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Don Wallace

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"Here is a timing chart that is an oversimplified example of what happens when a new product is introduced to the market in terms of public acceptance. Initially, if it contributes a real consumer service, . . . it rises high in public acceptance. But that unique spot is held for only a short time, because competition very quickly moves in and equalizes the gain. Then it starts to decline until another basic change makes it rise again in public acceptance. Competition equalizes it again, and thus this general curve is followed during the life of the product.

"Major changes usually involve new tools and plant layout; consequently, these basic changes are introduced not every year, but about every three to five years. It becomes imperative to use other methods during the 'in between' years to build up public acceptance. These are the years when it is necessary to have advanced features added, new appearance with minor tool changes to spark up the product."

Let us see how all this works out in the case of the G.E. refrigerator.

Household refrigerators have been produced by the General Electric Company since 1926, and account for more production and sales volume than any other appliance manufactured by the company. A study of the development of the refrigerator therefore provides an interesting picture of the evolution of the form of a mass produced product over a relatively long period of time. This development has not been an even one, but has consisted of periodic major changes in the form of the refrigerator, based on comparable technical changes, followed by relatively long periods of gradual improvement.

Interestingly enough, most of the major developments in refrigerator design to date were actually conceived and partially perfected very shortly after G.E. entered the field. But realization of these concepts often had to wait many years before technical developments or marketing conditions made fully large-scale production possible or timely. For example, the combination refrigerator-freezer, which was introduced by G.E. in 1948, was originally conceived in 1929, and several experimental models were built shortly thereafter. The long period which elapsed between original conception and experimentation and ultimate production was due primarily to the need for further engineering work to reduce manufacturing costs, and to the fact that the frozen food industry had not yet developed sufficiently to create the demand for such a unit.

General Electric first began to experiment with electrical refrigeration in 1910, but it was not until 1923 that a consistent program was launched as the result of an exhaustive study by Dr. A. R. Stevenson, Jr. Dr. Stevenson's analysis of the problem led to the development of the first hermetically sealed, air-cooled refrigeration mechanism. After several years of experimentation, the first of the famous "monitor top" refrigerators was produced, in 1926. The cooling unit of this model was frankly exposed where it could operate at maximum efficiency, on top of a refrigerator cabinet that looked like a conventional ice box. Even the apron at the bottom of the cabinet, originally intended to conceal a pan for collecting drippings from the ice, was retained in this model.

The monitor top refrigerator was produced until 1935, with yearly changes and refinements. But public prejudice against the exposed refrigeration unit began to mount, undoubtedly spurred on by the ridicule of competitors. The characteristic appearance of the exposed condenser coils wound around the steel case of the unit soon earned it the nickname "bird cage." Even the unit's mechanical efficiency, attempts to streamline it, and heavy national advertising could not overcome this handicap.

Some day the monitor top refrigerator may become an exhibit in the Smithsonian Institution, where it may be regarded as a historical object of great interest and even beauty, like the Wright brothers' airplane. But not for today's housewife.

By the early thirties, G. E. engineers had created a new sealed mechanism which could be hidden in the bottom of the refrigerator cabinet. The design of a flat top refrigerator cabinet based on this mechanism was undertaken in 1933, as the first major assignment of the newly formed Appearance Design unit. Henry Dreyfuss was retained as consultant on the project, and collaborated with the G. E. staff in the design of the new refrigerator. At

that time, the sides and tops of refrigerator cabinets were still made as separate parts, and the design of the new refrigerator clearly articulates the different components of the cabinet. The trend toward streamlining and bulging contours had not yet set in, and the lines of this model are crisp, and its planes flat. From the standpoint of lasting qualities, the form of this model still stands up among the best that G. E. has produced. The new flat top refrigerator was advertised as "Styled For The Years," and the phrase has since become a byword of G. E. Appearance Design. But the demand for constant model changes required by competitive marketing makes this an ideal difficult to meet consistently. The basic design of the 1935 model was retained until 1939, but with yearly modifications and embellishments that did not improve on the classical simplicity of the original model.

For the next few years, the trend in refrigerator design reflected the general trend set by automobile design toward inflated shapes. The radii of cabinet corners and edges became larger, door fronts swelled outward, and the tops became more dome-like in an effort to make the refrigerator appear larger and more imposing in visual competition with other makes on the dealer's floor. G. E. refrigerators made between 1939 and 1948 (there was a lapse in production during the war years) reflected this trend, though, on the whole, they were fairly restrained in design by prevailing standards.

By the end of World War II, a reaction had set in against streamlining and jello-like forms. The overinflated forms might create quite a visual impact in competition for attention in a store, but they stuck out like a sore thumb in the kitchen, and, with time, this became more and more apparent.

In the meantime, the tangent bending method of forming sheet metal cabinets was perfected. This made it possible to form the sides and top of a refrigerator cabinet from a single sheet of metal, thus providing a better seal for insulation, and opening up new possibilities in form. In developing new cabinet designs to be formed by tangent bending, the Appearance Design group emphasized more subtle contours and crisper radii for corners and edges, even though the latter involved somewhat greater production difficulty. The enamel outer surface of the cabinet was left entirely unembellished, and door pulls were handled with simplicity and restraint. This basic design, with the usual yearly modifications, including somewhat more prominent hardware and nameplates, has continued in production since its introduction in 1948.

After more than 25 years of development, the conventional refrigerator had reached a stage of mechanical perfection and standardization where the designer could do little beyond minor modifications of the interior, redesign of the hardware, and other details of "styling." At the same time, as kitchen planning tended more and more toward the integration of all elements into a harmonious ensemble, the main problem of refrigerator design was no longer one of mere styling, but the elimination of the refrigerator as an independent visual object and its integration with the entire kitchen.

The refrigerator is essentially a storage device, and the idea of its incorporation with kitchen wall storage cabinets, both for visual unity and for improved accessibility, had actually been conceived many years before. But technical difficulties postponed its realization for more than 20 years. In the average refrigerator, insulation consumes nearly as much volume as food storage. Since the maximum depth permissible for a wall storage unit is limited to less than 18 inches, necessary reductions in the thickness of doors and walls in order to conserve storage space could only be made by reducing insulation thickness to a point where thermal losses became excessive. For some years G. E. engineers and scientists had been engaged in research to develop more efficient insulating materials. This research was at first carried on without any specific application in mind. But the improved material which resulted made the wall-mounted refrigerator possible by permitting thinner doors and walls.

In the meantime, Market Research conducted a survey which indicated that the potential demand for this type of refrigerator was great enough to justify quantity production. The first cabinet designs tried to approximate the normal kitchen wall cabinet depth of 13 inches by choosing a depth of 15 inches, the minimum considered practical. But market and use testing indicated that this was insufficient, and depths were increased in stages on successive models until a depth of 17½ inches was adopted — sufficient to accommodate large food platters. After many other design modifications, full production in six colors began in March, 1955.

The wall-mounted refrigerator is one more in a succession of kitchen appliances that have been integrated with the overall kitchen plan, and have thereby ceased to be independent *objets d'art.* It remains to be seen how this trend toward greater emphasis on relationships of product forms within a total environment will be affected by the practice of introducing yearly changes in appearance design.