

## „DIE WELT ALS UHR“; OR THE CLOCKWORK UNIVERSE

Review of an exhibition of „Deutsche Uhren und Automaten 1550—1650“ given in the Bayerisches Nationalmuseum in Munich, 18. 4.—30. 9. 1980, and the National Museum of History and Technology in Washington

I know what time is, said Augustine, but if someone asks me, I can't tell him what it is. He was wiser than most, for there are few who would claim to know what time is, and of those who do, fewer still who can satisfy the rest of us. The point is, though, we don't have to know what time is; we just have to be able to measure it, and that is something we have done better and better ever since that unknown day in the late thirteenth century when the mechanical clock was invented in Europe. This achievement was not an accident; it was not, as some have said (including some contributors to the catalogue of this exhibition), an unanticipated by-product of an interest in astronomy. It was the work of a civilization that wanted to know the time, and it remained a monopoly of that civilization for about five hundred years.

From the start, Europeans were fascinated by the clock. It was the most complex and ingenious of mechanisms and its versatility made possible a wide range of derivative devices. In particular, it could be used to drive two older mechanisms: automata and planetaria-astraria. The former were a source of amusement and instruction; the latter, an instrument of astrological more than astronomical inquiry. Both of them, by their extraordinary imitation of nature, partook of the divine act of creation; they associated man with the gods. Not only the makers were thus exalted, but the owners and users. Every self-respecting medieval commune felt it had to have its tower clock, sounding and showing the hours to all, augmented if possible with lunar and zodiacal indications and an edifying pageant of moving figures — saints and patriarchs, hammer-wielding *jaquemarts*, trumpeting angels. These clocks cost a fortune to build, maintain, and overhaul or replace (every ten or twenty years), but they came to be indispensable to the organization of urban activities, and, like great cathedrals, an important element of municipal prestige.

Almost from the start, clockmakers worked to reduce the size of these mechanisms to domestic proportions. With better iron and steel, they could make thinner wheels and members; brass could be worked even finer; while the introduction of the coiled spring as a driving force in the early 15th century freed the clock from the servitude of place and made possible the portable timepiece: table and shelf clocks and, as miniaturization proceeded, pendant and pocket watches (*Hals- und Taschenuhren*). These smaller pieces, like the tower clocks, began as simple timekeepers with and without alarm; but they too were soon built with automata and astronomical complications that were the more marvelous for their compactness.

It was Germany — southern Germany in particular — that became in the 16th century the center of manufacture of these horological masterpieces. Augsburg was the leader, out Nürnberg, with long experience in the manufacture of scientific instruments, Ulm, Munich, and Vienna were not far behind (on Augsburg: Maximilian Bobinger, *Kunstuhrmacher in Alt-Augsburg* [Augsburg 1969]; on Nürnberg: Heinrich Lunardi, *900 Jahre Nürnberg; 600 Jahre Nürnberger Uhren* [Wien-Stuttgart 1974]; on Vienna: Lunardi, *Alte Wiener Uhren und ihr Museum* [Wien-München 1973]; Erika Hellich, *Alt-Wiener Uhren: Die Sammlung Sobek im Geymüller-Schlössl* [München 1978] deals with a later period. — A number of general works also deal with the clocks and clockmakers of this period. See especially V. Himmelein and H. H. Leopold, *Prunkuhren des 16. Jahrhunderts* [Stuttgart, Württembergisches Landesmuseum, 1974]; also *Die Uhr: Zeitmesser und Schmuck in fünf Jahrhunderten*. Ausstellung im Schmuckmuseum Pforzheim, 1967 [Kornwestheim 1967]). The skills and knowledge were there: these were major centers of *das alte Handwerk*, with large pools of well-trained metal workers, gold- and silversmiths, instrument makers (Nürnberg especially), jewelers, engravers, cabinetmakers, and the like. The demand also: the very fragmentation of Germany provided in the persons of rulers and court attendants a large, ready-made clientele for costly *objets d'art*. Besides, these were good years for south Germany: trade was flourishing, and ties to copper- and silver-mining areas and to flourishing north-south and east-west trade (Augsburg and Nürnberg were at the crossroads) generated new mercantile and financial fortunes alongside those of the estate and court nobility. There was also the special consideration of the Ottoman tribute (*Türkenverehrung*), which was paid in part with some of the most beautiful and costly clocks of the period. (The Turks did not know really how to maintain these timepieces, even with the help of imported European craftsmen, so they always needed replacements. The storerooms of the Topkapi Serail in Istanbul are filled with splendid clocks that stopped working and were simply discarded.)

The new exhibition *Die Welt als Uhr*, a joint venture of the Bayerisches Nationalmuseum in Munich and the Smithsonian Institution in Washington, is a tribute to and celebration of this golden age of German clockmaking. The co-producers, Klaus Maurice and Otto Mayr, are among the world's leading experts in this domain (Klaus Maurice is the author of *Die deutsche Räderuhr* [2 vols., München 1976], also of a monograph *Die französische Pendule des 18. Jahrhunderts* [Berlin 1967]. — Otto Mayr is currently preparing a study of the clock as symbol and metaphor). Maurice and Mayr compare these extraordinary products of technical ingenuity and artistic bravura to other great impractical masterpieces: the Pyramids, the Gothic cathedrals, space ships. All these complications after all — the automata, the celestial phenomena, the musical features — were counterfunctional;



they made it harder to tell the time accurately. No matter: „Die Räderuhr war ein Wunder des erfindenden Genies, ein Triumph handwerklich-technischer Kunst, eine Mechanik von ästhetischer Vollendung.“ It was, in other words, one of the highest expressions of the technical and artistic and spiritual impulses of the age and place (because nothing comparable is found elsewhere); and it embodied these so well, it came to symbolize the cosmology of the times. This is the *Leitmotiv* of the exhibition, and some of the most interesting passages in the catalogue treat of the clock as metaphor, as model of an orderly, mechanistic universe. Here we have once again, but in a deeper sense, the man-made mechanism as *imitatio Creatiois*.

The exhibit itself is so arranged as to convey these multiple aspects of the clockmaker's achievement:

— An entry hall with huge photo-enlargements of timepieces, globes, armillary spheres, clockwork movements, the famous shot of Charlie Chaplin on a turning gear (from the film *Modern Times*).

— A first exhibit room with escapement models to give the nontechnical visitor some idea of how timekeepers keep time. On the wall to the right: quotations pro and con regarding the clock as machine. The philosophers and monarchs of the optimistic centuries (1500—1800) had no trouble with this concept; thus Keppler (1605): „Meine Absicht ist, zu zeigen, daß die himmlische Maschine, nicht wie ein göttliches Lebewesen ist, sondern wie eine Uhr.“ The disenchanting romantics of the 19th century were less comfortable; thus Nietzsche: „Eine essentiell mechanische Welt wäre eine essentiell sinnlose Welt.“ The great Frederick loved the clock metaphor: that's the way he thought the state should work.

But the great feature of this room is the clocks, assembled from a number of countries, and collections public and private. They constitute a fascinating array, roughly contemporary in time but not in mode. Most are complicated, ornate, and enormously costly; a few are simpler and are intended to give some sense of run-of-the-shop work. Some run of the shop! The clocks have been selected primarily for their technical and esthetic interest; but they also shed light on the economics of clock production — the growing division of labor; the collaboration of specialists from different trades; the importation of parts from one city to another, in spite of guild constraints; the production of similar models in numbers, with only a few ornamental details to distinguish one timepiece from another.

It is impossible to mention more than a few of these clocks, by way of example. For the others, the interested reader should try to see them, either in Munich or Washington; barring that, he should purchase the well-illustrated catalogue.

— No. 5. A tower clock of 1469, by Albert Ott. It isn't very different from its Gothic predecessors of two hundred years earlier: all pocked wrought



iron of uneven composition, hence unsuited to fine work; irregular teeth, rough lantern pinions, heavy stone weights to drive the crudely meshing parts, a loud bell filling the hall (*Abb. 2*).

— No. 49. A cubical table clock by Steffen Brenner, Copenhagen, 1558: this was for me the surprise of the exhibit: I had never heard of this clock before, or its maker; but Maurice had (see *Die deutsche Räderuhr*, II, Figs. 222 + 224; *Abb. 1*). It is a wonder. The works are still iron, but iron of a much higher quality — homogeneous, workable; only contrate and crown wheels of brass. The clock has five dials, giving the usual temporal and astronomical indications (one dial is an astrolabe) including length of day and night, plus the movable feasts of the Church. To provide this range of information, Brenner uses the widest variety of mechanical arrangements: angle and worm gears, epicyclic gearing, inside as well as outside teeth. The case is in no way inferior to the works: the architecture is half-a-century ahead of its time; and the engraving, chasing, and casting, splendid.

—No. 52. An experimental clock by Jost Bürgi, the most inventive horologist of the late 16th century (*Abb. 3*): carefully calculated to the last centimeter; made of surgical-quality steel; wheels with hundreds of tiny, extraordinarily regular teeth; fitted with a constant-force device (remontoir) of Bürgi's invention and performing with an accuracy and regularity that far surpassed the work of his contemporaries. The dial, as the illustration in the catalogue shows, is a marvel of fine engraving and is the maker's only major concession to art. Bürgi's plain clock, all business, is one of the few allusions of the exhibition to the coexistence of a radically different contemporary current of horological work and invention: the pursuit of precision, which was to find fulfillment in the 17th century with the invention of the pendulum clock and the balance spring. (Thanks to Hans von Bertele, we now appreciate this extraordinarily gifted Toggenburger, whose genius and inventiveness embraced mechanics, astronomy, and mathematics. See von Bertele, "Precision Timekeeping in the Pre-Huygens Era", *Horological Journal*, XCV, No. 1143 [December 1953], 794—816, and the more recent Ludolf von Mackensen, mit Beiträgen von Hans von Bertele und John H. Leopold, *Die erste Sternwarte Europas mit ihren Instrumenten und Uhren: 400 Jahre Jost Bürgi in Kassel* [Munich 1979]. This book, which is a model of its kind, was published originally as the catalogue of an exhibition "Staatlichen Kunstsammlungen Kassel für das Astronomisch-Physikalische Kabinett" of the Hessisches Landesmuseum.)

From this room the visitor passes into a kind of small theater, where he is treated to the sound of baroque music — partly recorded, partly reconstructed — accompanied by a film of the clocks themselves and the little figures that pretend to blow the notes we hear. A little imagination, a little effort, and one can share something of the delight and astonishment of the courts of long ago.



Then into the next room to see some of these musical and automaton clocks: the lions that move, the dogs that bark, Diana riding a stag, the ship with Turkish crew (everyone armed and on the alert, except for the officers, who are enjoying drinks at a table in the forecastle). Some of these are so similar that we can assume they were made by the same workshop if not from the same molds: specialists manufactured these figures for clockmakers everywhere.

At the end, we have the clockwork models of the heavens, all but one geocentric — marvels of miniaturization and artistic presentation. The mechanisms reproduce the apparent movements of stars and planets with extraordinary accuracy — by means of special gearing, differential spacing of teeth, epicyclic and worm drives. By comparison the clockwork is less impressive: its primary function is not to measure the passage of time but to automate the planetarium-astrarium. Sometimes, as in the Baldewein globe of 1575 (No. 115; *Abb. 4*), the clockwork can be disengaged so that the globe can be turned forward or back; that, after all, is what planetaria are for.

All in all, *Die Welt als Uhr* is testimony not only to a peak moment of man's artistic and technical achievement, but to the virtues of the exhibition as a device for collection, comparison, and communication. Its role in these respects is enhanced enormously by the quality of the catalogue, which at 28 DM at the Museum (higher for the cloth edition, by Callwey of Munich) must be the biggest bargain in horological literature in many years. It offers not only an item-by-item description of the exhibits, but a collection of first-class scholarly articles on the clocks and watches of the period, their manufacture, and their meaning to contemporaries. Again, as with the exhibits, we have time and space here for only a few exemplary contributions:

— Otto Mayr offers a short essay on "Die Uhr als Symbol für Ordnung, Autorität und Determinismus." This brief anticipation of his forthcoming book draws on poetry, political philosophy, and scientific writing to convey the power of the clock metaphor in shaping the working concepts and arguments of the time. A useful, convenient, and congenial figure of speech? Yes, the clock was that; but it was something more: a model to be imitated, a guiding principle, a standard of performance, and always a reminder that life is short.

— Gottfried Mraz, whose essay treats of clocks as a part of the Turkish tribute, necessarily deals at the same time with the role of the tribute in shaping the character and size of the demand for complicated clocks. The essay rests in large part on the manuscript records of the Hofkammer Archiv, and these, the author tells us, are just a part — "*ein verschwindend kleiner Bruchteil*" — of the primary sources bearing on this question.



— Eva Groiss, "Das Augsburger Uhrmacher-Handwerk", is another first-class original contribution. The work rests primarily on the Augsburg municipal archives and constitutes a notable addition to the material already published by Bobinger. In particular, her quantification of the social origins of the clockmakers over a period of two centuries offers precise evidence on a number of questions for which we have thus far had only impressionistic answers: the character and consequence of discriminatory conditions of entry, the effect of residence, the role of religion. The data on the last point are striking enough to warrant repetition here: of 189 (out of 284) masters whose religious affiliation is known, 165, or 87.3 per cent, were Protestant. A reading of Develle's study of the clock- and watchmakers of Blois during the same period seems to show a similar preponderance of *Réformés*, though Develle never assembled his data with any such comparison in mind (E. Develle, *Les horlogers blésois au XVIIe et au XVIIIe siècle* [reprint of 3rd ed.; Nogent-le-Roi: Editions Arts & Metiers 1978]). Groiss does not attempt to say why this predominance of Protestants, beyond referring to the old sociological studies of Max Weber and R. K. Merton. The subject deserves further analysis.

— Finally, Peter Honig provides a mathematical analysis of the fusee, along with reflections on the changes and improvements by clock- and watchmakers over time. Theory and practice were separated by a gulf — fortunately, because the early theoretical analyses were wrong, while the practitioners found the best profiles by trial and error. In the beginning, the makers made their fusees high and narrow; without realizing it, they were using the upper part of the hyperbolic curve, which is more tolerant of error. Only later, from the late 18th century on, did they learn to use the broader, lower part of the curve, in large part in response to the demand for thinner watches. Honig concludes on an ironic note: it is now possible for the first time to unite theory and practice and make ideally-shaped fusees; but almost no one uses the fusee any more.

Thanks to these and the other excellent articles, the catalogue of this exhibition promises to be a standard source for the technical and artistic aspects of renaissance and baroque horology; preferably, though, in conjunction with Maurice's two volumes on *Die deutsche Räderuhr*. These now constitute the basic history of the subject, and the catalogue should be seen as an expansion of and complement to the earlier work. The Maurice study offers a larger set of illustrated examples; and the technical descriptions are more detailed than those in the catalogue, which continually refers back to the earlier source. There is also the question of integration and context: *Die deutsche Räderuhr* offers a rounded history and situates German horology in the larger context of European development over a longer period of time. Much of what appears in the catalogue is understandable only against this larger background.



With these major contributions in hand, what tasks remain on the agenda? Different readers will propose different desiderata. For me, the two areas that could most use further work are the economic and esthetic. The books do little or nothing to integrate this technical and artistic performance into the history of clock- and watchmaking as a branch of industry. The prices of these extraordinary pieces, for example, are given in contemporary currencies: Gulden, rheinische Gulden, Taler; but no effort is made to translate these into one another or into today's moneys. If we had wage data for the clock industry, they would make possible a conversion based on the cost of labor — probably the most useful measuring stick over an interval of hundreds of years. More needs to be done also with the links between the clock and watch industry and other branches of manufacture — with ironmaking, for example, which turned out a superior product and in so doing, made possible the fine work of such makers as Bürgi and Brunner.

Nor do the editors and contributors do much with the links between clocks and other forms of artistic expression. The differences between German clocks and those of other European countries offer analogies to those between German decoration in general and that of other countries. The profusion of ornament, the evident delight in craft skills, the bravura quality of the metal work, to the point where it almost transcends the limitations of the medium — all of this is the expression *in parvo* of the more ornate architectural monuments of the day — St. Peter's in Rome, the cathedral of Santiago de Compostela, the interior of the Theatiner Church in Munich — but with a tendency to profusion that anticipates the south German rococo of the 18th century. In the end, all that decoration cloys, and we have parodies of the earlier splendor: the Augsburg clocks of the late 17th and early 18th centuries (see Maurice, I, 177; II, Figs. 704—8; and 714—17: *altarförmige Uhren*) are examples of excess that signal ossification and the decline of the art form.

In short, the economic and artistic aspects of the industry coincide: the technical conservatism and constraints on entry and innovation correspond to a routinization of ornament that mistakes quantity for quality, fuss for elegance, cleverness for art. This was a dead end. The future of horology lay elsewhere — in the pursuit of precision, in functional instruments, in the elegance of simplicity that found its classic and enduring expression in the timepieces of Breguet at the end of the 18th century. The peacock world of the princes and courtiers — satins, velvets, and laces — gave way to the sober suitings of the bourgeoisie. *Prunk and Pracht* gave way to understatement. But everything is relative, and the very notion of understatement draws its substance from the ebullience of the earlier rhetoric. We are all the richer for it.

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