The Kentucky Review

Volume 11 | Number 2 Article 4

Spring 1992

Designing for Power: Lessons from T.V.A.

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> *The Tennessee River system begins on the worn magnificent crests of the Southern Appalachians, among the earth's older mountains, and the Tennessee River shapes its valley into the form of a boomerang, bowing to its sweep through seven states. Near Knoxville the streams still fresh from the mountains are linked and thence the master stream spreads the valley most richly southward, swims past Chattanooga and bends down into Alabama to roar like blown smoke through the flood-gates of Wilson Dam, to slide becalmed along the crop-cleansed fields of Shiloh, to march due north across the high diminished plains of Tennessee and through Kentucky spreading marshes toward the valley's end where, finally, at the toes of Paducah, in one wide glassy swarm the water stops forward and continuously dies into the Ohio.*

So wrote James Agee in a 1933 *Fortune* magazine article on the Tennessee Valley Authority. Through the poetic economy of a single paragraph, Agee summed up the river's scenographic richness as well as its powerful topography. However, it will take more than one paragraph to sum up T.V.A.'s importance as a paradigm and the lessons its evolution offers; for the paradigm has been made more complex over time and its lessons are many and varied.[1]

Power—in various guises and at many levels—is at the heart of the T.V.A. Most obvious is the fact that T.V.A. owes its conception to the unharnessed power of falling water. This potential energy could, through the use of dams and turbines, generate hydroelectricity, the power of Nature harnessed. There is, also, the political power necessary to overcome the myriad jurisdictions encompassed within the river basin's 41,000 square-mile area that includes portions of the following seven states: Alabama, Georgia, Kentucky, Mississippi, North Carolina, Virginia, and Tennessee. Then, too, there is the military and agricultural power of the nitrates to be manufactured by means of

the generated electrical energy. On the one hand, it is the power of destruction; on the other, it is the power of life. Lastly, there is the power of an idea, in this case the belief that government's proper function is to work for and with the governed to improve the quality of their individual and collective existence, an idea articulated in both the Declaration of Independence and the United States Constitution. It is important to remember this last point, the nature and function of government, because it rests on T.V.A.'s legality. From these same documents derives the argument for T.V.A.'s existence as articulated by Sen. George Norris (1861-1944) of Nebraska[2].

At this point, at least two questions come to mind: first, what was it that sparked in Norris the idea that the Federal Government should undertake a project of such magnitude as the management of the resources of an entire river watershed? And, what was there in Norris's background, if anything, that would suggest such an unprecedented approach (in this country) to problem solving as the marshalling of the resources of an entire nation for the benefit of a particular region of the country?

By way of background, it should be noted that prior to the end of the First World War, the United State government had invested over 100 million dollars at Muscle Shoals, Alabama, on the Tennessee River, to develop facilities for the manufacture of nitrates for munitions, production of which, because of the high temperatures involved, require large quantities of inexpensive electric power. None of these undertakings had been completed when the war ended. With the advent of peace, further construction was (and is) dominated by agriculture, Norris was well aware of another use to which nitrates might be put—fertilizers for farming.[3]

By extrapolation, Norris was innately sympathetic to the conditions facing farmers in the Tennessee River Valley, where ignorance resulted in the *deconsecration* of the soil, the breaking of the covenant man annually makes with Nature, in declining productivity, in erosion, and in deforestation. The result of all of this was a poverty whose impact was both pernicious and pervasive, one that produced a canker on the landscape: an affront to the eye as well as the soul of mankind. The same situation also offered the potential for enlightened intervention.

To Norris, the previous actions of the Federal Government at Muscle Shoals demonstrated a willingness to approach the solution

of problems whose importance was militarily strategic. These same resources, these same energies, this same *force of will* might also be applied to improve the quality of life for the residents of this impoverished area of the country. As a result, the enabling legislation for T.V.A. included three major points: flood control, navigation, and production and marketing of electric power above and beyond that used in the production of nitrates. The key to the success of this enterprise was construction of a series of dams and locks along the river. The dams and locks would control flooding and stabilize the river's depth for navigation. Constructed with turbines, these same dams would generate large amounts of (relatively) inexpensive electricity that could be distributed to rural and farming families. In short, the Federal Government would accomplish what the private sector of the economy had been unwilling or unable to attempt. In addition, many people could be put back to work, a most attractive prospect with the economy lethargic, staggering (in 1933) under unprecedented unemployment and poverty.

As chair of the Senate Committee on Agriculture, Norris worked long and hard to convince Franklin Delano Roosevelt to make the use of Muscle Shoals part of the strategy in his 1932 campaign for the presidency. As a result, shortly after his inauguration, President Roosevelt sent the following letter to Congress recommending creation of the Tennessee Valley Authority:

> The continued idleness of a great national investment in the Tennessee Valley leads me to ask the Congress for legislation necessary to enlist this project in the service of the people.
>
> It is clear that the Muscle Shoals development is but a small part of the potential public usefulness of the entire Tennessee River. Such use, if envisioned in its entirety, transcends more power development: it enters the wide fields of flood control, soil erosion, afforestation, elimination from agricultural use of marginal lands, and distribution and diversification of industry. In short, this power development of war days leads logically to national planning for a complete river watershed involving many States and the future lives and and welfare of millions. It touches and gives life to all forms of human concerns.
>
> I, therefore, suggest to the Congress legislation to create a

> Tennessee Valley Authority—a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise. It should be charged with the broadest duty of planning for the proper use, conservation, and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the Nation. This authority should also be clothed with the necessary power to carry these plans into effect. Its duty should be the rehabilitation of the Muscle Shoals development and the coordination of it with the wider plan.
>
> Many hard lessons have taught us the human waste that results from lack of planning. Here and there a few wise cities and counties have looked ahead and planned. But our Nation has "just grown." It is time to extend planning to a wider field, in this instance comprehending in one great project many States directly concerned with the basin of one of our greatest rivers.
>
> This in a true sense is a return to the spirit and vision of the pioneer. If we are successful here we can march on, step by step, in a like development of other great natural territorial units within our borders.
>
> The White House, April 10, 1933

That the country was in the throes of the Great Depression did not hinder Norris's (or Roosevelt's) chances of success. On many fronts, there were those who believed that capitalism was dead, democratic government impotent, revolution inevitable. With a few others, including the president, Norris's outlook was more sanguine. He believed in the essential strength and rightness of government, in the moral imperatives contained in the preamble to the Constitution where the reasons for establishing government were enumerated as follows:

> . . . to form a more perfect union, establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and posterity. . . .

The traumatized state of the economy in 1933 demanded innovation and action at an unprecedented scale, in unprecedented

ways. A creative and inclusive approach to problem solving at all levels was required, and responsibility for such action had been mandated by the people through the Constitution. Politicians had only to use this power. Roosevelt and Norris acted at once. For the president, the legislation giving rise to T.V.A. would create jobs and put people to work on something of lasting value to the nation. Further, as work progressed, T.V.A.'s highly visible accomplishments would renew the general faith in the government ability to act "to insure domestic tranquility" and "promote the general welfare." Whether Norris or Roosevelt understood it as such, T.V.A. became a means whereby democracy might be preserved in this country, and the first directors seen as keepers of this flame.

Whether inspired or calculated, President Roosevelt's decision to appoint a civil engineer (Arthur E. Morgan, 1878-1975)[4], a lawyer (David Lilienthal, 1899-1981)[5], and an educator (John Harcourt Alexander Morgan, 1867-1950)[6] was fortunate. Their collective education combined agriculture, civil engineering, and law. They were all reform-minded, open to explore new solutions to old problems, able to see possibilities for action where none appeared to exist. Finally, they spoke the language of those whom they were empowered to serve, i.e., the region's populace, or to direct, the requisite bureaucracy of architects, engineers, landscape architects, agronomists, conservationists, archaeologists, and others. Existing conditions and the times demanded that the board of directors interpret their task as broadly as possible; and while never explicitly described as such, theirs became a model of the holistic approach to problem solving.[7]

The term *holistic* was essentially unfamiliar to T.V.A.'s professional staff. For the most part, the individuals assembled to fulfill T.V.A.'s mandate were engineers, pragmatists all, for whom the function of thought was to guide action, for whom truth was preeminently to be tested by the practical consequences of application. In fewer numbers were architects and planners to whom responsibility fell to give physical form and spiritual expression to what were—or might have remained—essentially pragmatic solutions. The work and influence of two individuals, the architect Roland Wank (1898-1970) and the regional planner Benton MacKaye (1879-1975), can be seen to manifest this shift from simple pragmatism to a higher (spiritual) expression; to personify the holistic approach to problem solving at all levels

within T.V.A.; and to be enjoined from producing architectural or planning solutions that served or employed merely decorative or ornamental ends.

Wank was born and grew up in Europe. He was educated at the Academy of Beaux-Arts in Budapest and the Royal Technical University in Bruno, Czechoslovakia. He came under the pervasive influence of Otto Wagner (1841-1918), one of the most important architects in the Austro-Hungarian empire. Through his own work, as well as his numerous publications, Wagner encouraged his students to develop a "modern" expression for new as well as existing building types, now greatly influenced by the full impact of the Industrial Revolution. In the final analysis, however, Wank was more directly influenced, it would seem, by the work of Wagner's students than by Wagner himself.[8]

Just as T.V.A.'s architectural expression is rooted in European Modernism, the same case can be made for its approach to planning. Late in the nineteenth century and very early in the twentieth, the idea of regional planning is anticipated in the work of at least three Europeans: Arturo Soria y Mata (1844-1920) of Spain, Ebenezer Howard (1850-1928) of Great Britain, and Tony Garnier (1869-1949) of France. Contained within their respective works, Soria, Howard, and Garnier articulated the essential intellectual framework and national imperative for an approach to planning transcending both local boundaries, in Howard and Garnier's case, and national boundaries, in Soria's. Independently, and to differing degrees, their work recognized the importance technology and industrialization would have in the determination of regional growth and form.[9]

In this country, an equally important development directly relating to activities in Europe propelled planning to the conceptual scale of the region. The Regional Planning Association was founded in New York in 1923; it was, as one author has described it, "an informal clearing house for new thinking, which incubated many of the land-reclamation and social-development policies later put into effect by the New Deal, such as flood control, rural electrification, and reforestation of logged-over mountain tracts by the Civilian Conservation Corps." Benton MacKaye, a regional planner by intention as well as by instinct, was an early and important member of this association whose ranks also included the urban critic and historian Lewis Mumford.

More than a decade before MacKaye became associated with

T.V.A., in the *Journal of the American Institute of Architects*, he proposed a footpath to run the length of the Appalachian Mountains. Contained in this deceptively simple proposal (published in 1921) were his ideas concerning the necessity for regional planning, for thinking about problems at a scale that precluded political boundaries. In 1928, he published his most important work, *The New Exploration*, in which he presented a most compelling argument for regional planning. Coming as MacKaye's work does just prior to the Great Depression, it anticipates certain changes in attitude toward land development and the role government might play in the preservation and development of the environment.[10]

In retrospect, it seems both fortuitous and logical that MacKaye should be appointed regional planner for the T.V.A. (1934-1936) and that he would hold a similar position in the Rural Electrification Administration (R.E.A.). His analogies in *The New Exploration* examined the "wilderness of industrialization" as if it were a *terra incognita* and applied the same rigorous analysis to its understanding as one would to understanding the ecological balance of a watershed, a forest, or a wetlands. This is due, in part, to his education in forestry and his work for the Forestry Service; and partly it is due to his ability to apply the scientific method to different but related situations. In short, MacKaye was predisposed to thinking about large-scale problems, seeking a pattern or order that related parts to the whole and vice versa, and discovering, or leading out, a physical structure to environmental problems, one capable of solving more problems than it created in its solution.

The approach to solving problems as evolved by T.V.A. was predicated equally on necessity and logic. Dams were located where conditions were most favorable, where physical geography permitted, where the most electricity could be generated, and where raw materials were most conveniently available. What resulted was a careful balancing and integration of many more factors influencing design than simply function or the allowable compressive strength of reinforced concrete. What emerged was a symbiotic relationship between parts and the whole, the only enlightened way to approach the solution of problems at this scale.[11]

The legacy of Wank and the architects and engineers who worked with him is a highly visible one. Dams and locks were

constructed; the river gradually became navigable and flooding less and less a problem; in a few cases, workers formed the nucleus of communities that exist today. Less obvious, though no less profound, is MacKaye's impact as well as that of the planners, foresters, and landscape architects with whom he worked. We cannot see what was; we see only what is: Badly eroded hillsides are now covered with mature stands of timber; muddy streams are clear; fertility has been returned to the soil; an imperceptible restoration of the landscape has replaced the scars and desecration. Too quickly, though, both from within and from without, T.V.A. became engaged in a struggle for power, for primacy over areas of responsibility, for autonomy with a Congress that now feared it had created a bureaucratic monster, responsible to no power but its own, and the balance of necessary purpose and idealism, characteristics of T.V.A.'s original intention, gave way to bureaucratic ennui, or worse, to petty infighting. Born of social necessity and inspired moral suasion, T.V.A.'s history mirrors the changing national will, the movement from populist idealism and intervention to sustaining or maintaining the status quo.

Were one to single out the day external forces moved to expand T.V.A.'s mission beyond the limits governing the actions of its directors, it would be 2 December 1942. On that date in Chicago, a sustained, controlled nuclear reaction was achieved. In retrospect, we can see just how powerful a force this was; and T.V.A. provided the necessary and virtually unlimited electrical energy to manufacture the first A-bomb. While it is true that munitions production was one of the reasons T.V.A. came into being, the atom bomb went well beyond what had been envisioned in the enabling legislation. T.V.A., along with other national resources like industry, manufacturing, and agriculture, joined the war effort. It was a military necessity, and it was socially appropriate: the creation of T.V.A. had helped save the nation from political anarchy during the Great Depression. Now its energy and nitrate production, as well as its demonstrated capacity for problem solving with efficiency and elan, were pressed into preserving the world for democracy.

Having helped release nuclear energy, after the Second World War it was relatively easy for T.V.A. to provide even more electrical power with nuclear reactors, the now well-dammed Tennessee River providing a reliable water supply for cooling the reactors and generating steam from the turbines. However,

T.V.A.'s costly—in many ways and at many levels—dalliance with nuclear power, reflects a national infatuation with an escalating standard of living, continuation of which was predicated on two fantasies:

> —that electric power will always be available in unlimited and inexpensive quantities;
> —and that technology will never be misused or applied beyond appropriate limits.

The fantasy of unlimited and inexpensive electrical energy was abetted by the private power industry, including manufacturers of electrical equipment, whose prophecies of power consumption doubling every decade were largely self-fulfilling. Further, use of electricity was encouraged by the discounted rate given to "all-electric" homes. Such a marketing strategy ignored the efficiency and cost-effectiveness of other energy sources and placed an unrealistic premium on the marketed "convenience" and "cleanliness" of electricity. The second fantasy, that of an always sensible use of technology, is based on a misreading of human hahavior. Technology has been and will continue to be employed for good and evil, both terms being absolute rather than relative. It is important that we remember that morality resides not in technology itself but in the ends to which technology is put, as well as the limits within which technology can be said to operate effectively and appropriately.

These two conditions, effectiveness and appropriateness, are the sticking points in any analysis. They raise two questions. First, is it possible to evaluate whether or not a solution is effective *prior to implementation*—especially if it is a new idea or a new application of an existing idea? And, second, on what basis is appropriateness to be determined? Judged? Evaluated?

However convinced we may be of the essential "rightness" of T.V.A.'s holistic problem-solving approach, one reservation manifests itself. To accept this approach is to accept that it is entirely appropriate for mankind to attempt to drastically reshape the physical environment and to do so for long periods of time. The logical corollary to this assumption is that it is possible for mankind to predict (as well as understand) the consequences, both logical and otherwise, of our interventions into Nature's realm. Even with the use of highly sophisticated computer-generated

models, we remain unconvinced of this "truth." Alas, to harbor such doubts is to call into question T.V.A.'s efficacy as well as the efficacy of any organization charged with undertaking large-scale changes in the environment.

We must, unquestionably, correct environmental ills and protect property. We should, however, assume a more modest stance relative to our expectations and a more inclusive view of the scope of each design problem. The "can do" attitude that saw completion of the Panama Canal and other feats of twentieth-century construction and engineering does not go far enough, nor does it embrace enough factors in its problem statement. Nevertheless, the current governmental requirement that an analysis be made of the environmental impact of a specific project is a welcome and useful step; but it, too, assumes an ability to predict the full consequences of a proposed solution. It assumes that natural conditions are static. They are not. They are dynamic, taking place over very long periods of time, much longer than we can comprehend. Because of this, we human beings will always have a distorted perspective of history and mankind's impact on it. This brings us to the first of T.V.A.'s lessons. As Bill McKibben observed in a recent *New Yorker* article:

> Changes in our world which can affect us can (and do) happen in our lifetime—not just changes like wars, but bigger and more sweeping events. Without recognizing it, we have already stepped over the threshold of such a change. I believe we are at the end of nature . . . [and by nature] I mean a certain set of human ideas about the world and our place in it. But the death of these ideas begins with concrete changes in the reality around us. More and more frequently, these changes will clash with our perceptions, until our sense of nature as external and separate is finally washed away and we see all too clearly what we have done.

Seeing clearly also implies that we understand the "tools" employed to bring about change. One such tool is bureaucracy. What we now understand about all bureaucracies is that once created and implemented, they tend to assume an independent existence. Having realized intended goals, they seek continuance. In fact, at the very moment of achievement, of realization of their intended purpose, they should go out of existence; or at the very

least, they should be examined relative to function and reconstituted for a new purpose. Had such a requirement been followed, quite possiblity T.V.A. could have avoided the ill-starred course that resulted in its attempts to generate electric power from nuclear energy, the now largely abandoned reactors of which serve as hulking reminders of mankind's hubris and a bureaucracy existing beyond its conceptual limits.[12]

But why was this not allowed to happen? By the mid-1950s, twenty years after its birth, having fulfilled its mission, T.V.A. was looking for new challenges; nuclear-generated electric power was that challenge as was its almost equally short-lived interest in passive and active solar heating systems. T.V.A.'s large engineering staff needed such projects to occupy time and justify existence. Divestiture of responsibility for resource management and power generation and distribution was not considered, nor was transforming T.V.A. into a proactive research and development arm of the Federal Government. Had this occurred, the newly created agency might have taken the position of offering at a larger scale what had been provided to residents of the Tennessee River Valley—a demonstrated capacity to solve problems holistically; a better reasoned, integrated balance of needs and natural limits applied to a wide-ranging set of environmental and technological problems.

Rather than expending energy to stem the inevitable obsolescence of its infrastructure, taking the bold step of re-forming itself would place T.V.A. and its problem-solving methodology in ready anticipation of the twenty-first century. T.V.A.'s experience offers the mechanisms whereby this transformation might be accomplished along with recognition of the inherent limits governing such undertakings. To do so would be, as President Roosevelt pointed out in his original message to Congress, a "return to the spirit and vision of the pioneer," for "if we are successful here we can march on, step by step, in a like development of other great natural territorial units within our borders." As Kentucky's Wendell Berry points out in *A Vision*, however, "This is no paradisal dream. Its hardship is its possibility."

NOTES

[1]In my attempt to understand T.V.A.'s value as a problem-solving model, I received insight from what would appear to have been an unlikely source, a German emigré and teacher for whom I acted as a sort of chauffeur while a graduate student. Whereas I had been led to believe that T.V.A. represented simply an attack on free enterprise, Ludwig Hilberseimer, my teacher, suggested that it was an excellent example of planning undertaken at a scale large enough to have had real impact and lasting value, that the T.V.A. model is capable of application elsewhere.

Only later would I learn that the needs of Hilberseimer's appreciation for this approach to problem-solving—at a regional scale—could be found in his European work from the mid-to-late 1920s when he directed planning studies while a member of the Bauhaus faculty. Here he studied urban problems, not in isolation, but as part of a greater whole. As my conversations with him made painfully clear, my ignorance or prejudice—one and the same—limited my ability to see a "thing" for what it truly was rather than as a part of the conventional wisdom I had inherited. While I may not always have lived up to it, this "power of the intellect" is one lesson I have not forgotten.

[2]Norris, a Republican by party affiliation, an independent-populist by moral persuasion, shepherded the enabling legislation through Congress, when it benefited his electoral constituency only very indirectly, if at all.

[3]Having come from midwestern farming stock, Norris's outlook on life embodied the values of those people, i.e., the importance of hard work, the virtue of education, and the necessity to carefully and intelligently husband all resources. Further, Nebraska's light and unpredictable annual rainfall drove home to him the importance of the sensible management of this most necessary resource: water. Files of his correspondence are full of constituents' requests for help in constructing water-retention basins for irrigation; and having known hardship and tragedy at an early age (both his father and his only brother were dead long before Norris reached his maturity), as a youth he became the chief support of his family, acutely aware of the plight of the poor, of the farmer's dependence on the caprices of nature.

[4]Of T.V.A.'s first directors, the educational background and professional experience of Arthur E. Morgan (1878-1975) most clearly suited the responsibilities with which the authority was charged. Under his father's direction, Morgan received his professional training as a civil engineer. After five years of independent practice, in 1907, at the request of the Federal Government, he undertook a series of drainage investigations resulting in a reclamation project for Arkansas's St. Francis River. Similar reclamation projects were undertaken by him in several Gulf states. From 1910 to 1933, he was president of Morgan Engineering, until 1915 located in Memphis, Tennessee, and later in Dayton, Ohio, where after the Dayton flood of 1913, Morgan was largely occupied with designing methods of water control and flood prevention. This was the first project of its type in the United States to employ dams and other water-retention structures for flood control.

Although major water reclamation projects were to be the focus of much of his professional life, Morgan also had an abiding interest in higher education. From 1920 to 1936, he served as president of Antioch College, Yellow Springs, Ohio, where his abilities to think and act creatively were tested in a different venue. In 1933, President Roosevelt appointed Morgan to serve as T.V.A.'s first chairman, a position he occupied until 1938. In this capacity and in cooperation with constituted national, state, and local authorities, Morgan supervised the organization and partial execution of a unified physical, economic, and social development program for the Tennessee River basin.

[5]Educated as an attorney, David Lilienthal (1899-1981) began to practice law in Chicago in 1923, shortly after he was admitted to the Illinois bar. From 1926 to 1931, he was special counsel in utility matters to the city of Chicago. His work attracted the attention of Philip LaFollette, then governor of Wisconsin, who requested that Lilienthal reorganize that state's Railroad Commission. As a public service commissioner, Lilienthal undertook the complete revision of the public utilities statutes. After enactment, these served as a model for similar legislative reform in other states. In 1933, President Roosevelt appointed Lilienthal one of the three original directors of the Tennessee Valley Authority. When his three-year term was over in 1936, he was reappointed to a nine-year term. Pres. Harry Truman appointed him to an additional nine-year term commencing in 1945; and from 1941 to 1946 he was the third chairman of its board of directors.

Shortly before he assumed the chairmanship, the farsighted Lilienthal delivered a speech at the University of California, Berkeley, in which he argued that:

> Time may prove that the greatest value of the T.V.A. to the Nation is as a workable way to avoid the dangers of remote and overcentralized government, as a method of bringing the National Government closer to the people and their regions of America, to give them a greater voice in their National Government.

As an example of the "decentralized administration of centralized authority" of which he spoke, Lilienthal argued that T.V.A. was a public enterprise, operated on business principles, free of undue political influence and patronage. The Authority's Congressional critics, however, wanted T.V.A. to pay to the general treasury its annual revenues ($40,000,000 in 1945), thereby depriving T.V.A. of its ability to function outside direct Congressional control, subjecting its operations, through appropriations, to Congressional review and approval. Had this been accomplished, T.V.A.'s architects, engineers, and planners would have been forced to give political consideration to technical problems such as the location of dams. Lilienthal worked to see that this did not happen. T.V.A. was kept above politics—insofar as that is possible in a democracy such as ours.

[6]No relation to Arthur Morgan, John Harcourt Alexander Morgan (1867-1950), the third director, brought to T.V.A. background and

experience quite different from that of his fellow first directors. Educated in agriculture as an entomologist, in 1889 he was appointed professor of entomology and horticulture at Louisiana State University. In 1905 he moved to Tennessee, becoming professor of zoology and entomology at the University of Tennessee and director of its agricultural experiment station. After 1913, he served as dean of the College of Agriculture; and, in 1919, he was appointed president of the university, a position he held until 1933, when he was appointed to the board of directors of the Tennessee Valley Authority. He succeeded Arthur E. Morgan as second chairman of the Authority in 1938.

[7]Holistic can be taken here to mean the discovery and application of the comprehensive and mutually dependent relationship between parts and wholes. As a problem-solving approach, it is both structural and attitudinal, capable of manifesting itself as an effective and inclusive means of physical expression.

[8]While it is true that much of Wagner's students' work was inspired by the curvilinear lines and forms of the Vienna Secession, in other examples there is a proto-modern quality to their design proposals, an aesthetic inspired by the machine and the use of smooth, relatively unadorned surfaces and simple forms. Two student projects reveal this as well as Wank's ability to synthesize and assimilate the work of others. An untitled sketch, possibly for a memorial, by Josef Plecnik, dated 1899, evokes the synthesis of material and structure characteristic of engineering structures built by the Romans. While Plecnik's sketch does not indicate specific materials, the drawing implies a visually simple construction of arches, battered walls, and piers, all evocative of the plastic and monolithic qualities of *in situ*-reinforced concrete, or of a heavy stone masonry. It is the simple architectonic vocabulary used by Wank and his associated architects and engineers at T.V.A. in the design of Norris as well as other dams.

Another drawing, this one by Mariz Balzarek, dated 1902, for a "Spartan Lodge," a sports complex with a field house, bears striking resemblance to the Union Station railroad terminal, Cincinnati, Ohio (1929-1933), on which Wank worked, having immigrated to the United States in 1924. To span the field house, Balzarek appears to have proposed using a three-hinged arch; and in the end elevation, the space below the arch is subdivided by heavy mullions as is the case with Wank's railroad station. Wank's solution for the principal elevation of Union Station is similar, but there is an important difference between the two structures: Wank's is a semi-dome, the longitudinal section of which is an arch and clearly represented as such in the principal elevation. Balzarek's structure is, presumably, a series of arches arranged to enclose a space longer in one dimension than the other, the spatial typology of a barrel vault. With its extensive trackage and complicated, but well-resolved, circulation, Cincinnati's was the last major railroad terminal constructed in the United States. It was then, and remains, an important modern building. Quite possibly, Wank owed his appointment as T.V.A.'s chief architect to his role in the terminal's design as well as his demonstrated ability to effectively manage and resolve complex architectural and

planning problems and his ability to synthesize and incorporate the best of the work of others.

For more background on Wank, see Marian Moffett's "Looking to the Future: The Architecture of Roland Wank," ARRIS 1 (1989): 5-17.

[9]Soria linked the cities of the past, the historical centers, with one another using railway lines. These vast triangulations form the structure for urban growth because, as Soria reasoned, urbanization would follow the pattern and direction established by transportation networks. Similarly, Howard linked his new communities, whose population was anticipated to be 30,000, with railways which also connected these communities with the larger cities of the past, separated from one another by greenbelts held in perpetuity for use in agriculture, forestry, and recreation. In this sense, Howard's urban structure harkens back to that prevalent in the middle ages when, because of their size and the proximity of places of employment or work to places of residence, cities existed in a symbiotic relationship with their immediate environments, dependent on their locales for essential food supplies and raw materials.

Superficially, Soria's approach, predicated on large-scale transportation networks, and Howard's, predicated on an almost medieval model, appear contradictory. They nevertheless share two important ideas: that a new structure for urbanization would emerge in the twentieth century and that this structure would derive from the tools at hand, specifically the new technology, as represented by railroads, and the possibilities offered by industrialization.

Garnier's work, exhibited in Paris in 1904 but unpublished until 1917, is a clear attempt to design an entire "modern" city, predicated on mass transit, industrialization, and a direct, symbiotic relationship with its environment. Unlike Howard's schematic "diagrams" for the garden city, Garnier's proposal included beautifully rendered designs for virtually every building in his proposed community. Not only do his designs embrace and formally articulate then nascent Modernism, they also present a completeness of vision and understanding of an approach to solving the problems of the contemporary city integral with its region. In a physical sense, Garnier's is a highly accessible model of the holistic approach to planning, one with which both MacKaye and Wank must have been familiar.

[10]Because of the profound impact the Great Depression had on all aspects of life, not just its economic impact, such a change in attitude was clearly accelerated and broadened in scope to include more of this country's intellectual and political leaders than just the few members of the Regional Planning Association to whom the work had been originally directed.

[11]A summary of expenses outlined in T.V.A.'s first "annual" report (6 December 1938) covered operations from 16 June 1933 to 30 June 1938, conveys the magnitude of this undertaking. Fixed assets directly related to T.V.A. since passage of the enabling legislation were $209,000,000. Of this amount, $53,000,000 was for land and reservoir-clearance costs; $70,000,000 for completed dams, including powerhouse equipment; $15,000,000 for transmission and distribution plants; $3,000,000 for

fertilizer plants; $60,000,000 for dams and other projects under construction; and the balance of $8,000,000 for miscellaneous properties consisting of villages, dwellings, and other structures; construction equipment, trucks, and automobiles; office furniture and fixtures; and the cost of preliminary studies and planning applicable to possible future projects. To these add Wilson Dam, the inventories acquired at Muscle Shoals, and Wheeler Lock, and the total amount invested was in excess of $224,000,000.

[12]"Every idea has a right physical size," observed the sculptor Henry Moore. It is also possible that there is a built-in life span to every idea, some ideas being longer-lived than others, recognition of this might bring about a new way of thinking about and structuring human activities.