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1 **The role of plastic packaging in transforming food retailing**

2 **Abstract**

3 **Purpose** – Whilst plastic packaging has recently been critiqued for its detrimental effects
4 on the environment, it is largely overlooked in histories of food retailing. This paper
5 presents a historical perspective on plastic packaging, highlighting its role in transforming
6 UK food retailing throughout the middle to late twentieth century.

7 **Design/methodology/approach** – This paper is based on an analysis of the Marks &
8 Spencer Company Archive, supplemented by company histories and biographical
9 sources. Three examples were purposively selected based on their technologically
10 innovative role in maintaining and enhancing Marks & Spencer’s core values.

11 **Findings** – The analysis highlights plastic packaging’s significance in enabling Marks &
12 Spencer’s product development process whilst maintaining and enhancing the company’s
13 core values of standards, quality, safety, freshness, hygiene, and convenience. The
14 examples demonstrate the role of plastics in technological innovation, achieving key
15 commercial objectives in product development and contributing to the transformation of
16 food retailing.

17 **Research limitations/implications** – The research focuses on three specific examples
18 of packaging innovation, drawing out their wider implications for socio-technical change
19 in UK food retailing.

20 **Originality/value** – This historical research suggests that greater attention should be
21 paid to plastic packaging including its material properties and the services it provides,
22 moving beyond a blanket condemnation by acknowledging its multiple affordances in the
23 food sector. These historical insights are instructive when thinking about the future of
24 retailing and shopping in the context of the need for better environmental outcomes.

25 Keywords: Socio-technical innovation, Food retailing, Plastic, Packaging, Marks &
26 Spencer, Organizational research.

27 Paper type: Research paper

28 **1. Introduction**

29 The global plastic waste problem, epitomised by the increased use of single-use plastic
30 packaging, raises complex issues, most notably in association with the increasing
31 contamination of microplastics in marine and terrestrial habitats (do Sul and Costa, 2014;
32 Rillig, 2012). The scientific evidence on the implications for human health and wellbeing,
33 however, are less clear (Davison, Forthcoming). Of the 2.3 million tons of plastic
34 packaging placed on the UK market in 2019, around 40% was grocery packaging
35 (Valpak, 2020). Plastic's pervasive visibility and accumulation in the environment globally
36 has sparked a growing concern about its environmental impact and is a matter of
37 concern to producers, consumers, and governments. However, the blanket disapproval
38 and boycotting of plastics risks unintended consequences. For example, consumer
39 perception of the environmental impact of plastic packaging differs highly when
40 compared to various scientific life cycle assessments, leading to consumer buying
41 behaviour in most cases being less environmentally sustainable than intended (Otto et al.,
42 2021). The innovation and trialling of 'plastic free' alternatives by retailers run the risk of
43 more food being wasted (Denkstatt, 2010), while recent attempts by some retailers to
44 remove plastic packaging have either been scrapped or are 'increasingly challenging'
45 given their financial and operational implications (Barrie, 2019; Farrell, 2021).

46 This paper considers a more nuanced narrative of plastic as ordinary and pervasive,
47 highlighting how this constitution has come to be. Since its large-scale production from
48 the 1950s onwards, plastic packaging's material properties have diversified significantly
49 resulting in numerous innovative packaging designs (see Risch, 2009; Twede, 2016;
50 Hawkins, 2018) and fulfilling multiple purposes throughout the supply chain including -
51 but not limited to - the protection, preservation, and distribution of the product (Rundh,
52 2005). More generally, packaging's marketing and communicative dimensions are noted
53 in its contribution to enabling retail change. Packaging makes it possible to identify and
54 invent product differentiation, branding products in the form of logos, print fonts, and
55 illustrations and the formation of symbolic qualities (Rundh, 2005; Hawkins, 2013;
56 Fernqvist et al., 2014).¹ Whilst it can be argued that plastic packaging's inherent
57 technological advancements have become an influential aspect of food retail change, its
58 significance has been somewhat neglected. Its mundanity as the material 'we see but
59 don't see' (Cochoy and Grandclément, 2005, p.646) is a possible reason for this. For
60 example, the role of technology in transforming food retailing throughout the nineteenth
61 and twentieth centuries has primarily referred to other advancements including the
62 mechanization of the factory system, efficiency in the division of labour, developments

63 of food science and processing, innovations in associated consumer technologies
64 (freezer, microwave and refrigerator), and the ‘Americanization’ of retailing through self-
65 service methods and the supermarket (Shaw et al., 2004; Pilcher, 2005; Spaargaren et al.,
66 2011; Stanton, 2018).

67 Given the ecological problems associated with plastic packaging are deeply connected to
68 its everyday use by consumers and professionals in the food system, it is important to
69 study how societies have organized their provision of food, especially in respect to how
70 food is cultivated, processed, distributed, and consumed (Sattlegger et al., 2020).

71 Responding to this and the recent calls to understand the ‘norms and practices that
72 maintain the role of plastics in society’ (Nielsen et al., 2020), this paper considers plastic’s
73 technical capacity and the service it provides as part of a wider socio-technical
74 arrangement (Evans et al., 2020). That is, the meaning of a technical artefact (plastic
75 packaging) or technological system is shaped by and acquires its meanings in the
76 heterogeneity of social interactions (Bijker, 1997). Hawkins’ (2011, 2013) work on the
77 PET bottle provides an example of this, highlighting plastic’s technical capacity which
78 reconfigured existing meanings and understandings by introducing new drinking
79 practices in comparison to existing material containers made of aluminium and glass.

80 The following section introduces the retail case of Marks & Spencer, highlighting its role
81 as a food innovator throughout the middle to late twentieth century. Utilising
82 biographical and autobiographical narratives of the company’s history, I establish the
83 company’s dominant retail position through the enactment of a set of ‘core values’ of
84 standards, quality, safety, freshness, hygiene and convenience. In doing so, I evidence
85 plastic’s lack of recognition in enabling these core values, emphasising further its
86 neglected contribution in histories of retail change. The next section provides detail on
87 the archival research process, with attention paid to the use of Hill’s (1993) three
88 common ways of finding archival material with purposive and theoretical sampling used
89 after the iterative review process. I then introduce and discuss three examples – cake
90 packaging, retortable packaging and meat packaging – each of which reveal wider
91 connections between technical and social change in the history of food packaging and
92 the enabling of Marks & Spencer’s expansion of food development whilst maintaining
93 and enhancing its core values. In conclusion, the research highlights how contemporary
94 debates have historical resonance in demonstrating plastic’s ‘lock-in’ through its
95 contribution to multiple affordances in food retailing throughout the twentieth century.

96 This is instructive when thinking about the future of food retail in the pursuit of better
97 environmental outcomes.

98 **Marks & Spencer as a food innovator**

99 More than a retailer, Marks & Spencer's (hereafter M&S) reputation for technological
100 innovation, linking mass manufacturing to mass retailing, set itself apart from more
101 traditional retailing whose business was primarily to 'trade' (Tse, 1985). The company's
102 scientific-technological development since the 1930's through its engagement with
103 research institutes and research departments of industries played a significant part in
104 mastering sufficient scientific and technical knowledge, ensuring a speedier and larger
105 application to industry (Rees, 1969; Tse, 1985; Worth, 2007). Initially applied to textile
106 products which constituted the bulk of M&S's turnover prior to World War II (Briggs,
107 1984), the underlying principles of the 'technological' approach were extended to its food
108 business in the early 1950s at a time when the Food Development Department was being
109 established (Tse, 1985). This coincided with the years after the Second World War in
110 which rationing and shortages were experienced. Key materials were often rationed and
111 'stretched', giving rise to poor quality products (Goldenberg, 1989). With the
112 'dismantling' of the rationing scheme in the early 1950s, consumers demanded more
113 choice and food retailers, like M&S, eagerly responded varying prices, offering new
114 products and cutting rising costs (Oddy, 2003).

115 Its subsequent success mirrored the principles responsible for the growth of its textile
116 business with science and technology playing a key role in the company's expansion and
117 innovation of its food business and the consequential progressive development of the
118 British Food Industry (Goldenberg, 1989). The company's basic principles emphasised
119 five core values: *standards, hygiene, safety, freshness and quality* (see Rees, 1969, pp.202-203;
120 Tse, 1985, p.93). In conjunction with M&S, manufacturers worked to narrowly defined
121 *standards*, exact specifications and requirements. Its own laboratories were tasked with
122 investigating food products regarding aspects of *freshness* and purity of ingredients, whilst
123 also working in co-operation with selected manufacturers in improving the *quality* of its
124 raw materials. Maintaining the highest *hygienic* standards involved production in modern
125 factories under clean conditions, with M&S influencing food suppliers to modernize
126 plant and production methods. The company took the view that 'foods must not only be
127 good to eat but also *safe* to eat' (Goldenberg, 1989, p.102) with specific raw materials and
128 reliable processing techniques safeguarding the safety of more perishable goods. Prior to

129 the 1950s, the understanding of a product's *freshness* was minimal. The company's policy
130 and research to determine a maximum 'life' in which food freshness could be preserved,
131 established a finite 'store life', prompting a revolution in the food industry. And whilst
132 not initially acknowledged through the Food Division's formative years, delivering
133 *convenience* to consumers was often noted alongside M&S's core values of safety and
134 freshness in achieving a high standard of product quality (M&S, 1991a, 1995).

135 The combination and interrelation of these values culminated in achieving a level of
136 overall product quality that satisfied the needs of the customer, whilst being extremely
137 difficult for competitors to emulate (Tse, 1985).² This was communicated to consumers
138 through M&S's 'St Michael' brand name, which was gradually used by the food sector
139 from the late 1950s onwards. The 'Welbeck' label, a lesser brand, was used prior to this
140 reflecting Simon Marks' initial view of food products not meeting the quality of the 'St
141 Michael' brand (Chislett, 2009). The culmination of this set of core values represented
142 the blueprint by which the company expanded and developed its food business after the
143 Second World War and consequently introducing 'new' foods to the British public.
144 Plastic's contribution, however, is often referred to superficially, contributing to the
145 quality and freshness of its contents and as an aid to efficient transportation and handling
146 of goods (see Rees, 1969). Whilst reference to the improvement of food quality materials;
147 the advocacy of a technical approach to food development; the development of
148 technological systems such as food processing and the 'cold chain' refrigeration system;
149 the exploration and expansion of growing produce around the world; and air-freighting
150 new and exotic produce are often emphasised and exhibited at the M&S Company
151 Archive Museum, plastic packaging's contribution, particularly that of its material and
152 technological dimensions, is somewhat limited. As such this paper provides a fresh
153 perspective on UK food retail history situating how plastic packaging enabled M&S's
154 expansion of food retailing by maintaining and enhancing its core values.

155 **2. Research Methodology**

156 This paper is based on a study of the M&S Company Archive. While previous research
157 on the impact of technological innovations in transforming food retailing have
158 predominantly relied upon newsletters, articles, reports and advertisements across
159 industry trade journals, magazines and newspapers (see Hagberg 2016; Bernat 2017;
160 Hawkins 2018), this paper pays empirical attention to retailers themselves, an alternative
161 body of literature and one that is less prone to 'industry and marketing rhetoric' (Cochoy,

162 2009, p.37). Major food retailers have grown into powerful actors in contemporary food
163 chains and networks (Oosterveer, 2011), promoting particular social conventions and
164 expectations in everyday life, including ‘convenience in shopping, meal patterns, meal
165 types, personal relationships and more’ (Dixon, 2007, p.40). Understanding plastic’s
166 pervasive character within this context allows particular attention to be paid to the
167 material and technological dimensions of packaging over that of its representational
168 dimensions, showing how such advancements were key to the delivery of M&S’s core
169 values as a retailer. As such, of the 71,000 items relating to corporate information,
170 marketing material and the products themselves, attention was primarily paid to M&S’s
171 corporate information including: company accounts, documents, reports, letters,
172 speeches, and annual reports. In doing so, this paper pays empirical attention to the
173 internal management, operation, and development of technological innovations in
174 transforming food retail.

175 The archive was analysed regarding key concepts associated to a socio-technical systems
176 approach. Attention was paid to the services plastic packaging enabled through its
177 innovation and how this was translated in a food retail setting. In doing so, the paper
178 acknowledges that objects, such as plastic packaging, are implicated in social relations
179 and demand close attention (Bennett, 2010). This paper follows the understanding in
180 which non-human entities can be considered social actors (actants) that play a role in
181 science, technology, and society at large (Cochoy, 2009). As such, plastics have material
182 agency, influencing the things and networks around them based on their material and
183 physical characteristics (Liboiron, 2016). Usually however, the user perspectives are
184 focused upon in cultural studies, resulting in the *development* of technology disappearing
185 from view and technology itself becoming a black box (Geels, 2004). It is through the
186 presentation of the three examples that the paper contributes to a growing understanding
187 of plastic’s agency and responsibility (cf. Evans et al., 2020) in UK food retail history
188 through the delivery and enhancement of Marks and Spencer’s core values. Empirically,
189 this paper follows other studies that have explored the role of objects that equip actors,
190 generally consumers, in particular ways (e.g. Cochoy, 2007, 2009; Hagberg, 2016).

191 To provide a comprehensive explanation of plastic packaging’s role within food retail in
192 the UK is difficult given it is poorly documented (cf. Hagberg, 2016). This is
193 compounded by the fact that archives only capture ‘traces’ of the discussion (Hill, 1993),
194 therefore any suggestion of approaching the archive in a very specific nature in respect to

195 'Plastic Packaging', would be counterintuitive as such categories 'do not just suddenly
196 appear in their final form' (Hagberg, 2016). As such, this paper mobilised each of
197 Michael Hill's three common ways of finding material in archives (Hill, 1993). First, a
198 preliminary *topical search* using the online catalogue appropriate to the research aim of
199 understanding plastic's wider role in food retail history identified initial items of interest.
200 For this study, topical themes included: specific plastics (e.g. cellophane, polypropylene,
201 high-density polyethylene), packaging functions (e.g. freshness, sell-by date,
202 preservation), types of use (e.g. single-use, reuse, recyclable), aspects of research
203 development (e.g. food quality, quality control, packaging technology) and other material
204 packaging examples (e.g. canned, glass, bottled glass). Second, consulting a number of
205 *finding aids*' including the collection guide, M&S company biographies and
206 autobiographies highlighted several series and sub-series within the archive for review.
207 The use of the collection guide was extended to the topical search with the identification
208 and categorisation of several documents under a particular (sub-)series highlighting items
209 of interest. And thirdly, communication with the archivist in relation to the topical search
210 utilised their *specialised knowledge* of the collection providing informed suggestions.

211 The research process took into consideration the archive's structural constraints and
212 non-circulating nature (Hill, 1993), conducting topical searches and the review of finding
213 aids away from the archive before reviewing and photographing items when visiting in
214 person. In seeking to be robust within the analytical process, each methodological
215 approach was used in conjunction with one another, iteratively interrogating the
216 company archives and analysing material. The research process stopped when a level of
217 'saturation' had been reached and items of interest were exhausted. In total 393 items
218 were reviewed in person, with 137 items photographed for further analysis away from
219 the archive.

220 What results from this process of 'archival ethnography' is the linking of material across
221 time, place, and theme from the archive, to reconstruct an account and establish a
222 narrative (Decker and McKinlay, 2020). In doing so, the paper adds to a growing body of
223 research that signals the historical turn in organizational studies (Decker and McKinlay,
224 2020; Decker et al., 2020). Whilst several plastic packaging examples were documented,
225 the extent to which these were fully comprehensible was limited. As such, the following
226 examples of cake, retortable and meat packaging were selected purposively due to the
227 level of material identified and their wider significance in terms of the theoretical

228 concerns of the paper. Specifically, the case of cake packaging highlights the capacity to
229 maintain overall food quality, ensuring freshness and high standards of hygiene were
230 maintained at a time when the end of rationing signalled a drive for better quality food
231 products; the retortable packaging case illustrates the growth of eating for leisure and as a
232 pleasure pastime, which influenced a drive for pre-prepared 'gourmet' foods of quality
233 and convenience; while the third example of meat packaging demonstrates the
234 maintenance of product safety in combination with the cold-chain process, whilst
235 enhancing freshness and quality through the extension of shelf-life and the sale of 'fresh
236 not frozen' products, which consequently had wider structural impacts of the meat
237 industry. Taken together, the three examples highlight the technologically innovative role
238 of plastic packaging in achieving different commercial objectives, as defined in M&S's
239 core values. It is the presentation and discussion of each example that I turn to now.

240 **3. Cake Packaging**

241 The first example considers the development of cake plastic packaging contributing to
242 values of hygiene and freshness. Since 1940, the cake and biscuit industries had been
243 starved of basic raw materials (M&S, 1954a) and in the years after the Second World War
244 key raw materials were rationed, stretched and substituted, resulting in poor quality
245 products known derisively as 'shop cakes' (Goldenberg, 1989, p.31). However, from
246 1954 onwards many raw food materials such as butter, fats, flours and eggs were no
247 longer rationed, allowing the Food Division scope to develop a range of high quality
248 'fatty' foods based on this improvement in the quality of food materials (M&S, 1954b,
249 1977). It is commented by Goldenberg (1989, p.47) that this initial development of the
250 Cake Department gave M&S a 'ten-year lead over other food retailers' securing its
251 reputation and competitive advantage for a period of time before cake suppliers utilised
252 the 'know-how' and other chain stores established their own Technological teams.

253 We can also trace plastic packaging's role in the development of this line of food.
254 Throughout the early 1950s M&S requested their suppliers to pre-wrap all cakes and
255 biscuits and to eliminate those not suitable for pre-packaging (M&S, 1953, 1964). Prior
256 to 1948, products such as cakes and biscuits were cut in store and bought in any
257 denomination before being wrapped or packaged (M&S, 1955). With the advent of self-
258 service, consumers were empowered to touch, pick-up and select their own product.
259 Wrapping the product, generally in regenerated cellulose packaging, immediately after
260 production ensured that previous standards of hygiene achieved throughout manufacture

261 were maintained and deterioration due to contamination by microorganisms less likely.
262 The packaging personified and communicated to the customer M&S's clean factories,
263 improved standards of hygiene and sanitation, reassuring them that the cleanliness and
264 overall product quality had been maintained throughout the wider manufacturing
265 process. As such, in delivering this technological service of maintaining high standards of
266 hygiene, plastic packaging was often commonly referred to as 'hygienic wrap'.

267 Whilst this narrative supports the current understanding of plastic packaging as a
268 protective barrier maintaining hygiene standards throughout manufacture, distribution
269 and self-service, it diverges from the understanding that the plastic packaging device was
270 somewhat invisible (cf. Hawkins, 2018). Going further, and introducing the development
271 of their gateau range, I highlight the technical capacity of a specialised plastic film (QSAT
272 300) in maintaining the freshness of its high quality 'fatty' foods. The 'Genoese' gateau
273 was originally popular in M&S's catering and café businesses, with its vitacream (a
274 synthetic cream popularly used in the war and immediate post-war years) and jam filling
275 covered with chocolate fondant and decorated with French walnut halves (Figure 1)
276 (M&S, 1962a; Goldenberg, 1989, p.34). But delivering the product fresh to be consumed
277 in a domestic environment was more difficult. With decorations enhanced and attractive
278 to the eye to stimulate 'impulse buying', many cakes (and subsequently other foods)
279 depended on being stored under the correct condition of equilibrium humidity in
280 preventing the product from either drying out or absorbing moisture outside of the
281 packaging (M&S, 1962b). For the gateau, preserving the cake base in a fresh condition,
282 whilst not adversely affecting the chocolate fondant decoration presented difficulties
283 (M&S, 1954a). At that time, only two types of regenerated cellulose films were available
284 for wrapping: a moisture-proof, heat sealing film used for cakes where drying-out must
285 be prevented and where atmospheric moisture must be excluded; and a non-moisture
286 proof film which would allow cakes to 'breathe', preventing condensation on the inside
287 surfaces of the film without being heat-sealed (M&S, 1962b; Goldenberg, 1989). Neither
288 could be used for the gateau as the film needed to be partly moisture proof to allow the
289 cake to breath, preventing condensation and mould growth, whilst needing to be heat
290 sealable so that the product could be mechanically wrapped (M&S, 1958, 1962b;
291 Goldenberg, 1989). Whilst each could be achieved individually, neither was able to
292 achieve both.

293 The subsequent production of a new semi-permeable film, QSAT 300, in collaboration
294 with Rayophane enabled decorated cakes and other soft-topped cakes to be over-
295 wrapped by a heat-sealable film, which could still ‘breathe’ (M&S, 1962a, 1962b, 1964).
296 With the growing complexity and on-going ‘conveniencization’ of food development
297 (Jackson et al., 2018), the innovation of QSAT 300 highlights the technical capacity of
298 new material packaging techniques ‘capable of significantly interacting with and altering
299 the biological life of food’ in respect to maintaining the service of product freshness
300 (Hawkins, 2018, p.398). These innovations therefore demonstrate the role of novel
301 forms of packaging in allowing M&S to achieve their core values of hygiene and
302 freshness.

303 [Figure 1 here]

304 4. Retortable Packaging

305 The second example considers the innovation of the retortable pouch (Figure 2), a
306 plastic imitation of the tin can originally introduced in the early 1970s, which highlights
307 plastic’s role in improving the *quality* and scope of the product through its manufacturing
308 process, as well as enhancing the *convenience* of the food product for consumers. Based on
309 a combined investigation between food and packaging technology, a 1982 project set out
310 to innovate better tasting and fresher foods (M&S, 1982). With the tin can reflecting a
311 substantial part of the food market, yet in decline for several years, the investigation into
312 a possible plastic imitation, the retortable pouch, provided an opportunity to usurp the
313 ‘old and trusted tin can’ (M&S, 1983a).

314 [Figure 2 here]

315 The tin can had limitations in what food products it could store safely whilst maintaining
316 a level of food quality. Due to its geometry, outer layers of food would reach process
317 temperature prior to the centre portion of the product during sterilisation and thus be
318 ‘cooked’ for longer, leaving outer layers over processed and adversely affecting the
319 content’s food quality in respect to colour, flavour, texture, and nutrients (Griffin, 1987).
320 The retort pouch on the other hand, allowed high processing temperatures and rapid
321 heat transfer due to its profile (flat geometry) and thin material (Amézquita &
322 Almonacid, 2009). In reducing heat exposure to the product, retort pouches enabled the
323 processing of heat-sensitive products not suited to canning, especially in respect to high-

324 temperature/short-time processing which would optimise nutrient and flavour retention
325 (Robertson, 2013). For M&S this was an interesting proposition as they were not in the
326 grocery canned food market in any significant way due to their focus and ability to
327 deliver better quality fresh foods (M&S, 1983a). None of the St Michael canned meals
328 included delicate ingredients such as fresh cream, herbs and wine due to the limitations
329 of the can manufacturing process which destroyed the quality of flavours and textures
330 when ensuring the safety of the product. For retortable packaging, the quality of these
331 ingredients kept their natural flavour after the manufacturing process and even after
332 being in-situ in the packet for months (M&S, 1974, 1982.). Main dishes included chunky
333 chicken in a cream sauce, beef stroganoff and cannelloni and spaghetti pasta dishes,
334 whilst other products included soups and new potatoes in butter (M&S 1974).

335 The 1960s was a key decade in terms of the introduction of convenience foods and can
336 be understood in respect to wider social changes including eating for leisure and as a
337 pleasure pastime (M&S, 1985; Jackson et al., 2018). The pouch was advertised in M&S's
338 'St Michael News' as offering the same quality as fresh and frozen recipe dishes. M&S
339 outlined its material and technological advancements over the tin can when stating it did
340 not rust or corrode; it could be easily opened with a knife or scissors; and was lighter
341 than a can (M&S, 1974). For the consumer, the 'handy foil pouches' offered no mess and
342 no cooking smells, reduced cooking times and less washing up, which was particularly
343 pertinent with the rise of the 'working woman' (M&S, 1974, 1985). This material
344 technology situates itself amongst other convenience devices (such as the fridge, freezer
345 and microwave) with its use in response to the changing configuration and temporal
346 organization of daily life (Warde, 1999). Whilst convenience food is often 'tinged with
347 moral disapprobation' (Warde, 1999, p.518), Jackson et al. (2018) highlight that many
348 types of food can be regarded as 'convenient' through the processes and practices these
349 material arrangements are enrolled in. The proliferation and widespread service of
350 'convenience food' is a response to 'time-saving' and 'time-shifting' in order to
351 accommodate the increasingly de-routinized schedules of everyday life (Warde, 1999).
352 The flexible foil and plastic packaging provided high quality pre-prepared 'gourmet'
353 foods, that required both minimum preparation (time-saving) and the reduction in
354 competency and cooking skills, with tasks moved to the food process stage (time-
355 shifting). As a result, a meal could be prepared in the pouch and emptied onto a plate
356 ready to eat – "the ultimate so far in convenience" (M&S, 1974). In this case, then, the
357 retortable pouch enabled M&S to secure its core values of quality and convenience.

358 5. Meat Packaging

359 The final example considers the innovation of meat packaging, drawing attention to
360 plastic's apparent invisibility in contributing to food *safety, freshness and quality* in
361 combination with the cold-chain technique. The merchandising of 'perishable' or 'high
362 risk' foods such as fresh meat and poultry generally lacked engagement from the Food
363 Division in its formative years due to the liability of bacterial contamination with
364 consequential spoilage, food poisoning and illness (Goldenberg, 1989; M&S, 1991b).
365 Nathan Goldenberg, M&S's first food technologist and later Head of the Food Division,
366 subsequently recommended a number of steps to ensure that products were handled
367 correctly under carefully controlled conditions designed to prevent bacterial
368 contamination and growth. A defining feature of selling fresh meat was attributed to and
369 dependent on adhering to the 'cold chain' technique (M&S, 1981). Notably, Goldenberg
370 refers little to plastic's role in the delivery of these services other than to be used to
371 individually wrap each product at the supplier (see Goldenberg, 1989, p.204). The
372 technological advancement of refrigeration throughout the supply-chain helped not only
373 in the field of hygiene but also 'enabled highly perishable carcass meat to be handled,
374 shipped and displayed without the loss of quality' (Williams, 1976).

375 While the development of refrigeration was a major advance in food technology in the
376 second half of the twentieth century (Oddy, 2003), it is important to shed light on
377 plastic's role and contribution in this technological network. In contribution to this,
378 vacuum-packed products (Figure 3), if used correctly, delayed the growth of bacteria,
379 delayed spoilage of meat and were organoleptically more acceptable than other cooked
380 meats packaged in air-permeable material. If not used in conjunction with the cold-chain
381 process and stored inappropriately at ambient temperatures, it had the ability to deceive
382 both the retailer and consumer of potentially toxic meat products, with pathogens
383 potentially growing without the accompanying warning signs of spoilage (M&S, 1965).
384 This was at a time when greater processing of food and changing technology brought
385 further worries, including the growing use of chemicals – antibiotics, pesticides and anti-
386 oxidants -- throughout the 1960s and latterly, a succession of safety problems, including
387 salmonella, E.coli, foot-and-mouth disease, Bovine Spongiform Encephalopathy (and the
388 human variant, Creutzfeldt Jacob Disease) throughout the final third of the twentieth
389 century (Oddy, 2003, 2009). Oddy mentions several interrelated factors relating to the
390 transition to low-temperature technology in the domestic kitchen and use of domestic

391 appliances (refrigerator, freezer and microwave oven) that potentially contributed to this
392 trend in food-poisoning (Oddy, 2003, pp.213-214). While refrigerated display cabinets
393 became part of shop fittings throughout the 1950s, most customers had no refrigerators
394 at home and so food, particularly meat, was sold with the intention for immediate
395 consumption (Oddy, 2003). As such, vacuum-packaging was not regarded as a substitute
396 for good refrigeration control but magnified the efficacy and complemented the process
397 in delivering a safe product (Horowitz, 2006).

398 [Figure 3 here]

399 Prior to 1981, the selling of fresh meat frustrated M&S by the product's short shelf life
400 (M&S, 1981). As such, chickens were originally sold frozen, something which consumers
401 disliked due to the lack of taste and excessive water content (from the freezing process)
402 and something Lord Marks himself strongly opposed (M&S, 1972). His view was that
403 any frozen food in general, was inferior in quality to fresh foods. Commercial food
404 processing throughout the 1950s often faced issues with freezing rupturing the cellular
405 structure of food, resulting in appearance and quality deterioration, whilst chemical
406 change in fat could result in 'freezer burn' (Oddy, 2003). A few trials conducted by M&S
407 confirmed that fresh chilled chickens were softer in texture, more succulent and had a
408 better flavour than frozen chickens where the flesh was tough and tasteless (M&S, 1964).
409 An issue of mechanical refrigeration however was that poultry stored in this manner
410 required some sort of packaging to prevent dehydration (M&S, 1966). In 1982, the
411 investigation of a no gas mix controlled atmosphere packaging extended the life of whole
412 chickens by two nights and overcame previous issues of taint from CO₂ (M&S, 1982).
413 This was particularly important for weekend display and post-peak recovery of poultry
414 products enabling M&S to store chickens in bulk conditions. Yet at a cost of 5p per
415 product, the decision to apply this technique directly was not taken at the time (*Ibid.*).

416 Considering the use of gases in controlled atmosphere packaging, identifying the correct
417 balance was often difficult. A review by the Central Food Technology Department
418 highlighted only a small number of gases - oxygen, carbon dioxide, nitrogen, and nitrous
419 oxide – were sufficient to use as 'legal food additives' (M&S, 1983b). Each gas had
420 advantages and disadvantages in their use, most notably: oxygen maintained the bright
421 colour of 'fresh' red meat, a visual sign that housewives long used as a freshness indicator
422 (M&S, 1981, 1988) and prevented anaerobic conditions which could lead to botulism.
423 Carbon dioxide delayed the increase of microorganisms, with this inhibitory action

424 increasing with gas concentration, yet a concentration too high could give rise to
425 anaerobic respiration of the product (M&S, 1983b). The mixture of both oxygen and
426 carbon dioxide and the gas-impermeable barrier of the plastic packaging therefore
427 retained the natural colour and extended shelf life by 2-3 days respectively (M&S, 1981).
428 This had a wider structural impact on the meat industry, with butchers' shops
429 diminishing in numbers. In 1961, there were approximately 42,000 butchers' shops in the
430 UK, but by 1971 this had fallen to 34,000 (Williams, 1976). M&S established that all
431 meats should be packed in controlled atmosphere plastic containers, taking over a year
432 and seven meat suppliers to do so. In doing so, the company catalysed its UK suppliers
433 to change from butchers to 'plastic box makers and industrial gas experts' (M&S, 1981).
434 The manufacturer Cavaghan & Gray reflected this transition of the meat industry from
435 'old-fashioned bacon curers' in 1966 to 'highly sophisticated producers of chilled
436 convenience food dishes of most types' by 1988 (Sieff, 1990). These innovations in the
437 fresh meat and poultry industry therefore maintained product safety in combination with
438 the cold-chain process, enhanced freshness by extending the product's shelf-life and
439 enhanced quality enabling the sale of 'fresh not frozen' chicken and other meat products.

440 **6. Conclusions**

441 Focusing on innovations in plastic packaging, this paper makes three contributions and
442 these are used to structure the conclusion. First, and primarily, the paper highlights that
443 despite the current condemnation of plastic packaging, it has contributed significantly in
444 transforming UK food retailing. While food retailing has dramatically changed
445 throughout the course of the twentieth century, reflecting the advancement of
446 technology (Stanton, 2018), plastic's role has been somewhat neglected, going largely
447 unrecognised. It is acknowledged that other innovations such as the mechanization of
448 the factory system, efficiency in the division of labour, developments of food science and
449 processing, innovations in associated consumer technologies (freezer, microwave and
450 refrigerator), and the 'Americanization' of retailing through self-service methods and the
451 supermarket model have been instrumental in the transformation of food retailing. But
452 as this paper illustrates, plastic packaging has actively enabled and contributed to
453 advancements of UK food retailing alongside these innovations, including the capacity to
454 maintain overall food quality, 'sealing in freshness' (Hawkins, 2018), delivering services
455 of 'industrial freshness' often attributed to the cold chain process (Freidberg, 2009), as
456 well as facilitating the on-going 'conveniencization' of food products that we see today.

457 Furthermore, it is necessary to refer to wider social changes at the time including the end
458 of rationing, which signalled a drive for better quality food products; the growth of
459 eating for leisure and as a pleasure pastime (Jackson et al., 2018), which influenced a
460 drive for pre-prepared ‘gourmet’ foods; and the increase of a female labour force and the
461 changing structure of household composition resulting in changing food consumption
462 patterns and practices. Through the theoretical contribution of the paper, plastic’s
463 material agency and responsibility (cf. Evans et al., 2020) has been situated amongst a
464 wider network of actants relating to science, technology and society (Cochoy, 2009).
465 Situating the services that it provides both amongst and connected to the supply side
466 (e.g. technology, knowledge, management, structures) and on the demand side (consumer
467 preferences, cultural meanings, infrastructures) refers to further implications on the
468 future of food retailing. Its embeddedness in food retail practices demonstrates a ‘lock-
469 in’ to the services it provides, contributing to the growing acknowledgement that it is not
470 possible to merely remove unsustainable objects (Fuentes et al., 2019). As recent
471 attempts illustrate, the removal or substitution of plastic has been more difficult and
472 challenging than originally assumed (Barrie, 2019; Farrell, 2021). What has been
473 presented suggests that despite the blanket disapproval of plastic packaging, we enjoy the
474 services that it provides. Consequently, these histories are instructive when considering
475 the future of food retailing in respect to promoting sustainable shopping. It would be
476 interesting to see further research on alternative retail methods that are increasingly being
477 trialled in UK retail spaces in the aim of achieving more sustainable outcomes, in order
478 to understand the reconfiguration and subsequent reinvention of supply and demand
479 networks and practices of retail.³

480 The second contribution refers to the paper’s distinctive focus on a particular retailer,
481 highlighting plastic packaging’s role in enabling M&S’s product development process
482 whilst maintaining and enhancing its core values. In doing so, this paper situates plastic’s
483 innovation amongst the retailer’s own business and organisational history which has long
484 established science and technology playing a key role in the expansion and innovation of
485 its food business. In the examples presented, the services that plastics maintain and
486 enhance – standards, hygiene, safety, freshness, quality and convenience – are
487 inextricably linked to the commercial objectives of M&S, particularly at a time when its
488 Food Division was acknowledged as a lead innovator in the British food industry.
489 Through the contribution to these core values, the research underlines plastic’s
490 assimilation by powerful actors in food chain networks which have promoted particular

491 social conventions and expectations in everyday life (Dixon, 2007; Oosterveer, 2011). In
492 doing so, it acknowledges plastic's role alongside other technology advancements already
493 presented and recounted in The M&S Company Archive Museum.

494 Expanding upon the second contribution is the third and final contribution of employing
495 a historical review of plastic packaging, particularly that of archival research on
496 businesses and organisations. This departs from existing research that draws upon
497 marketing and advertising materials (see Hagberg 2016; Bernat 2017; Hawkins 2018) and
498 instead turns our attention to the material and technological advancements of plastic
499 packaging from the perspective of retailers themselves. The examples presented often-
500 reflected broader changes with the food retail environment with the materiality and
501 technological innovations applied to other food stuffs. For example, the advancements
502 made by M&S in controlled atmosphere packaging were then applied to other food
503 products including fish, snack products, salad meals and fresh and prepared produce
504 (M&S, 1981). More examples such as those explored in this paper would contribute to a
505 more comprehensive understanding of plastics role in UK food retail history.

506 In conclusion, the paper has shown how contemporary debates about the role of plastic
507 packaging has historical resonance. From a socio-technical perspective, plastic packaging
508 has become 'locked-in' to food retailing throughout the twentieth century. This
509 subsequently has implications in reinforcing current approaches as well as providing a
510 more nuanced account of the potential role of plastic and other forms of packaging in
511 informing sustainable transitions.

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¹For further discussions on packaging in general refer to Twede (2012), Marsh and Bugusu (2007) and Cochoy and Grandclément (2005).

²At this point in time there was no clear separation between quality control and quality assurance. Nathan Goldenberg, M&S’s first food technologist and later Head of the Food Division, rejected the term ‘quality assurance’ as a form of ‘kidology’ in thinking that quality could be ‘assured’ in mass production (1989, p.92).

³Opportunities of transitioning to a circular economy of plastics include, but are not limited to, reusable packaging (see EMF, 2019).