Book Review:
A Milestone in the Philosophy of Technology

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Few research projects have been as influential in their area as “The dual nature of technical artefacts” has been in the philosophy of technology. Starting in 2000 and led by Peter Kroes and Anthonie Meijers, the project group set out to investigate the nature of technical artefacts. Their work has become important in at least two ways. First, it set a methodological standard for the philosophy of technology. It did this by showing that the discipline becomes much richer when we delve into the details of actual engineering practices such as design, modelling, and standardization. We need bird’s-eye views of the relations between technology, science, and society, but these grand views become much more interesting if they are informed by frequent dives into the minutiae of actual engineering. Of course the dual nature project was not the first to investigate engineering practice philosophically, but it was instrumental in instigating an “empirical turn” that has made the philosophy of technology much more relevant for engineering and the technological sciences.

The project group’s second major achievement was to introduce a new and fruitful approach to the metaphysics of technical artefacts. This approach grew out of dissatisfaction with previous accounts that were found to be inadequate. On the one hand, technical artefacts have often been described in merely physical and structural terms. That is clearly insufficient. You have not understood what a set of chimes is if you only know how it is constructed (with hanging metal tubes of different lengths). A set of chimes has to be understood in relation to its function as a musical instrument.
On the other hand, there are descriptions of technical artefacts that take them to be merely mental or social constructs. That is equally insufficient. “One cannot solve the problem of putting a man on the moon by words (signs) alone” (p. 185). All this led Peter Kroes and his colleagues to the conclusion that technical artefacts have to be conceptualized in terms of both physical structure and human intentions. The relevant human intentions are typically expressed in terms of function; in order to understand what a clothes iron is one has to understand that its function is to remove creases from clothes.

The dual nature model has developed into a versatile tool that can be used to attack a wide variety of problems in the philosophy of technology. The classification of technical artefacts has to be based on both functional and structural properties. A design process can be approximated as a process that translates functions into structures. (To design a rice cooker means to construct a physical device that realizes the function of cooking rice.) The moral and social significance of a technical artefact relates to both its functional and physical characteristics. (An ethical analysis of motorcars will have to include both their function as transportation devices and their physical characteristics such as the use of material resources.) But in these and other cases, successful use of the dual nature model requires a significant amount of sophistication. More often than not, distinctions have to be introduced between different types of functional and/or physical characteristics.

In this book, Peter Kroes summarizes and augments more than a decade of research on the dual nature of technical artefacts, covering topics such as technical functions, artefact kinds, design processes, and the normativity of artefacts. The book has clear delimitations in the types of artefacts that it covers. Non-technical artefacts such as artistic and social artefacts are left out. These are sensible exclusions (although I believe that students of social artefacts will find use for some of the distinctions that Kroes introduces). He also restricts the discussion to what may be called classical technical artefacts, explicitly excluding both software and technologically modified organisms. These are somewhat less unproblematic exclusions.

Software programs, of course, have both structure and function. Programming can usefully be described as a design process in which functions are translated into structure, and usually there are competing structures with the same function. Moreover, some of the concepts that Kroes discusses in relation to design methodology, such as means-ends reasoning and the division of functions into subfunctions, are just as relevant in programming as in the design of physical objects. In modern engineering, software design and the design of physical structures have
become increasingly integrated. Therefore, the extension of the dual nature account to technical artefacts whose structure is symbolic rather than physical would seem to be a most useful contribution.

As to engineered organisms, Kroes rightly points out that these include not only genetically modified organisms but also organisms that have been modified through conventional breeding. Today’s dairy cows, domestic pigs, wheat, and strawberries—to mention just a few examples—are drastically different from their wild forebears. Bioengineering, even in the form of traditional breeding, gives rise to interesting philosophical issues that are partly similar to those discussed in the dual nature analysis of technical artefacts. For instance, we use functional terms to describe domesticated animals and plants (racing horses, draft horses, breeding bulls, rootstocks, animal feed plants, etc.). Current developments in biotechnology give rise to a host of interesting metaphysical issues that have attracted surprisingly little attention. Although Kroes’s decision to leave them out here may have been wise, this is another important area for future philosophical research.

One of the most important contributions in this book is the clear distinction that the author draws between an object’s function and its functional kind. As a very rough first approximation, many technical artefact kinds seem to be definable in terms of their typical functions. For instance, a candlestick is a device which holds a candle in a position in which it can be burnt, so why not just define “candlestick” as an object with that function? Kroes shows that this simple format for defining functional kinds does not work. He does this by pointing out two major complications in the relationship between the two.

First, not all assignments of functions have the power of making their object a member of the corresponding functional kind. I may have kept burning candles in the same old wine bottle for a decade or more, but it is still a bottle, not a candlestick. To explain this Kroes introduces what may be called the prerogative of the designer: The designer determines the “kind-proper function” of an object. This is the function that defines what technical artefact kind the object belongs to, something that cannot be changed by later function ascriptions, for instance, by owners or users of the object. A user can decide the object’s “use-proper function,” for instance, by deciding to use a specific wine bottle for holding candles or (as is common among burglars) to use a specific screwdriver as a window opener. Such decisions are different from the temporary (“accidental”) use of the bottle or the screwdriver on a single occasion for the respective purpose, but they still do not make the object member of another technical artefact kind than that determined by its designer.
Kroes expresses this as a distinction between an object that is “for φ-ing” and an object that is “a φ-er.” As a user I can make a specific pair of tongue-and-groove pliers into an object “for nut-cracking” but I cannot make it “a nutcracker” because I cannot revoke the (kind-proper) function ascription of its designer.

The second problem that he refers to is the status of objects that do not match up to their function ascriptions. This is most clearly illustrated with malfunctioning objects. The CD player in my living room cannot be used to play disks any more and will have to be replaced. However, it is still a CD player. Generally speaking, malfunctioning technical artefacts do not lose their membership in technical artefact kinds. As Kroes shows, previous accounts of technical functions have had considerable difficulties in accounting for this. Arguably, a theory of technical function that cannot account for malfunctioning is itself a malfunctioning theory.

These distinctions are summarized in Figure 1, in which a simple Venn diagram summarizes the relationships among the three categories of ascribed function (“X is for φ-ing”), functional kind (“X is a φ-er”), and functionality (“X can be used for φ-ing”). Each point in the diagram represents the combination of some concrete object and a function. Field 5 represents the central case of a successfully designed object which is used for its intended purpose, such as my wristwatch in relation to the function of showing the time of the day. Field 4 represents the case illustrated by the wine bottle to which I have assigned the role of a candlestick: this object has the function of holding candles but it does not belong to the corresponding functional kind of candlesticks. My broken CD player illustrates the type of objects we find in field 2. (The same field also contains objects belonging to technical artefact kinds that refer to unrealizable functions such as “perpetuum mobile” and “homeopathic remedy.”) The old coat that a farmer used as a scarecrow and the crows as a sitting-place belongs in field 1; it has been assigned the function of scaring off birds but it was not designed for that purpose and neither does it fulfil it. In field 7 we find, for instance, my best woodworking chisel in relation to the function of opening paint cans.

Fields 3 and 6 are more problematic. Kroes says explicitly that if “X is a φ-er” then “X is for φ-ing” (53). From this it follows that these two fields should be empty. There is an obvious and rather strong argument for this standpoint: When the designer classifies an object as belonging to a specific functional kind, that should normally imply that (s)he also assigns the corresponding function to the object. For instance, when a designer classifies an object as a drill bit, it is expected (s)he also would assign to the object the function of creating a cylindrical hole when operated with a drill. However there are limiting cases when this is
less clear. Modern suppliers of plate armours and swords do not necessarily imply that the products they sell actually serve the functions indicated by their names.

An object may be classified by its designer as a sword without being assigned (by the designer or anyone else) the function that a sword is normally assumed to have. However, the cases that fit into fields 3 and 6 seem to be so marginal that it may reasonable to follow Kroes in treating these fields as empty.

According to Kroes, technical artefact kinds are defined in terms of both their structural and their functional features, according to the following pattern:

An object X is an instance of the technical artefact kind K if and only if X is the result of a largely successful execution of a largely correct design of a K. (105)

This definition is in my view a significant improvement over previous definitions. It takes the dual nature of technical artefacts and their kinds seriously, and
it acknowledges that both functional and structural properties have to be involved in the characterization of technical kinds. There is one additional aspect of this characterization, however, that needs to be emphasized: Technical kinds differ widely in the relative importance of functional and structural features for their characterization.

At one extreme there are technical artefacts that are characterized (almost) entirely in terms of their structural properties. This applies to “steel wire,” “plank,” “copper rod,” and many other raw materials and multi-purpose components. These are usually seen as technical kinds (even though Peter Kroes may have been right when pointing out, in conversation a couple of years ago, that when we describe objects like these in purely structural or physical terms we are, strictly speaking, referring to them as physical rather than technical objects). At the other extreme we have technical kinds that are characterized (almost) entirely in terms of their functional properties. “Clock” may be one example A clock is “an instrument for the measurement of time” (Oxford English Dictionary), and there do not seem to be any structural or physical characteristics in common between a sundial and a quantum clock. Note that this does not contradict Kroes’s definition as quoted above; it only shows that there are great variations in what a correct design of a clock (K) can be.

Many technical kinds can be subdivided into subkinds. Predominantly functional kinds often have subkinds that are characterized predominantly or solely in structural terms, and vice versa. The difference between the kind “screw” and its subkind “copper screw” is entirely physical. That between “rope” and its subkind “elevator rope” is predominantly functional. In this way, functional and structural specifications combine in chains to characterize technical kinds, in ways that are perhaps somewhat more varied and complex than what is evident from Kroes’s definition and discussion.

This book is a milestone, a major achievement in the philosophy of technology. It is sure to have a lasting influence, due to its systematic and balanced treatment of several central issues, to the careful distinctions it introduces into the discussion on functions and functional kinds, and—perhaps most importantly—to the new research issues that it opens up. For philosophers in search of important research issues in the philosophy of technology I have no better recommendation than to study Peter Kroes’s book.