Wales and Affiliated Associations, 34 Norway, 12 Nottingham and District Brick Manufacturers' Association, 34

Obsolescence, 47
Ohio, 31, 71
Oil fuel, 40, 94, 95, 103
Old age insurance, 60
"One hand" hollow block, 8, 26
Ontario, 19
Ordovician shales, 66
Ornamental bricks, 7
Output per man-hour, 9, 43
Overburden, 67, 68
Oxygen, 102

"Pale" bricks, 6
Palæozoic rocks, 66
Paris, 19
Paving brick, 9, 25, 84, 85
Pennsylvania, 31
Perforated bricks, 8, 13, 26
Peterborough, 8, 30, 59
Placebricks, 7
Plastic process, 72, 80, 82, 83
Plough shovel tractor, 68
Pneumatic spade, 69
Poidometer, 79
Pompeii, 3
Porosity, 66, 78
Potters' Association, 34

Power, 45
Precast concrete units, 4
Pre-heating, 90
Pressed Brick Manufacturers Association, 33
Price of bricks, 13-16
Production, 18-20, 30
Profiteering Act, (1919), 32, 50
Profits, 50
Pulverised coal, 40, 95, 103
Pyrites, 65, 91
Pyrometer, 100

Quartzite rock (Ganister), 54

Railway transport, 54 Rammed earth, 4 Rates, 48 Reading silver greys, 8 Recruitment, 60 Red brick, 9 Refractories Association of Great Britain, 34 Reinforced brickwork, 5, 27 Reparations Commission, 49 Rhineland Brickmakers' Association, Ring discharge grinder, 74 Ring roll pulveriser, 74 River mud bricks, 70 River transport, 57 Road transport, 56 Roman brick, 3 Royal Commission on Transport, 56 Royal Institute of British Architects, 11, 12 Royalties, 38 Ruabon, 76 Rubbers, 5, 7, 26 "Rug" texture bricks, 7, 11 Rupel Valley, 19, 30 Russia, 12, 20 "Rustics," 7 Rynsteine, 12

Safeguarding of Industries Act, 23 St. Augustine, Florida, 3 St. James' Palace, 2 St. Nicholas Chapel, Coggeshall, 2 Salaries, 41 "Salmon" bricks, 6 Salt, glazed bricks, 5, 7 Sand, 65 Sand-facing, 8, 65 Sand-lime bricks, 1, 4, 24, 25 Sandstone, 65 Scotch kiln, 92

Scotland, 8 Scottish Employers' Council for Clay	Stiff plastic bricks, 6, 72, 83,84 "Stint" system, 41
Industries, 34	"Stock," 7, 80
"Scove" kiln, 44	Stock Brick Manufacturers' Associa
Scraper tractors, 68	tion, 33, 34
Screens, 77	Stock bricks, 8, 25
Scum, 65, 66, 90, 97	Stockingford, Cambrian shale, 66
Searle, A. B., 46, 47	Stoking, 94, 103
Seasonal occupation, 61	Stone, 3, 5, 24
Selenite, 64	Stone removing machines, 75
Selling costs, 50	"Stool," 80
Semi-dry process, 6, 9, 27, 72, 84	Storage of clays, 76
Shale, 63, 66	Stourbridge Firebrick Trade, 34
Shale planer 70	"Strike," 80
Shale planer, 70 Sheffield Ganister Association, 34	Structural Tile Association, 35 Stucco, 3
Sherman Anti-Trust Act, 35	Sulphur gases, 90, 91, 103
Shift systems, 40	Sumping, 71
Shingles, 5	Svenska Tegel Försäljnings, 35
"Shippers," 7	Sveriges Tegel Industrie Förening, 3
Shoeburyness, 8	Sweden, brick architecture, 4
Shrinkage, 63, 85, 91	import of English bricks, 20
Shrinkage measurment, 101	production of brick, (1930), 19
"Shuffs," 7	sizes, 12
Silica, 65	trade associations, 35
Silica brick, 60	works, capacity, 31
Silica Brick Makers' Association, 34	Switzerland, juvenile labour, 60
Silicosis regulations, 60	perforated bricks, 8
Silo, 5	pneumatic spades, 69
Sittingbourne, 8	price of bricks, 16
Sizes of bricks, 11, 12, 26 "Skintle," 11, 86	sizes, 12
	syndicatisation, 30, 35
Sky-scrapers, 5, 10, 26 Slop moulding, 80	transport, 56 zig-zag kiln, 95
Slough, 8	Syndicat des Fabricants de Produits
Slum clearance, 17	Céramiques, 35
Social service charges, 48	Synthetic stone, 24
Soft bricks, 6	•
Soft mud bricks, 6	"Tapestry" bricks, 7, 11
Soft-mud process, 9, 44, 81, 82	Taxation, national, 49
Souring, 78	Taxes and Social Service Charges, 38
South America, 20	Temperature recording apparatus,
South Eastern Federation of the	100
Building and Engineering Brick	Tempering, 77–79
Trade of England and Wales, 34	Terra-cotta, 3, 24, 26, 66, 94
South Wales, 66 South Western Counties of England,	Terra Cotta Association, 34
District Federation of Clay In-	Texture, 9, 10, 11, 82 "The Brick Builder," 37
dustries and Affiliated Associa-	"Tile bricks," 5
tions, 34	Tiles, 94, 95
Spain, 12, 20	Timber construction, 2, 4
"Specials," 6	Tonindustrie Kalendar, 11
Standing Committees of the Board	Trade Associations, 32–36
of Trade on the investigation of	Trade Unions, 59, 60
prices and trusts, 13	Transport, 28, 50, 53-57, 67
Steel construction, 4	Tudor brick, 2, 3
Steel-framed buildings, 4, 26	Tyneside Firebrick Manufacturers'
Stiff mud bricks, 6, 9, 44, 82, 83	Association, 34

Unemployment, France, 60 Unemployment Insurance, 60 United States Census of Distribution, United States, alternative building material, 4 American Face Brick Association, brick novelties, 26 brick trade depression, 16 budgeting systems, 51 clamp-burned bricks, 67 clamp kilns, 92, 93 clay excavating methods, 70 cost of production, wages, 43 costliness of brick houses, 4 decrease of brick imports, 24 development of reinforced brickwork, 5 duty on bricks, 23 earnings, 43 extended use of terra-cotta, 26 facing brick production, 20 gas firing, 94 hand moulded bricks, 81 high output, reasons for, 44 hollow clay block, 26 imports from Belgium, 24 from Canada, 24 from England, 20 lack of government housing control, 17 marking of foreign bricks, 23 mortar joints, 11 multi-colour brick, 10, 26 oil firing, 94 output per man-hour, 43 percentage production by various methods, 9 perforated bricks, 8, 26 price of bricks, 16 production of bricks, 19 production, rate computation, 44 raw clay conveyance, 70 reinforced brickwork, 27 relative costs oil and coal fuel, 40 repairs allowance, 48

United States—contd. size of standard brick, 12 soft-mud process, districts using, steel and glass construction, 5 stiff-plastic process, 84 Tariff Information Survey Report (1921), 23taxation, 49 trade associations, 32, 35 activities, 36 Trade Unions, 60 transport by water, 57 use of sand-lime bricks, 25 weights of bricks, 13 wire-cut process, rate of output, 83 works, capacity, 31

Veneer, brick, 5 Vincennes pottery works, 98 Vitrified brick, 6 Voussoir bricks, 7

Waal-stein, 8, 10, 12 Wages, 41, 59 Walsall and District Brick Makers' Association, 34 Washington, George, 6 Waste material, kiln waste, 66 Waste utilisation, 38, 40, 67 Water, 45 Water-smoking, 90 Water supply, 46 Weathering of clay, 70 Weights of bricks, 13 Welfare conditions, 60 Widows' and Orphans' insurance, 60 Wire-cut process, 82, 83 Women employed, 42, 43 Wood-frame houses, U.S.A., 4 Workers employed, 58 Workmen's Compensation Acts, 60 Works, capacity, 31 layout, 44

Yorkshire reds, 8 Yselsteine, 12