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TechnOzarks: Essays in Technology, Regional Economy, and Culture

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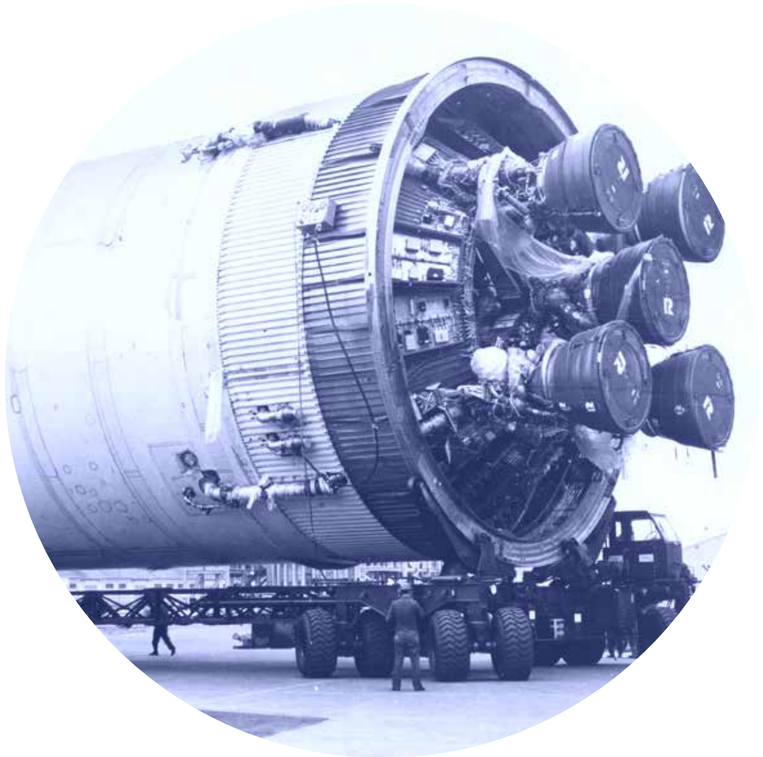

*Techn*Ozarks:

Essays in Technology, Regional Economy, and Culture

Edited
by
Thomas A. Peters
Paul L. Durham

Foreword
by
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President and CEO of the
United Way of the Ozarks

The Ozarks Studies Institute of
Missouri State University
Springfield, Missouri
2019

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Introducing The OSI Publications Series in Ozarks History and Culture

The Ozarks Studies Institute (OSI) of Missouri State University seeks to preserve the heritage of the Ozarks, its culture, environment, and history by fostering a comprehensive knowledge of Ozarks' peoples, places, characteristics, and dynamics. The Institute promotes a sense of place for residents and visitors alike and serves as an educational resource by collecting existing—and discovering new—knowledge about the Ozarks and by providing access to that knowledge.

Following *Living Ozarks: The Ecology and Culture of a Natural Place* (2018), *Techn*Ozarks is the second volume in the OSI series. Along with its companion journal, *OzarksWatch*, the series aims "to introduce the Ozarks to the world," and vice versa.

What readers have said of the first volume, *Living Ozarks:*

> Authors in this anthology are aware of tourism's fantasies that overlay geology's reality and that the Ozarks' fragile natural landscape requires stewardship. We know that the environment shapes all creatures that live within it, including us. We must be prepared to address our presence as part of the natural—what is the cost to absorb our footprint?
>
> —Lynn Morrow, editor, *Ozarks in Missouri History: Discoveries in an American Region*

> Any discussion of sustainability in the Ozarks must involve not only the natural environment, but also elements not commonly thought of as natural resources: the history, the heritage, and the people. These are key elements that make this region unique and attractive to outsiders and tourists and give the Ozarks its unique identity. *Living Ozarks: The Ecology and Culture of a Natural Place* brings this point home in a decisive and definitive work.
>
> —Paul W. Johns, author, *Unto These Hills: True Tales of the Ozarks*

OZARKS STUDIES INSTITUTE

Inventing the Ozarks (I):

On the Confluence of Technology, Regional Economy, and Culture

James S. Baumlin

In his *Journal of a Tour into the Interior of Missouri and Arkansaw* (1821), Henry R. Schoolcraft—the region's first English-speaking "tourist"—records his impressions of Finley Creek and the environs south of modern-day Springfield. His diary entry for January 4, 1819 follows:

> The prairies, which commence at the distance of a mile west of this river, are the most extensive, rich, and beautiful, of any which I have ever seen west of the Mississippi river.... The lands consist of a rich black alluvial soil, apparently deep, and calculated for corn, flax, and hemp. The river-banks are skirted with cane,... and the lands rise gently from the river for a mile, terminating in highlands, without bluffs, with a handsome growth of hickory and oak.... Taking these circumstances into view, with the fertility and extent of soil, its advantages for water-carriage, and other objects, among which its mines deserve to be noticed, *it offers great attractions to enterprising emigrants*, and particularly to such as may consider great prospective advantages an equivalent for the dangers and privations of a frontier settlement. The junction of Findley's Fork [*sic*] with James' River, a high, rich point of land, *is an eligible spot for a town*, and the erection of a new county ... would soon give the settlers the advantages elsewhere enjoyed in civil communities.... A water communication exists with the Mississippi. Steamboats may ascend White River to the mouth of its Great North Fork. Keelboats of twenty tons burthen may, during the greater part of the year, ascend to the mouth of James' River; and boats of eight tons burthen may ascend that to the junction of Findley's Fork,... to which the navigation may be continued in smaller boats, thus establishing a communication by which the peltries, the lead, and the agricultural products of the country, could be easily, cheaply, and at all seasons, taken to market, and merchandize brought up in return. (pp. 58-59; emphasis added)

Like most tourists or "prospectors" of his age, Schoolcraft sees the present *but looks to the future*. Resources—mineral, wildlife, and agricultural especially—when matched with adequate transportation, conspire to make this "an eligible spot for a town, and the erection of a new county." *There was money to be made* by those "enterprising emigrants" who'd be willing to endure "the dangers and privations of a frontier settlement." Equally important, their collective work would transform wilderness into a "civil communit[y]," a place where the amenities of culture and the good life could be pursued. I'm willing to declare Schoolcraft's *Journal* the region's first piece of published Ozarks "boosterism." I'd also declare Schoolcraft's predictions, made 200 years ago, to have proved true.

The following is an essay in the history of a place *and an idea*: specifically, of technological innovation and its role in creating a progressive, future-oriented "booster" image for early Springfield and the Ozarks. In recent years, historians have focused on the region's economy and politics; on its shifting demographics; on ecology and shifting practices in land-use; on industry—agriculture, mining, and manufacture—and on technologies under discussion here: the railroad (arriving in 1870), the automobile (in 1901), and radio broadcast (in 1921).[3] From the start, let me state that this is *not* a local history of the railroad *per se*, or of the motorcar, or of radio telecommunication; it is, rather, an exploration of attitudes and aspirations of Springfield *as a town* and of the Ozarks *as a region* whose growth rested in the possession and exploitation of such technologies as these.

"The booster spirit was strong in Springfield," writes Charles K. Piehl of the decades following the Civil War (p. 89). The first big "boost" came in 1870, when the region's "bright and happy future, the subject of our wishes for many long years,... arrived" with the railroad.[4] A second boost or "boom" came in 1887, when Springfield merged with "New Town" or North Springfield. As the August 19, 1887 issue of the *Springfield Daily Leader* reads, the newly consolidated town "booms and booms and keeps on booming. It is a perpetual motion boom." This booster-boomer spirit lasted well into the 20th century; arguably, vestiges of it remain to this day.

Though the Chamber of Commerce organized in 1919, prominent businessmen had long supported "the Springfield Club" and the northside "Commercial Club." By these and other "business fraternities," boosters sought to attract outside investment and settlement through the promise of cheap land, civic order, scenic beauty, and urbane culture.[5] Natural resources abounded; needful were the tools to extract, refine, transport, and sell the same. Enter the technologies—trains, autos, radios—that promised a healthful, prosperous, comfortable Ozarks lifestyle. In his article, "The Small City in American History," Timothy R. Mahoney distinguishes towns from small cities from major metropolises, particularly as these evolved in the Middle West.[6] Typical of the small town, Mahoney notes, "is that at one time, many, if not most, of its citizens imagined themselves to be living in a 'future metropolis' or at least a significant regional center" (p. 316), the economy and culture of such towns having been "constructed within the framework of a 'booster ethos'" (Mahoney, p. 316):

> In towns across the country a predominantly American-born middle-class elite articulated

3. See Lynn Morrow and Linda Myers-Phinney, *Shepherd of the Hills Country: Tourism Transforms the Ozarks, 1880-1930s*, and Brooks Blevins, *A History of the Ozarks, Volume 1: The Old Ozarks*. See also essays gathered in several collections: Lynn Morrow, *The Ozarks in Missouri History: Discoveries in an American Region*; Stephen L. McIntyre, *Springfield's Urban Histories: Essays on the Queen City of the Missouri Ozarks*; and William B. Edgar, Rachel M. Besara, and James S. Baumlin, *Living Ozarks: The Ecology and Culture of a Natural Place*.

4. "Speech of Hon. John S. Phelps," from *Opening of the Atlantic and Pacific Railroad* (p. 8). For discussion of the arrival of the railroad and the rivalry between "Old Town" and North Springfield, see Piehl's "Race of Improvement: Springfield Society, 1865–1881," in Morrow (pp. 71-100).

I take this opportunity to thank colleagues Craig A. Meyer, Elaine Stuart, Lynn Morrow, and Cathie English for help in improving early versions of this essay.

5. "I believe that a man should be proud of the city in which he lives and that he should so live that the city will be proud he lives in it." This anonymous quote stands on the back page of the Chamber's first official publication, *Springfield Greets You* (1919). We can take it as the Chamber's boosterish civic motto.

6. "In the urban history of the United States," writes Mahoney, "two predominant narratives have emerged: that of the metropolis and that of the small town" (p. 314). He continues:

> The former is the story of regional and national centers of economic development that enjoyed steady, even rapid, growth and became focal points of the emergence of the modern nation. The latter is the story of local or regional centers that played peripheral, secondary, or reactive roles in the national economy.... What is missing, of course, is a story line for those urban places in between the small town and the metropolis: small cities of America. (pp. 314-15)

From the Civil War through the Second World War, Springfield fit fairly neatly into the small-town economy and ethos, as Mahoney describes it. After World War II, Springfield evolved into one of those "small cities of America," making for new opportunities and challenges (some of which will be described below).

> a local boosterism. According to this view one achieved success in work and enjoyed the satisfactions of family life through self-control, hard work, and religious faith. Middle-class citizens built a successful town by developing the town economy, establishing a system of law and order, founding institutions, creating a civic life, and formulating booster policy. (p. 316)

In Springfield from the 1870s and 1880s through the 1920s, Mahoney's description is spot-on: for, "at the core" of its booster ethos "was a strong entrepreneurial impetus that distinguished most towns in the Midwest from those in the upland South and New England" (p. 317). This ethos is on full display in *A Booming City* (1887), a pamphlet published by the local real estate firm, Lapham and Bro. Though its "commercial importance" came "by slow stages, covering a generation," Springfield "awoke a few mornings since, to find itself confronted by that young Samson of the West, the 'Boom,' which, with his magic wand, *makes towns of villages and cities of towns*" (p. 8; emphasis added).

Within this booster-boomer ethos resided an optimism over the future that Springfieldians pursued, not just as businessmen but as entrepreneurs—investors speculating in land, industry, and technology. The local newspapers spurred inventors on, reporting on their innovations and calling for more; booster advertisers spread the word, "letting the world know that Springfield is up and coming—not going or standing still" (January 19, 1927 *Leader and Press*). In its practice of entrepreneurship, the Ozarks yoked economy, ecology, technology, and culture together. Exploitable resources proved the region's great attraction: Enter the entrepreneur. Geographic isolation (caused by the daunting terrain) proved the region's great challenge: Enter technology—specifically, the innovations in manufacture and transport that would bring regionally produced goods to markets state- and nationwide.[7] In local history, the inventor needed the investor, and *vice versa*. With every innovation in transport, communication, or manufacture, *someone* had to buy it, bring it to Springfield, and adapt it to local conditions. Springfield's booster ethos enabled this synergy by uniting capital and labor, exploiting the regional ecology while growing the regional economy.

Before automated assembly lines and prefabricated components, most items of local manufacture were assembled manually from machine-tooled parts. If an engine or some item broke, it would be repaired in a local shop by skilled labor. Parts might be tooled on site and the item rebuilt—and even, perhaps, "improved" by some adjustment, however minor. In this manner, as Pagan Kennedy notes, the local factory "turned workmen into inventors" (*Inventology*, p. 5). Tools and technologies that served in one terrain underperformed or broke down in another. Local conditions—the difficulty of transport particularly—made practical problem-solving part of one's job. A survey of patents registered to Springfieldians from the 1870s through the mid-1920s shows that most were transportation- or work-related, aimed at improving safety, speed, and efficiency, reducing costs, or increasing profits.

So, while future-oriented boosterism remains an abiding theme, local innovation provides its twin thesis: The region's achievements follow predictable patterns in what might be called entrepreneurial technoculture. Local industries faced local problems tied to local conditions of terrain that demanded local solutions. While Springfieldians innovated for health, hearth, and home—medicines, clothing, cookware, stoves, and other domestic items were registered with the U.S. Patent Office—most innovations served industry (mining and agriculture especially), power supply, and transportation (the railroad and, by the 1910s, the automobile). At the time, these were "emerging technologies" of national import. From the turn of the 20th century to the Great Depression, Springfield enjoyed decades of industrial/mechanical/technological innovation. The twin themes of boosterism and entrepreneurship played their part in creating a distinctively modern Springfield: that is, an urbanized, industrialized Springfield whose Ozarks hinterland provided resources and markets as well as recreation. Though this present survey takes 1929 as an endpoint, the booster-boomer promise of future prosperity was fulfilled, in large part, by Springfield's growth through the latter half of the 20th century.

It's worth asking whether Springfield of the 2020s will prove as innovative, in its own way, as Springfield of the 1920s. Futuristic in their time, the "big machines" of previous decades yield to today's nanotechnologies, which are carrying us headlong into the "digital futures" of 21st century technoculture. Does the region's need to attract new entrepreneurs return us to boosterism? The question is worth asking, though it's not yet time to answer. We need first to finish outlining the thesis and underlying technocultural assumptions, not just of this present essay, but of the volume it serves to introduce.

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> We are not here to dwell on the past—we are to consider the present and the future.
>
> —"Speech of Hon. John S. Phelps," from *Opening of the Atlantic and Pacific Railroad, and Completion of the Southwest Pacific Rairoad to Springfield, Mo.* (1870)

> Technology in the modern episteme is meant to bring the future under human control.
>
> —J. Macgregor Wise, *Exploring Technology and Social Space* (1997)

In *Living Ozarks*—first of the OSI Publications Series in Ozarks History and Culture—the focus lay in intersections of culture and ecology: in the role that nature (in its rich resources of land, water, and wildlife) has played in creating, and sustaining, the Ozarks as we experience it today. In this second volume, *Techn*-Ozarks, the focus lies in intersections of culture and technology: in the role that innovation (in agriculture, transportation, communication, and commerce) has played *in building* the Ozarks, adjusting its tools and industries to the region's unique features (and, in the process, reshaping its landscape). We have learned to enjoy the land and conserve its resources; such was the message of *Living Ozarks*. We continue to learn how to use the land and its resources wisely; such is a message of *Techn*Ozarks.

What is "the Ozarks," as explored in this present anthology? Increasingly urbanized; no longer isolated geographically; having brought some natural

7. We need to remember the 210 miles separating Springfield from St. Louis; the 155 miles separating Springfield from Kansas City; the 195 miles separating Springfield from Tulsa; the 260 miles separating Springfield from Wichita; and the 295 miles separating Springfield from Memphis. Even as railways arrived from each compass point, the region remained in relative isolation, given these distances. If a train broke down or needed service, it would be fixed here, with parts at hand. One cannot overstate the innovative energies of "the Frisco" and other local machine shops: As their engineers and machinists proved time and again, necessity is the "mother of invention."

After the railroad came the automobile; but it, too, was hampered by terrain. Begun for bicycles and taken up by the automobile, the national Good Road Movement made crawling progress through southwest Missouri: From the 1870s through the 1920s, Ozarks roadways were notoriously bad. Writing in 1915, Jonathan Fairbanks and Clyde Edwin Tuck see little improvement from pioneer days:

> If the reader will take a map of Missouri, and trace the route of that little caravan of pioneers, he will find that they covered probably 250 miles of the roughest hill country in the Ozarks, a route which even today, with all the improvements in roads and bridges that have been made in eighty-four years, would put any automobile on wheels out of business. (p. 685)

resources (mining, logging) to near-exhaustion while expanding to newer, "renewable" sources (hydroelectricity, solar- and wind-power); having survived the transition from a primarily production-based to a service-based economy; seeking its share in an expanding global market whose prized commodity is *not* mined or grown or manufactured goods, but is *information*. Such describes the current state of the Ozarks generally, and of Springfield in particular. *Techn*Ozarks offers essays in the history of innovations that have built the Ozarks into a vibrant culture and economy. *Techn*Ozarks also—in the spirit of the region's first English-speaking explorer, Henry R. Schoolcraft—aims to see the future already contained, in germ, in the present.

The future poses its challenges; we can name several already. Will a fully modernized, globalized Ozarks lose its character as a unique "natural" environment, a place of healthful recreation and refuge? (When climate change takes its seemingly inevitable toll, will we have kept a sufficient supply of water and arable land?) Will Ozarkians celebrate, or lament, the region's assimilation into the global economy and, by extension, into the "global village"? (As time and space continue to shrink, will events occurring "around the world" and "around the block" affect us equally?) These and other challenges are posed as questions whose probing belongs not to science or technology alone, nor to business or government, but to an informed citizenship whose future health and prosperity lie in the balance. And it is, indeed, the Ozarks' future that we seek, in that "technology," as J. Macgregor Wise tells us, "is meant to bring the future under human control."

In saying that the Ozarks today is transiting from a "modern" to a "postmodern" culture and economy, we're compelled to police our terms, starting with modernism. What does that mean or entail? In hazarding an answer, we look to four markers of modernity, each implicated in technology. A "modern" Ozarks is *urbanized*, with housing, businesses, entertainments, workplaces, schools, government offices, and other services concentrated into major city centers encircled by suburbs and exurbs; it is *industrialized*, connected to (and participating in) a regional, national, global production-economy; it is integrated into *networks of transportation* carrying goods (and people) quickly and efficiently across expanses of land and sea and air; and it is integrated into *networks of communication* carrying information accurately and instantaneously across the globe. Though the region remains primarily rural, its natural resources in land, water, agriculture, and minerals have long been exploited: grown and harvested, extracted, refined, machined, packaged, shipped, and traded. And there's a further resource upon which a modernized Ozarks depends: Beyond production and transportation of goods, the region's development rests in an abundant, accessible *supply of energy*. Out of these markers—urbanization, industrialization, transportation, and communication, with energy as an underlying resource—our modernized version of the Ozarks has been "built."

Geographically, the Ozarks describes a place on a map with defining features of topography; geologically, the Ozarks has its distinctive features above and below ground; ecologically, the Ozarks has its flora and fauna, though these have changed over time through human intervention; ethnographically, the Ozarks has seen its share of displacements and migrations. As an inhabited space, the region's greatest changes have come through technology: that is, through industries and machines and tools and techniques (and the socialized/institutionalized knowledge of their uses) that have transformed the landscape. Driven by technology, the Ozarks has turned from "wilderness" to "pioneer settlement" to "timberland and mining land" to "vacation land." This last development—a.k.a. the tourism industry—remains

central to the region's self-promotion today. To many outsiders, the Ozarks is sold as a nostalgic image, an old-time Hill Country marked by lakeside condos, rentable bass boats, and commodified pop culture, Branson style. For most Ozarkians, the situation "on the ground" is more complex. While capital wealth and trained labor concentrate in urban centers, many of the region's historic smaller towns (often premised on single industries: mining, logging, livestock, textile and clothing manufacture, etc.) have fallen on hard times. Agribusiness has largely replaced the rural subsistence farming that, for more than a century, sustained families on smallish plots of land. But industry, economy, ecology, and culture intertwine: Where any one of these goes into decline, the rest suffer.

A vast literature has grown around the history and sociology of technoscience.[8] Compared to this literature, ours is a pencil sketch of the technologies that have shaped, and will continue to shape, the Ozarks in its economy, ecology, and culture. We lack space to explore adequately the ways that technology commands each aspect of contemporary life, down to the very definition of our humanness. (Are we the masters or servants of technology? Has technology and its "built spaces" replaced nature as our *habitus* or dwelling place?) For now, we're content to focus on the markers of modernity described above—that is, on energy supply, communication, transportation, industrialization, and urbanization—and on the roles these have played in "boosting" Springfield and the Ozarks, building the region into its current recognizable form.

1. The Iron Horse Arrives

On May 3, 1870, the railroad had at last arrived in a depot north of Springfield, carrying dignitaries from St. Louis, Jefferson City, and other points along the way. Disembarking to cheering crowds, cannons firing, and "flags fluttering in the breeze," they spent the day celebrating and speechifying. First to speak was Springfieldian and future Missouri governor, John S. Phelps (1814-1886):[9]

> Many of you perhaps have had business relations for years with some of the people of this city … yet, as this is your first visit to our beautiful country, you can hardly appreciate the difficulties under which we have labored without an easy and expeditious connection with the other portions of the State. We were almost in an isolated condition; access to our country could only be obtained by days of tiresome and weary travel over rough and rugged roads, and through a hilly and mountainous country, whilst for years you have been in the enjoyment of railroad communication. (pp. 7-8)

Such were the region's past circumstances, dictated by terrain. As for the future, it had just arrived—by train:

8. See, for example, the rich gathering of materials in David M. Kaplan's *Readings in the Philosophy of Technology* (2009). Though this present essay ends by questioning the social, political, and ethical implications of contemporary technoscience, my approach remains social-constructionist: a fancy phrase, but not too difficult to apply. The social-constructionist model assumes a two-way street between material technology and human society. Within the social-constructionist model, writes Kaplan, "society simultaneously shapes technology as technology shapes society" (p. xviii). He explains:

> Far from being applied science, technology on this model is more like *embodied humanity*. Technologies are part human, part material, and always social.... The advantage of viewing technology in this way is that it calls attention to the way that humanity, technology, and the environment are bound up together in a relationship of mutual constitution. (Kaplan, p. xviii; emphasis in original)

9. I quote from the commemorative pamphlet, *Opening of the Atlantic and Pacific Railroad, and Completion of the Southwest Pacific Railroad to Springfield, Mo., May 3, 1870*. The title page gives "Springfield / 1870" as the place and date but lists no author or press. The Southwest Printing Office of North Springfield—publisher of *The Springfield Republican*—is a likely local candidate, with the railroad serving as underwriter.

> Everything which can be produced in the United States can here be produced in superabundance, except the ice of Alaska, the cotton and rice of Carolina, and the tropic fruits of Florida.... The bright and happy future, the subject of our wishes for many long years, has just arrived upon us. No longer shall we be compelled to travel by stage on bad and dangerous roads, over a broken, hilly and mountainous country, to reach the commercial emporium of our State.... [A]nd though I have spoken of hills and mountains between this city and St. Louis as objects we dreaded in our journey, yet those hills and mountains are rich in minerals, and will soon greatly contribute to swell the volume of wealth of our State. (pp. 8-9)

Phelps overstates the region's "superabundance," but he was right about the role of rail transport.[10]

The epoch of modernism begins with mechanized production—a.k.a. "the Industrial Revolution," which (as we've all been taught) began in coal- and iron-rich England in the 18th century and, crossing the Atlantic, exploded through Yankee ingenuity and entrepreneurship, moving steadily westward across the North American continent as rivers and railroads allowed. Its slowed arrival into the Ozarks—lamented by Phelps, above—is explained by the lack of efficient transport, whether by river or by rail. During its pioneer days, amenities of modern culture dribbled into rather than flooded the Ozarks; how quickly things changed can be gauged by a report in *The Springfield Daily Leader* for May 26, 1870, some three weeks after the formal opening of the depot of the Southwest Pacific Railroad on Commercial Street in that "new town" to the north of old Springfield:

> Boonville Street, from early morning to late in the evening, is crowded its entire length with wagons and teams hauling goods from the depot. In their new relation to the markets of the country, our merchants are no longer kept "waiting for the wagon." Goods that were formerly from ten days to three weeks in transit from St. Louis now arrive in twenty-four hours.... Our merchants ... can now largely increase their stocks on the capital invested, and assort their stocks to please customers. There is no longer danger of goods becoming old and unsalable on their hands. Country merchants coming in find the stocks in our market all that they could wish,... and when we take into consideration that goods of all descriptions are offered at St. Louis prices,... we cannot see why any should go beyond us for their supplies.

No longer a group of pioneers "waiting for the wagon" to bring in goods, the townspeople became suppliers to the larger Ozarks region. By this report, the railroad transformed both Springfields, the "old town" and the "new" together.[11]

10. While repeating the typical futurist tropes, the rest of Phelps's speech is remarkable in calling for global commerce and immigration. The laying of tracks, he knew, would continue south to the Gulf and west to the Pacific:

> But let us remember that we are seeking to extend and enlarge our commerce with China, Japan, and the East India trade which is rapidly increasing. As our business relations with the people of China and Japan shall become more extended, these nations, with their abundant population, will furnish many emigrants to this country. And why shall they not come among us, if they shall desire to do so?... Why shall they not, by their industry, add to the wealth of this nation; and why shall they not become citizens, if such shall be their wish? Shall we repel laborers from coming amongst us? We say let them come.... (p. 13; emphasis added)

Now *that*'s globalism, expressed in 1870s Springfield.

11. Indeed, much of the story of post-Civil War Springfield revolves around iron rails, beginning with the building of two separate, incorporated towns: "Old town" Springfield, whose town square (intersected by Boonville-South Street and College Street-St. Louis) served as its business center, and "new town" North Springfield, centered around Commercial Street. In 1878, a second track located on Main Street (just north of the town square) brought the St. Louis-San Francisco Railroad into downtown Springfield. Though fierce cultural-economic rivals at first, the two towns merged in 1887.

Here's the point: Transportation technology—here, the placement of railroad tracks—shaped the city's map-grid as we know it today. Road construction has continued this gridwork, cutting and dividing (and defining) neighborhoods, shopping and entertainment districts, industrial zones, and so on.

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> Many appellations have been applied to the present epoch ... such as the electric or steam age; none of the terms, it seems, being broad enough. But if we should christen it the age of invention, we would evidently not go far amiss.... If we look at the far-reaching effects of the inventions of only a few such wizards as Edison, Tesla, Bell, and Maxim, we would see the appropriateness of the last-named phrase to this the greatest age since the dawn of the world's history.
>
> —Jonathan Fairbanks and Clyde Edwin Tuck, *Past and Present of Greene County, Missouri* (1915)

In the epigraph above, Fairbanks and Tuck offer to christen their own "present epoch" as "the age of invention." And rightly so. But even as they list the age's great inventors—Edison, Tesla, Bell—they give credit to those lesser-known names who, "by mere commonplace hard work," have improved the lives and labor of their fellows. These include inhabitants of the Ozarks:

> Here and there, in every civilized nation may be found someone ... who has by his genius or talent or, perchance, by merely commonplace hard work, produced some device that has lightened or facilitated man's work, and therefore added his little quota to the great aggregate force that is lifting from humanity's shoulders "the burden of the world." (p. 1923)

This description holds for the region's early inventors: In the main, they were farmers, shop men, and machinists—laborers who, by "some device" of their own making, sought to lighten or facilitate their own daily labor. In celebrating the lives of Greene Countians, Fairbanks and Tuck singled out these sorts of men.

Thus far, we've considered what the train did for Springfield; reversing the terms, we can consider *what Springfieldians did for the train*—and for other technologies. Just as the railroad demanded its accommodations of terrain, so the local technologies of farming, mining, logging, and rail-less transport demanded their own adaptations. Local newspapers took pride in reporting on inventors and their innovations. A survey of inventions from the 1870s through the 1920s attests to the interrelatedness of local needs and available technologies. The rocky, root-riven Ozarks soil put farmers and their implements to the test: Tired of repairing broken coulters and ploughshares, back-sore from piling up rocks and pulling out stumps manually, the region's farmers began improvising.[12] All forms of transport were studied, but rail received the most attention, leading to local innovations in ground-leveling and the laying of track; in strengthening car couplers for train safety; and in improving tools and techniques to make engine maintenance/repair quicker, safer, and more efficient.[13] These were developed by

12. Writing in 1915, Fairbanks and Tuck note the evolution of regional agriculture and technology:

> In pioneer days when farming implements and machinery were of the crudest kind, requiring a goodly supply of both muscle and grit,... brawn, more than brains, was needed ... in order to rescue the fertile soils from the wilderness of forest and prairie growth. In these modern days of worn and worn-out soils and the abandoned farm, with the most improved labor-saving farm machinery, the business of farming needs brains more than brawn, that our soils may be rescued from the wilderness and desert or wasted fertility that has stifled and depleted them. (p. 1002; emphasis added)

13. In surveying patent records for the years 1870 through 1929, I'd

the railroad employees themselves. It was their own daily labor that they sought to make quicker, safer, less repetitive, and more efficient: They saw a need, took the materials at hand, and adapted them to local conditions.

Today's innovator-entrepreneur tends to look beyond "merely local" needs, applications, and markets. Still, the problem-solving model remains more or less unchanged. In today's parlance, might we call Springfield Wagon Company the region's first successful "startup"? From 1872 to its closing in 1951, the company's innovations in manufacturing wheel hubs and related components allowed its wagons to conquer the rugged Ozarks fields and roads. After dominating markets in Missouri, Arkansas, Texas, and Oklahoma, Springfield Wagon came to monopolize this aspect of rural rail-less transport, becoming sole provider to the U.S. Army. By 1925, virtually all wagons produced commercially in the United States were produced by the Springfield Wagon Company. But, while impressive in themselves, the Wagon Company's successes were overshadowed by the individual achievements of its co-founders and early shareholders—F. J. Underwood and H. F. Fellows above all.

Singlehandedly, Flavius J. Underwood (1831-1914) "secured about twenty patents," note Fairbanks and Tuck:

> [H]e built the first successful two-horse cultivator, which has revolutionized agricultural work, especially in the corn producing states. He enjoys the distinction of being the first person to advocate and demonstrate the circulation of steam for the purpose of heating buildings, which method is now so universally employed. Among his many inventions is a coal chute which he patented in 1904 and which is widely used. He believes his best invention is a machine for boring out hubs in which to insert boxes. (p. 1083)

While the last item above pertains to wagons, his other inventions served other purposes: tool manufacture, home heating, and farming. In fact, Underwood's body of work demonstrates the regional interconnectedness of industrial agriculture, tool manufacture, and efficient rural transportation. And though his inventions were used nationwide, each supplied a local need or solved a local problem—for which reason "his name," declare Fairbanks and Tuck, "is deserving of a high place among the successful inventors of his day" (p. 1083).

If Underwood represents the entrepreneur-inventor, Homer F. Fellows (1831-1894) represents the business-entrepreneur who anticipated—and promoted, purchased, invested in, or managed—virtually every "emerging technology" of his lifetime, bringing them to Springfield. In 1859, "he was one of the stockholders of the first telegraph line through Springfield" (Fairbanks and Tuck, p. 1366). He also "built the first telephone line that came into Springfield,... which connected his office and residence" (p. 1366). In 1870, he was among the first to open business in North Springfield. In 1871, he built Springfield's first grain elevator. During the Panic of 1873, he rescued Springfield Wagon from bankruptcy "and remained manager of the wagon factory the rest of his life" (p. 1367). In 1881, he was "the chief promoter of the Springfield street railway system" (p. 1366), serving for years as company president. He was a chief shareholder in "the Kansas City, Ft. Scott & Memphis railroad, which was made a part of the Frisco System in 1900" (p. 1367). And "he was one of the organizers of the Springfield Water Works" (p. 1367), serving for years as its president. Twice elected mayor, he was a longtime member of the school board. Upon his passing, he was properly eulogized. As Homer Barlow Stevens writes,

> Homer F. Fellows was an esteemed and valued citizen—public-spirited, strong in courage, clear in judgement, unimpeachable in character, and faithful to every trust reposed in him.... His character as a man of enterprise and genius is quite apparent. He was broad in his conceptions as he was upright in his methods. He was a public benefactor, the results of whose life have been a prominent factor in the development of this city and community .... (p. 312)

The words "public" and "citizen" resonate in the passage above. Together, they embody the American Midwest "booster ethos," as Mahoney describes it: "Citizens" like Fellows "built a successful town by developing the town economy,... founding institutions, creating a civic life, and formulating booster policy" (p. 316). Fellows was lionized in his lifetime, not for creating private wealth, but for creating "a city and community." As a business-entrepreneur, the "innovation" to which he made real contributions was Springfield itself.

2. Cars and Roads

Fellows' wagons were custom-made for the Ozarks terrain; nonetheless, the challenge of rail-less transport *lay beneath*, not upon or above, the wagon's wheels. By the turn of the 20th century, iron rails had tamed the region in part; where trains could not reach, one still relied "on bad and dangerous roads," as Phelps described them, roads that traversed "a broken, hilly and mountainous country." Invention had its incentives: "Invent it and you are wealthy for life," declares an article in the October 9, 1908 *News-Leader*. And that "it," for which "the wealth of a Rothschild is waiting," was "the invention of a satisfactory paving material." One might note that tarmacadam—a paving mixture of petroleum-based asphalt and sand—had been put into mass production just the year prior. But the surfacing material was difficult to transport and had yet to reach southwest Missouri. Besides, the article's author lacks vision of the future use of road surfacing, as his follow-up sentence suggests:

> At present what is good for the wheels is bad for the hoofs, and vice versa. That is to say, where the road is smooth and the wheels run easily there is no grip for the hoofs; and where it is rough the vehicle is hard to drag.... What is wanted is a smooth, hard, absorbent surface, with at the same time the perfect grip.

Today's inventologist might point to the author's "design fixation" (Kennedy, p. 246), which cannot see beyond the horse-drawn carriage. It's for a *horseless* carriage—the automobile—that the Ozarks' roads would eventually be improved.[14]

estimate that some 300 were registered to addresses in Springfield, Missouri (Annual Reports for the years 1872-1876 and 1926-1929 are unavailable online.)

The forty-eight patents in agriculture included a harvester-rake (1870); a cultivator (1878); a hand corn-planter (1879); a hedge trimmer (1880); a horse hay-rake (1882); a combined plow and harrow (1884); a wire and-picket-fence-making machine (1888); a post-driver (1891); a hand planter (1900); and a machine for cultivating orchards (1901).

Of the ninety-four patents in transportation, the following brief selection served the railroad: a train chimney (1870); a clamp to hold ratchet drills for drilling railway rails (1877); a car-coupler (1883); a railway-joint (1892); a railway bridle-rod (1904); a ditching machine (1904) for road excavation; a frogless railway switch (1907), being a rail section where trains cross over and change tracks; a brake-shoe brace (1908); concrete tie and rail-fastening (1909); a railway crossing (1911); a stop for railway switches (1915); a rail anticreeper (1915) to slow lateral displacement of track; a guard for railway frogs (1920); and a whistle-operating mechanism (1925).

By the 1910s, patents servicing autos included a device for raising and supporting automobiles (1916); a fuel supply to internal combustion engines (1917); and an acetylene-gas mixer (1917) for headlights.

14. Another example of design fixation comes from the January 11, 1900 *Springfield Leader and Press*: "If an automobile can be invented to navigate some of our bad streets, our people would no doubt invest heavily." Put baldly, the problem lay not with the automobile, but with the streets.

At the turn of the 20th century, few Ozarkians had as yet seen a working automobile, though most had heard of it and many recognized its potential.[15] A technology in itself, the gasoline-powered internal combustion engine provided the energy source that would drive the industries of rail-less transportation. To this day, road construction remains a work in progress; still, the decades ensuing (from the 1920s through the '60s) turned the Ozarks into a spiderweb of asphalt-concrete roadways, with motor vehicles—cars, buses, trucks—carrying goods and passengers far beyond the reach of rail. By the 1970s, passenger rail transportation had left the region, unable to compete.

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"We are approaching the age of the automobile," declares an article in the August 4, 1899 issue of the *Springfield Leader and Press*:

> In this age of applied science, our old equine friend is passing away. That he may still be seen ambling unapprehensively up and down the streets of our different American cities is quite true, but now that the automobile has passed out of the experimental stage of its existence and is firmly established in popular favor, it is simply a matter of time till the merchant and the millionaire, the drayman and the doctor, will all "mote" about the face of this earth for business or pleasure, as the case may be.

In 1899, apparently, a "drayman" or beer brewer was sufficiently well-heeled to be mentioned alongside a doctor or merchant. For the common man, however, price remained an issue: "During the last year or two great improvements have been made in the building of automobiles, and the only problem now ... is the question of reducing the cost of construction."

A group of local entrepreneurs thought they had found a solution. "THE AUTOMOBILE: A Company Forming to Operate This Latest Fad in Springfield," reads a headline in the August 21, 1899 issue of the *Springfield Leader and Press*:

> Springfield will soon be decidedly in fashion. Springfield is to have the latest fad on record—the automobile. A company is now being formed having for its object the purchasing and operating of this new vehicle....
>
> It is intended to purchase the patterned portions of the machine and have them put together and the balance manufactured in the city. By this procedure it is claimed a saving of at least one-third may be made.... The company will start operations with two carriages, two hacks or buses, and one baggage wagon. As business demands it other vehicles will be added to their stock.

Here's a typical Ozarks-style improvisation: Buy what you can't make for yourself and manufacture the rest at home. The plan fell through, however, leaving the town car-less. A year later, in its April 21, 1900 issue, the *Springfield Leader and Press* gave the headline, "Automobile for Springfield." "The Pickwick Livery Company has ordered an automobile," the article notes, "which will run from the depots to the hotels. It will cost about $4,000, and it will be here just as soon as the factory can turn it out. It will be the first automobile in Springfield." Did it arrive, in fact? In its newspaper ads through 1901, the Pickwick Livery & Transfer Co. makes no mention of an automobile—which, surely, would have been a "draw" for business.

It was on April 7, 1901, that local history was made. In its April 8 issue, the *Springfield Leader-Democrat* reported "a strange vehicle on the streets yesterday":

> People gathered about to make a close inspection and see how it was made and horses shied at it. It was no more or less than an automobile, propelled by gasoline and made by a young colored man of Springfield. The trip of this first horseless carriage made in Springfield was not entirely successful but the vehicle moved and could be steered and stopped at will. It did get a rapid move on it and there are some glaring faults in its construction[, but] the young colored man has the right principle and he can perfect the machine so it will carry him on smooth streets at a rapid rate.

The "young colored man" abovementioned was Springfield's own Walter Majors, an African American who built the town's first workable car. Surely cars had driven through town, given their use in promotion and product advertising. But this one, made at home in Majors' garage, drove up Commercial Street, came to an idle, and drew a crowd. The auto had arrived and was here to stay.[16]

By 1902, Springfieldians could buy cars from Martin Howard & Co. Other dealers entered the market. By 1903, the automobile was a regular downtown sight, sharing the road with streetcars and horse-drawn carriages. By 1904, cars were racing at the Fairgrounds. And causing accidents: "J. M. DOLING WAS HURT," reads a headline in May 25, 1904 *Springfield News-Leader*, whose subject-line adds, "Horse Became Frightened At Automobile And Buggy Overturned."

> Hon. J. M. Doling, ex-member of the legislature and owner of Doling Park, was the victim of a serious runaway accident yesterday afternoon.
>
> About five o'clock Mr. Doling, who was returning from the public square, met an automobile, which caused his horse to make a sudden turn. The buggy was overturned, but fortunately did not fall upon the occupant. Mr. Doling however was thrown violently to the ground.... The patient has

In this particular visit, "he came ... to demonstrate the advantages of his college to colored residents of Springfield." We're told, too, that he "will speak at the negro churches here before leaving." Surely his lay-sermon covered more than the college. For Springfield's African American community, Majors exemplified success in innovation and business. He was a walking (rather "motoring") advertisement for the St. Louis college, the Springfield community—and for his fancy Speedwell "Six," a five-seat touring car whose 1913 version cost a whopping $2,850 fully equipped. And, on this trip, the local roads posed more problems than racial prejudice:

> Roads in Michigan, Illinois, Iowa, Kansas and Oklahoma are in excellent condition compared with Missouri roads, Majors said. With good roads leading into Springfield, he said, scores of tourists would pass through here daily. At every point he stopped, Majors encountered unusual hospitality and at many points was assisted in changing tires by white men who disregarded color prejudices.

For further discussion of Walter Majors' achievement, see the essay by Richard Schur, included in this present volume.

15. It's easy to forget the impact that one-time revolutionary technologies have on our worlds, since these tend "to become invisible" during daily use, retreating into the white-noise background of our lives and environs. (As a rule, technology calls attention to itself only when it breaks down or needs human management.) John Sellars, director of Springfield's History Museum on the Square, tells of an oldster living at the turn of the previous century, when the technologies of modernism were making their way into the Ozarks. Asked which "first sight" of which invention most impressed him, it was not the high-flying airplane but the dust-throwing automobile that caused the greatest wonder. For, "if that were possible," said the old Ozarker, "anything could follow."

16. The automobile stayed, but Majors didn't: In 1907 or '08, he left for St. Louis. Still, he often returned to a hero's welcome, having "spent the greater part of his life in Springfield" and remaining "widely known among the older railroad men," with whom he had worked. I quote from the September 24, 1916 issue of the *News-Leader*, whose headline reads, "'Duck' Majors Here on 4,000-Mile Auto Tour." The article continues:

> Walter L. Majors, colored, better known as "Duck" Majors, who built and operated the first gasoline car in Springfield in 1896, and [is] now head of the Oxford College of Hair and Beauty Culture at St. Louis, arrived in Springfield last night in a specially equipped "Speedwell" six-cylinder 70-horse-power automobile. Majors will leave Friday for St. Louis, completing a 4,000-mile tour of the Middle West....

sustained a severe gash on the left cheek and ... six stitches were taken....

He does not blame any person for the accident, saying that the horse jumped suddenly and it could not be avoided. He expects to be all right in a few days and is thankful that it was no worse.

It was a clash between technologies—between a horse-drawn and a horseless carriage. And, in Doling's case, the newer technology "won."[17] By 1906, one could rent a chauffeured car in town by the hour. And Ozarkians were out testing the technology's limits. The September 1, 1906 issue of the *Springfield News-Leader* reports on a "LONG AUTOMOBILE TRIP." The paper's readers would smile at the news that "Mr. and Mrs. F. T. Snapp left from their home in Joplin in their automobile" (a Buick, we're told), and "made the trip to Springfield in nine hours, covering ninety-eight miles." From Joplin to Springfield in nine hours: *Not bad!*

In 1915, Fairbanks and Tuck give the following assessment: Though "it has not been so very many years ago since the first automobile made its appearance in Springfield," the auto business "has grown with perhaps greater strides than any other line in the twentieth century" (p. 972). They continue:

> These autos are not only to be found in the larger cities, but in almost every city and town in the Union, and even on the wide plains of the West and in mountainous districts. One finds them in many of the rough, poor sections of the Ozarks. People not only enjoy riding in them, but they realize that they are time savers and thus in many instances money makers. Those engaged in this line of business, whether in manufacture, selling or repairing, are making a success. (p. 972)

Thus the automobile and its technologies (in manufacture, sale, and repair) contributed mightily to Midwest entrepreneurship: By the 1920s, "the age of the automobile" had arrived, scratching its way through "rough, poor sections of the Ozarks." It was an age, not just of the automobile, but of roadbuilding; and it was an age dominated by the likes of John T. Woodruff (1868-1949). His story has been told elsewhere, so what follows is a summary.[18]

Though he began as a "railroad man," working as an attorney for the Frisco, Woodruff saw the Ozarks' future in its rail-less roadways. By the 1920s, the Ford Motor Company (among other industry brands) was reinventing American transportation—and American lifestyle, which became increasingly dependent upon the automobile for work *and leisure* (including that newfangled urban-American middle-class practice of "Sunday drives" and vacationing). Springfieldians needed easy ways to get in and out of town, and

17. I'm uncertain as to the first Springfield fatality, though Fairbanks and Tuck give a gruesome account of Albert N. Hanson:

> The death of Mr. Hanson occurred on April 16, 1915, as the result of an accident. He was driving across the street in his automobile when a street car crashed into his machine, hurling him from his seat a distance some twenty feet, his head striking the curbing. Burning oil from the gasoline tank of the automobile was scattered over him and the oil took fire, igniting his clothing. Help reached him immediately, but he remained unconscious to the end which came a few hours later, as a result of injuries to the head. (p. 1078)

18. For an authoritative source, see Thomas A. Peters, *John T. Woodruff*. Perhaps ironically, the automobile's energy source—gasoline—depended on the railroad for its supply chain. In delightfully concatenated prose, Lynn Morrow writes, "autos could never have been in the Ozarks without the railroad tank cars that docked at rail towns and pumped gasoline into large petroleum tanks by the railroad for over-the-road tank trucks that loaded up and then drove to gas stations to fill smaller tanks whose contents were then transferred again to consumers driving autos with smaller tanks yet. The tank truck drivers and their overland routes were fed by national franchises, like Standard Oil, Sinclair, Conoco, etc. And the local agents, often in county seat towns,... drove the routes and provided petroleum products to gas stations" ("The Auto").

Woodruff lobbied—successfully—to put the town on the map of the nation's first great east-west motorway, eventually to be named Route 66. As Woodruff writes in his memoir,

> The fever to build common things is intermittent. It comes by fits and spurts. Not so as to roads. Once you come down with it, the fever and fervor continue. Travel on horseback, by wagon, buckboard, buggy, or stagecoach required roads of course, and there were then roads of a kind. But the advent of the motor car propelled by the internal combustion engine called for more roads, good all-weather roads.
>
> The feverish anxiety to gain these took root in the Ozarks as early as anywhere else. The result was the enactment by the Missouri Legislature of laws authorizing the creation of the Special Road District in the country and the "Eight Mile" District in and around the city of Springfield, Missouri. We were not remiss in employing the plans thus provided, in any respect.... ("John T. Woodruff," p. 54)

Whereas the Ozarks lagged behind in other transportation technologies, it strove "to keep pace" in this definitively modern development.

The history of Route 66—the nation's "Mother Road," which passed through Springfield's town square—has been told numerous times. What we'd call attention to here is the "feverish" entrepreneurial spirit that Woodruff describes, one that saw a specific technology, "the internal combustion engine," fed by an accessible power supply (gasoline), turned into a means of transport that would reshape the terrain, *forever changing the Ozarks*. In 1926, when Woodruff opened the Kentwood Arms Hotel on St. Louis Street, he prophesied the role that the automobile would play in building modern Springfield. Kentwood Arms would be the town's first hotel built specifically for motor-tourism. (Previously, hotels were built near the train depots in service of rail passengers. Other motor-hotels—a.k.a. motels—would follow, though typically less impressive, along Route 66.)

Local entrepreneurs—boosters all—have left their mark. Before there was John Q. Hammons (1919-2013) and C. Arch Bay (1909-1993), there was John T. Woodruff (1868-1949); before him, there were H. F. Fellows (1831-1894), Sempronius H. "Pony" Boyd (1828-1894), John S. Phelps (1814-1886), and others leading back to Joseph Rountree (1782-1874) and John Polk Campbell (1804-1853). They built the region by attracting settlers, investment capital, and technologies of transport. (Even Campbell contributed in this regard, being a horse-trader by profession.)

Beyond the story of Midwest town-building, the history that we've told declares the slow, steady triumph of modernism—specifically, of the "conquest of time and space" via technology. The story of local transport is one not just of access, but of speed: Distances and terrains that took pioneer settlers weeks, even months to traverse could now be measured in hours. So long as it's moveable, there's nothing nowadays that can't be brought into, or taken out of, the Ozarks.

We have concentrated thus far on transportation as one of four markers of modernity. We turn now to a second marker, communication: for it, too, is implicated in the modernist "conquest of time and space."[19]

19. Note that any discussion of radio telecommunication must take account of its energy source: electricity. If wood and coal powered the 19th century, and gasoline (among other petroleum products) powered engines in the 20th century, then this most modern of all energy supplies—bolstered in 1913, with the completion of Powersite Dam in Forsyth, Missouri—has carried the Ozarks reliably into the 21st century. It can be said, without much exaggeration, that our lives (and certainly our economy and lifestyle) depend on an interconnected regional/national power grid. *Sans* electricity, the "information age" is inconceivable.

For a discussion of Powersite Dam, see the essay by Thomas A. Peters, included in this present volume.

3. Boosting by Radio

"In the last twenty years, neither matter nor space nor time has been what it was from time immemorial. We must expect innovations to transform the entire technique of the arts, thereby affecting artistic invention itself." Paul Valéry, French artist-philosopher, wrote these words in 1928. While his subject is aesthetics, his claims hold for all modes of electronic telecommunication/transmission. Soon, Valéry suggests, "it will be possible to send anywhere or to re-create anywhere a system of sensations, or more precisely a system of stimuli, provoked by some object or event in any given place." He continues:

> Just as water, gas, and electricity are brought into our houses from far off to satisfy our needs in response to a minimal effort, so we shall be supplied with visual or auditory images, which will appear and disappear at a simple movement of the hand, hardly more than a sign. Just as we are accustomed, if not enslaved, to the various forms of energy that pour into our homes, we shall find it perfectly natural to receive the ultrarapid variations or oscillations that our sense organs gather in and integrate into all we know. I do not know whether a philosopher has ever dreamed of a company engaged in the home delivery of Sensory Reality.

Composed some ninety years ago, Valéry's triumphalist vision seems to describe today's technologies of cable television and movies on-demand, of the internet and iPhone, of video game consoles and virtual reality goggles. From this distance, it's hard to imagine that radio, "mere" radio, was the source of Valéry's rapture.

Though radio came first, its development makes these future technologies seem unsurprisingly inevitable. For the radio had already conquered time and space as *problems of mass communication*. As Valéry writes, it made "a piece of music audible at any point on the earth, regardless of where it is performed." Further, it preserved "live" events for future performance, allowing its engineers "to reproduce a piece of music at will, anywhere on the globe and at any time."[20] Again, his focus rests in aesthetics, but the technologies of transmission range through all informational content, from broadcast news to encrypted military messaging.

In fact, an ad in the December 13, 1925 issue of the *News and Leader* had already touted the APEX Radio Apparatus (available locally) and its "mastery over the most advanced radio engineering principles," which "makes distance the obedient slave of your desires and places at your instant command the whole continent of radio enjoyment." As a further point of fact, Springfield's State Teachers College—precursor to Missouri State University—made a significant *scientific* investment some years earlier: "Radio Set to be Installed at State Teachers College," reads a headline in the December 11, 1921 *Springfield Leader and Press*:

> A complete radio station will be installed in the rooms of the science department....
>
> It was in recognition of the imminent possibilities of radio telephony that the Teachers College authorities decided to install the radio equipment. Not only the students of the science department but students of all departments and divisions of the institution will benefit by the modern wireless station ....
>
> To disseminate wireless news a Daily Radio News Bulletin will be distributed among students, it is planned. The service of a dozen or more students who are now prepared to "receive" and "send" messages will be used to demonstrate the possibilities and practicabilities of wireless telephony and telegraphy.
>
> The radio telephone receiving station ... will be "tuned" to receive from Washington, Pittsburgh, Chicago, Denver, St. Louis, Kansas City, and points of the lower South....
>
> What a decade will bring to light in the possibilities of radio is a matter of extravagant speculation. Practical scientists and electrical experimenters are confident that the music is now within easy reach of all.... Speculation has it that concerts in distant cities and possibly sermons will be "picked up" in the home.

Apparently, we didn't need to quote the French philosopher on the future of radio transmission. Springfield newspapers had beaten him to the punch.[21] The article ends noting that "the Teachers College in making an outlay for modern radio equipment is keeping abreast of the time." That's what a school is *supposed to do*, and what a school like Missouri State is doing now with the latest imaging, digital, computational, and virtual reality technologies.

In *Commercial and Government Radio Stations of the United States* (1921-1923), the U.S. Department of Commerce lists "WQAB Teachers College" among the nation's first "experimental and technical and training school stations" (p. iv). Apparently, the school shared a radio frequency (kHz 833) locally with two smaller commercial stations, "WKAS L. E. Lines Music Co." (10 watts) and "WIAI Heers Store" (20 watts). Another government document, *Amateur Radio Stations of the U.S.* (1923), lists the fairly strong-signaled "9CEG Springfield High School, Benton and Center St." (1,000 watts), along with several privately owned stations of varying broadcast strength: "9CID Kirk T. Pruess, R.R. 11 Park Ave." (750 watts), "9EGI Granville P. Ward, 236 W. State St." (500 watts), "9AUK Charles Birget, 1367 Summit Ave." (250 watts), and "9DOR George F. Lytle, 760 E. Elm" (20 watts). While Springfield High (like Southwest Teachers College) bought state-of-the art equipment, the smaller stations were cobbled together in true amateur style. Beyond the sheer inventive spirit, one feature unites them all: Being "experimental," *none of them survived*.[22]

But it wasn't an amateur's tinkering that piqued entrepreneurial interest. Springfield's Chamber of Commerce was keen on bringing federally licensed, *professional* radio to town, given the technology's outreach in advertising—that is, in boosting the community. In 1927, the Chamber got its wish.[23] "Initial

20. "Radio Fans Hear Foreign Stations," reads a headline in the January 29, 1926 *Springfield Leader and Press*. Foreign reception had become a friendly competition:

> Radio station 2-LO London, England, was heard last night by several local radio fans.... Mrs. Harry Gabriel, 506 East Grand Street, reported she received three or four numbers very distinctively over her radio set.... Radio fans in Marionville were able to reach many foreign stations last night.... A. L. Owens heard a musical program broadcast from Statio OAX, Lima, Peru.

21. If cyborg technology—the hybridizing of human and nonhuman capacities—seems postmodern in sentiment, consider the article, "Telepathy May Be Radio's Big Freak, Experts Believe," printed in the September 6, 1925 issue of the *Springfield Leader*: "Instead of dealing with this phenomenon as a psychic factor, scientists are coming to believe that the mysterious action of one mind on another is accomplished through the transmission of some sort of ether waves...."

Given that the first federal license for public radio broadcast was issued in 1920, we note the speed with which this technology disseminated regionally, nationally and, indeed, globally.

22. Formed in 1927, the Federal Radio Commission effectively killed stations by refusing to renew their licenses. The AM band had become woefully overcrowded (FM would not be introduced until 1941), forcing smaller stations to share frequencies (Goodman). The Radio Act of 1927 "limited radio broadcasting to licensed broadcasters" (Stefon) and eliminated "split frequency" programming, while FRC General Order 32 (1928) effectively removed "experimental status" as a category for licensing. The FRC "cleaned up" the AM airwaves by licensing big commercial stations almost exclusively—which explains the quiet demise of WQAB Teachers College. (After World War II, educational and "public" radio stations would reappear on the FM band.)

23. Local histories of radio typically begin with Ralph D. Foster's KGBX station, which began broadcasting in 1926 in St. Joseph, Missouri and moved to Springfield in 1932. Though Foster put

Program Broadcast of Local Station," reads a headline in the January 3, 1927 *Leader and Press*: "Radio Station WIBM took to the air at the Landers Theater this morning with a test program," with afternoon and evening programs to follow: "... and tonight at 10 o'clock the Chamber of Commerce will broadcast a program at the courtesy of the *Springfield Leader*. Some excellent local artists are scheduled for tonight's program and fans are promised a real treat."

The "test program" proved successful, as reported in the January 19, 1927 *Leader and Press*. Woodruff's own "Kentwood Arms hotel has been selected as the permanent home of WIBM," reads the article. In occupying the main ballroom, "without doubt this arrangement will give WIBM one of the finest studios in the country." The article continues:

> The beauties and virtues of the Ozarks will continue to be made known to the outside world through WIBM and the name of Springfield will be kept constantly before thousands of listeners throughout the middle west.
>
> The conclusion of the enterprise was made possible through the cooperation of some of Springfield's most representative leading men. Certain programs will be given over to nearby towns through the cooperation of their local chamber of commerce bodies.

More than a private commercial enterprise, such a station served the entire business community: Those "representative leading men" who brought WIBM to the Kentwood Arms ballroom were selling an image and reputation—that of a "modernized" Ozarks. They were "letting the world know that Springfield is up and coming—not going or standing still."

The radio, thus, provided the region with its most powerful "boost" yet. As with the technologies of transport, the technologies of radio broadcast conspired with booster policy to create a prosperous, progressive, forward-looking self-image. Global economic depression and war lay in the immediate future; still, Springfield's "leading men" were determined to grow from town to city. And grow it did. As the Ozarks' "Queen City"—the region's largest urban center and rail transportation hub, powered by hydroelectricity, blessed with natural resources, fed by local farms, enjoying a skilled (and largely unionized) labor force, and led by men and women of capital wealth and creative vision—Springfield was poised to lead in the transformation of the Missouri Ozarks.[24] It would achieve this transformation through technologies of communication, transportation, and "citified" culture.

By mid-20th century, the energy, transportation, and communication infrastructure of "modern" Springfield had been laid down and largely completed. By the turn of the new millennium, further changes were in store: Out of the city's increasingly tech-driven service economy, a "postmodern" Springfield would evolve. (Again, it's "technology to the rescue.") And the city's relation to the surrounding region would evolve, as well. What began as a pioneer settlement had at last grown into a metropolitan center encircled by suburban and peri-urban regions and its own vast Ozarks hinterland. *These* subjects, however, deserve an essay in themselves.

Springfield on the broadcast map, clearly radio had arrived before KGBX and Foster's RadiOzark Enterprises. But it didn't stay: The C. L. Carrel Broadcast Company of Chicago operated WIBM under a portable license. On May 4, 1927, following a successful ten-week stint, WIBM returned to the Windy City.

24. Given the masculinist bias in entrepreneurship, it's not inaccurate to speak of the businessmen in Springfield's modernizing; and yet, just south of Springfield in Bonniebrook stood the family home of Rose O'Neill, whose invention (and savvy marketing) of the Kewpie doll had made her "fabulously rich" (McCanse, p. 8)—a millionaire "captain of industry," as she's described in the February 20, 1921 *New York Times* article, "Women Who Lead the Way." Of Ozarkians living in the '20s, few besides Woodruff could rival O'Neill in cultural impact.

Inventing the Ozarks (II):

In Transit to Postmodernity

James S. Baumlin

> Many people have an eye on Springfield now.
> *It's the growingest place in the Midwest.*
> —Mayor Carl Stillwell, Groundbreaking Ceremonies for the R. T. French Company's Springfield Plant (1971)[25]

> [In postwar Springfield,] there was an enormous pent-up demand for everything that could be built in a factory.... Improved radios, for example; and soon there would be the incredible boom in television (who would have believed, in 1945, that Springfield would one day be the site of the world's largest television factory?). Power mowers, once used only on golf courses and vast estates, would soon be a common neighborhood item at a low price (who could have expected Springfield's own Mono Manufacturing to become a leading producer?). Paper cups, once seen only in railroad cars, soon were to find their way into homes and restaurants across the nation (who would have dared bet that the world's largest paper converting plant was shortly to call Springfield its home?).
> —Harris E. Dark, *Springfield Missouri: Forty Years of Progress and Growth, 1945-1985* (1984)

Previously, I charted Springfield's meandering path to mid-20th century modernity: By technologies of communication and transport, the Ozarks' "Queen City" overcame its spatiotemporal isolation and, drawing resources from the surrounding region, developed an infrastructure supportive of export-industry and manufacture. If we pass over the Great Depression and World War II and follow Springfield's GIs back home, we'd be entering a vibrant small city ready and able to employ, house, teach, care for, and entertain its citizens, one fully connected to the world beyond. We'd also note that its successes in industrialization and urbanization stood in contrast to its hinterland, where agribusiness was replacing family subsistence-farming, and once-prosperous mining and mill towns were suffering underemployment, economic stress, environmental degradation, and shrinking population.[26]

In transiting from modern to "late modern" or "postmodern" technoculture, *it's the city itself* that evolved, changing demographically as well as economically. For postmodernity marks the triumph, not just of transportation and communication (the subjects of previous discussion), but of urbanization.[27]

25. Quoted in Harris E. Dark, *Springfield, Missouri* (p. 158; emphasis in original).

26. Though I doubt the necessity of doing so, let me make the following disclaimer: Of course one can live the good life in rural regions of the Ozarks. One can find employment, raise a family, and enjoy friendships, pastimes, and the fellowship of neighbors while "staying connected" to the rest of the world through roads that do reach into these communities and cable- and satellite-delivered media that do reach up into the hills and down into the hollers. This undeniable (and pleasant) fact does not negate the general trend regionally, nationally, and globally as urban populations rise while rural populations continue to decline.

27. Though classification by size is simplistic, U.S. Census data list three "city-sized" urban centers in the Ozarks: Springfield (pop. 167,000), Fayetteville (pop. 86,000), and Springdale (pop. 80,000). Large towns are scattered throughout the region: At the northernmost tip lies Jefferson City (pop. 43,000); at the easternmost edge lies Cape Girardeau (pop. 39,000); to the west lies Joplin (pop. 52,000); in the southwest lie Rogers (pop. 68,000) and Bentonville (pop. 52,000). Towns of intermediate size include Nixa (pop. 21,000), Rolla (pop. 20,000), Ozark (pop. 20,000), Poplar Bluff (pop. 17,000), Fort Leonard Wood (pop. 17,000), Republic (pop. 16,000), Lebanon (pop. 15,000), Carthage (pop. 14,000), West Plains (pop. 12,000), and Branson (pop. 11,000).

The Ozarks has hundreds of small towns under 1,000 and

> region would replace rail travel, and post-World War II prosperity would revive the tourism-based fortunes of the Branson area with the creation of an outdoor drama based on *The Shepherd of the Hills*, the development of the Silver Dollar City theme park, and the establishment of a sort of hillbilly music row in the 1960s and '70s, yet another attraction that grew out of and perpetuated the romantic invented past and present of the Ozarks. (p. 126)

While the Hill Country has its ecological and cultural aspects, it's the technologies that most concern us here. A best-selling print novel, a nationally syndicated radio show, and a hit network TV show—technologies all—were the means of mass-produced image-making. More than commodified *culture*, more than media *technology*, "the Ozarks" arose out of their confluence: It is, indeed, a realization of place-as-technoculture.

Again, the "living pioneer" and the "untouched wilderness" are gone: Maybe they're retrievable still in Shannon or Texas Counties, but they're not in Greene or Stone or Christian. Once absorbed into postmodern technoculture, nature ceases to be itself. This is neither a complaint nor a problem to solve: It's a recognition, rather, of our "postmodern condition," in which the "wilderness" is reimagined, reconstructed, managed, and rented out by means of the region's artificial lakes and lakeside resorts, golf-course country clubs, and "nature centers." The premodern "pioneer culture," similarly, is reimagined and reproduced in plays and old-time theme parks whose visitors pay to watch food kettle-cooked on wood-stoked fires, the hand-sewing of quilts, and the blacksmith's anvil-hammerings.

More than any place in the metro region, Branson belongs to postmodernism. And the city-dwelling tourist takes advantage. If you have a car and a credit card and live anywhere nearby, chances are that you've visited the Hill Country, enjoying it scenic vistas and attending some of its shows; if you have a family, you'll make regular trips to the region's theme parks. But our sense of the Ozarks as a one-time wilderness has given way to "the Ozarks" as a nostalgic replica of the same—a stylized, media-produced representation of rural folk culture that stands in apparent antithesis to urbanity, industrialization, and modernity. This commercialized reproduction of wildlife and folk culture, wherein the Ozarks morphs into "the Ozarks"—call it "Shepherd of the Hills Country," if you wish—serves urban technoculture. In its artificial lakes and carefully maintained hiking trails, "the Ozarks" lets us leave the city for a morning or afternoon or weekend of boating, camping, hunting, and fishing, after which we can return to the lodge and its private bath and flush toilet, its fine dining and entertainments, and its full array of electronic devices and amenities (including cable TV and Wi-Fi connections, in-room refrigerators and individually controlled HVAC systems). Having hiked, floated, hunted, and fished, we'll return to the city and the workday world partly refreshed but longing for more.

Blevins is right: The Ozarks Hill Country ethos is "invented." And we need to take that term literally, given that postmodern technoculture transforms all aspects of our lifeworld—material, cultural, aesthetic—into commodifiable, "mediated" experience. Arguably, the single most significant invention that the Ozarks currently markets to the rest of the world is "the Ozarks."[38]

3. Questioning the Future

It's easier to reconstruct a region's "authentic" premodern past than to describe its present or predict its future. As entry points into a discussion of the Ozarks' place in "the 21st Century Digital World," I pose a series of questions and challenges, inviting readers to do what Ozarkians have always done well: to innovate as best as one can for the common good. But, in point of fact, we cannot speak of possible futures for Springfield and the Ozarks without expanding our purview: We can preserve our community and its folkways—its regional culture and character—*so long as the planet allows*. Surely this segue into ecology comes as no surprise. The global-local nexus presupposes a viable lifeworld; for which reason "our biggest worries," writes Don Ihde, "*ought to be global*, first in the sense of concern for the Earth's environment, and second, in finding [a] means of securing intercultural ... modes of tolerance and cultural pluralism" (p. 115; emphasis in original). If Springfield is to "boost itself" strongly and securely into the 21st century, it must embrace tolerance and pluralism along with an entrepreneurship aimed at global-local solutions to global-local problems.[39]

In previous generations, one might have counted on a town's "representative leading men" and women to lead the way forward. But contemporary technoculture overwhelms us with information, such that no one person can possess the whole. A *surplus* of data is one marker of postmodernity; the *fragmentation* of this data into "expert systems" is another. That is, postmodern technoculture functions by dividing information among "experts," who "specialize" in *component*s of larger systems—institutional, disciplinary, commercial, technological—without full knowledge or understanding of the functioning of the whole.[40]

If we are to thrive as a community within the larger "global village," we need to build a conversation, and a collaboration, among the various "experts" and stakeholders in contemporary technoculture. For the nonce, we'll reduce the conversation to four agents: "the citizen," "the scientist," "the politician," and "the corporation." Out of these four agencies, we can build a viable community. But trust, you'll note, remains a necessary prerequisite: In a decentered, fragmented world, *we rely on others' expertise*.

Such is the postmodern condition: "The citizen" must rely on "the corporation," which must rely on "the politician," which must rely on "the scientist," which must rely on "the citizen," and so on ...

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> [T]he city of the future, and no very distant future, will have no trolley poles or wires and no horses. All movements will be on rail by silent air motors or by horseless carriages equally silent. All pavements will be asphalt. Unlimited light will be as cheap as unlimited water is today. No coal will be delivered at private houses and no ashes taken

38. For discussion of the Morris family (Bass Pro) and the Hershends (Silver Doller City) in "inventing" "the Ozarks," see the essay, "Building Businesses and Building Community, Ozarks-Style," included in this volume.

39. In an epigraph above, I've quoted Steven Conn (p. 303), who gives two ingredients for successful future economy and culture: 21st century Springfield seems to have transited successfully with respect to its postindustrial economy; as to its cultural transformation into an inclusive, truly cosmopolitan city, this remains a work in progress. Perhaps the boosterism of the 21st century will aim to attract, not just the techno-savvy entrepreneur, but the "global citizen," as well.

40. "As late as the 1870s," Kennedy notes, "families settling on the American prairie would mend their own coffeepots, nail together hog-slaughtering stands, and repair wagon axles" (*Inventology* p. 168). She continues:

> "Every active and ingenious farmer should have a good workshop and his own set of tools for repairing implements," wrote a [newspaper] columnist of the time. Back then, a town was not just a collection of houses but also a gathering place for blacksmiths, tinkers, seamstresses, and cobblers who manufactured the accouterments of daily life. Inventors weren't remote experts; they lived next door. (p. 168)

Such pioneer self-reliance belongs to the past: Unless we've expertise in the items following, our SUVs and HVAC systems and iPhones—and even, for goodness' sake, our own coffeepots—lie beyond our mending.

from them. With no horses, no coal, and no ashes, street dust and dirt will be reduced to a minimum. With no factory fires and no kitchen or furnace fires, the air will be as pure in the city as in the country. Trees will have a chance; houses will be warmed and lighted as easily and cheaply as they are now supplied with water.

A city will be a pretty nice place to live in when the first twenty years of the twentieth century are passed.

—"In the Near Future," *Springfield Leader and Press* (March 29, 1897)

The late-twentieth-century "urban renaissance" is surely tentative and, all things considered, small, and it is far too early to predict whether it will last. But the baby boomers, now empty-nesters, who want to give up their driving commute and enjoy the cultural life of cities, and the 30-somethings who are feeding any number of creative urban endeavors, are clearly onto something. And the local food mavens who shop the farmers markets ... thereby supporting local farmers are finally linking city and country in mutually supportive ways. Likewise, there are intriguing signs that the antagonism between city and suburb is mellowing at least a bit. As more and more Americans come to reside in metropolitan regions surrounding the central cities, many are beginning to understand that *the futures of both city and region are fundamentally interconnected*. Air and water quality, economic development, transportation networks—all of these and more are problems that crisscross the political boundaries that separate cities from suburbs. Metropolitan regions that succeed in the coming century will be those that recognize this shared destiny and develop a political agenda to foster it.

—Steven Conn, *Americans Against the City* (2014)

Today, we stand at a crossroads. Through the first half of the 20th century, booster-towns across the American Middle West sang paeans to the future. The future *belonged to us*, did it not? And the nation's entrepreneurs were poised to shape it and possess it. In the 21st century, attitudes seem to have downshifted. "The citizen," "the politician," "the corporation," and "the scientist" seem too often to work at cross-purposes. Does "the corporation" *serve* "the citizen"? Do they share the same goals? Surely they share the same community, the same resources, the same planet. While some on the corporate side of technoscience work to protect profits, others work to protect the environment, fending off catastrophe—though which of the following happens first (if any at all) remains anyone's guess: infectious pandemic, the drowning of coastlines through rising sea levels, the release of methane gases with the melting of arctic permafrost, the drying-up of fresh water supply, or warfare leading to "nuclear winter"—not to mention the chance (however small) that an asteroid *will* smash into the Earth, throwing us into another Ice Age. We can't assume that the Ozarks will somehow recover its premodern isolation, remaining unscathed, self-providing, and self-reliant.

"The scientist" prepares models for such possibilities; whether we have the technologies, or even the political will, to meet them remains an unanswered question. Arguably, "the scientist" working today faces greater challenges than "the scientist" working in "machine age" modernism, when polio and tuberculosis, deforestation, economic depression, and military competition among regional powers were the most pressing threats. The stakes were high back then; somehow, they seem higher now, and the time shorter.

Despite our postmodern reliance upon "expert systems," we've fallen into a crisis of trust. Again, "the politician" *must* rely on "the scientist" and "the citizen" *must* rely on "the corporation" if we're to survive, much less thrive, as a community and nation. Urbanized and globally interconnected, our world rests upon technoscience. There's no turning back. Though technoscience made much of the mess that we're in, it's our best chance at cleaning the mess up.[41]

And yet, given the current fierce competition among political-economic narratives, trust in "the scientist" has eroded at a time when this trust is needed most. In the 21st century, the best "booster policy"—for corporations and communities alike—will promote economy and ecology at once, using technological innovation as its means.

Consider, then, that the materials gathered in *Techn*Ozarks seek to inform public debate over technoscience and its global-local impact. An aim is to make policy—that needful conversation among "the citizen," "the politician," "the corporation," and "the scientist"—more informed, balanced, and intelligible to "the citizen" especially, for whom technology remains largely invisible (until it breaks down). Even as it seeks to inform, *Techn*Ozarks seeks to raise wonder in readers: For science offers *ways of seeing* (that is, of expanding human perception) that give their own delight. The images gathered in this anthology show the ease with which science morphs into art, and *vice versa*. And, in the main, the texts gathered here celebrate as much as commemorate technologies in their local history and contributions to culture.

The questions that follow look beyond 21st century metro Springfield and its Ozarks hinterland. They are social, ethical, and political by implication, and I leave readers to work out their own responses.

Given the modernist conquest of time and space, we have declared ourselves "global citizens." Yet the recent rise of nationalism and "identity politics" expresses anxieties over globalism. The Ozarks is no longer content to adapt technologies to its own terrain; contemporary entrepreneurs aim at global markets—but at what cost culturally, ecologically, politically?

The entrepreneur today may drive to work—out of town or down the street—on behalf of a multinational corporation based in Beijing or Basel and drive home to a lakeside condo or loft apartment downtown. For some, their commute might be by Skype. Can we work globally and live locally at the same time?

We wish to benefit from global markets while maintaining our cultural, political, and economic autonomy and urbane lifestyle. Can we do so in a world where the "American lifestyle" is untenable on a global scale? Can we continue to create technologies that foster lifestyles that consume resources beyond the planet's capacities? Can the Ozarks insulate itself from the rest of the world's problems while enjoying the world's resources? Perhaps more important: Can we continue to produce and consume without caring for the region's ecology—its environmental health?

Further questions arise. Can we set challenges for Ozarks' entrepreneurs today? Can "the citizen" and "the politician" and "the corporation" and "the scientist" agree on priorities in innovation? Can we

41. "The Valdez oil spill, Bhopal, the Challenger explosion, Three Mile Island and Chernobyl, and the eco-terrorism of the Gulf War" (Ihde, *Philosophy* p. 120) are six in a long litany of "big-tech" disasters. Others lay closer to home. There's Times Beach (abandoned, its streets contaminated by dioxin); Bridgetown's Westlake landfill (radioactive, a leftover from the Manhattan Project); and Herculaneum (lead-dusted, like other mining towns within the Ozarks' "lead belt").

Currently, the EPA lists thirty-three active "Superfund sites" in Missouri ("Superfund National Priorities List"), including Springfield's Fulbright landfill, a 98-acre site located in the flood plain of the Little Sac River. Owned by the city and operated from 1962 through 1968, the Landfill "accepted industrial and domestic wastes from the Springfield area for disposal, including plating wastes, paint sludge, pesticide residues, waste oil, and wastes containing solvents, metals, acids, and cyanide" ("Fulbright Landfill"). Closed since 2007, the Litton Systems plant on West Kearney contributed to this and other hazardous waste sites, including sites near the Springfield-Branson National Airport. For their current status, see the 2019 report of the Missouri Department of Natural Resources ("Litton Systems"). While contributing to technology, Litton's circuit boards unleashed some powerful pollutants.

work to solve inequalities in global economy and consumption? Can we work to conserve natural resources necessary for "quality of life" in our own urbanized cultural setting? Can we build consensus over "quality of life" issues?

In what ways can contemporary technoscience contribute to "the good life" for all, globally as well as locally?

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> Why technology in the first place? The answer, anthropologically and philosophically, revolves around humans relating to their environment, whether conceived of as a small territory, or more largely, as contemporarily, to the Earth itself.
>
> —Don Ihde, *Philosophy of Technology* (1993)

Though I've sounded the alarm in paragraphs above, it's toward a hopeful future that I'd cast my glance. Let me end, therefore, with a paean of my own to the future that I believe is already upon us. More than commerce and service, more than the commodification of culture, more than the making of metro Springfield, we are busy reinventing ourselves as a species. Embedded in our lifeworld, the technologies of artificial intelligence (AI) have created cyborg companions for us, responsive to our needs.[42]

Swarm AI may be next to evolve, wherein distributed user networks function as a collective intelligence—a "human swarm." Memory becomes communal, external: When one stores information on a cell phone, the machine "remembers for us." One day, perhaps, memory will expand internally by microchip implant. Our bodies have become engineerable prosthetically, genetically. Increasingly, the boundaries between human and nonhuman dissolve.[43] More than rely on the electric power grid that enervates computer circuitry, *we have become part of that grid*, by virtue of the human-machine interface. Our iPhones and computer tablets are exoskeletal. We are "plugged in."

Here in 2019, I write in the present while gazing across a short horizon to any already-emerging futurity. I take inspiration, however, from a techno-philosopher writing in 1964—more than a half-century ago. A prophet of postmodernity, Marshall McLuhan foresaw our transit from "the mechanical ages" into something wholly new, powered by electrons:

> During the mechanical ages we had extended our bodies in space. Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. Rapidly, we approach the final phase of the extensions of man—the technological simulation of consciousness, when the creative process of knowing will be collectively and corporately extended to the whole of human society, much as we have already extended our senses and our nerves by the various media. (*Understanding Media*, pp. 3-4)

It was McLuhan who proclaimed the human-machine interface, the fact that "all technologies are extensions of our physical and nervous systems to increase power and speed" (p. 98). And, in this new age—which, again, *is already upon us*, though its implications and applications continue to emerge—our human-social relations change, as well: For "electricity ... decentralizes. It is like the difference between a railway system and an electric grid system: The one requires railheads and big urban centers. Electric power, equally

42. Our pop-culture vocabulary has become so saturated by postmodernity that we take terms like "AI technologies" for granted. "VR technologies" (immersive "virtual reality" programs, computer-generated) have become commonplace; we can even write of "cyborg companions" without blushing—the cyborg being a *cyb*ernetic *org*anism, part biology, part machinery.

43. For an intriguing discussion, see the web article by Vivienne Ming, "Why I'm Turning My Son into a Cyborg."

available in the farmhouse and the Executive Suite, permits any place to be a center" (p. 39). Hence, the "center-margin structure" of 20th century geopolitical mapping is now "experiencing an instantaneous reassembling of all its mechanized bits into an organic whole. *This is the new world of the global village*" (p. 101; emphasis added). Surely this reassembling of the "center-margin structure" has implications for metro Springfield and its hinterland.

And, yes, it is to McLuhan that we owe the term "global village." To many in the Ozarks, this remains a foreign phrase, unsettling in its implications. It's a notion, nonetheless, whose time has come for Springfield, the Ozarks, the nation, the world.

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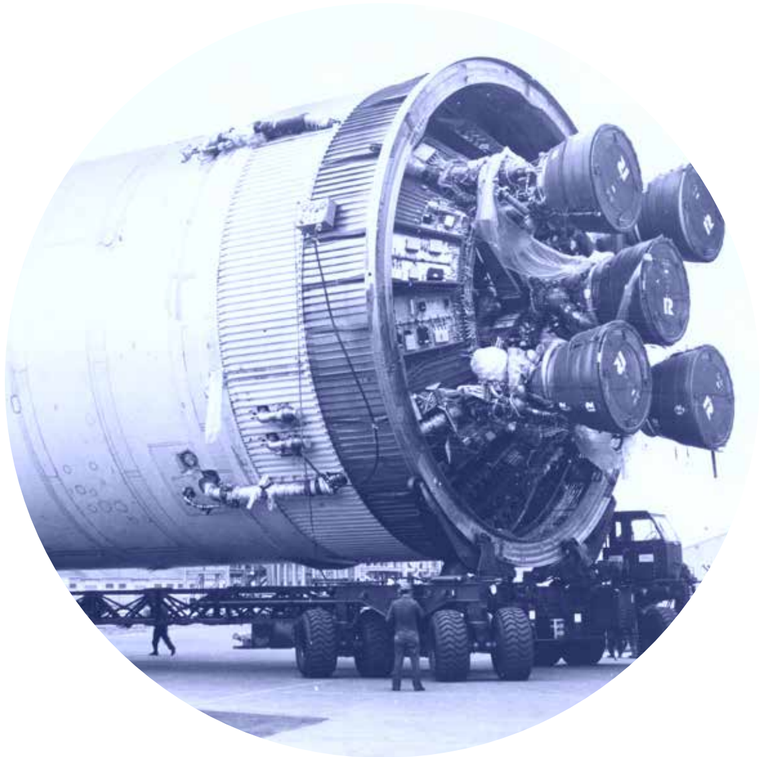

*Techn*Ozarks:

Essays in Technology, Regional Economy, and Culture

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Springfield, Missouri
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Silica granule, scanning electron microscope (630x magnification). *Courtesy of Austin O'Reilly, Dynamic DNA Laboratories, Inc.*

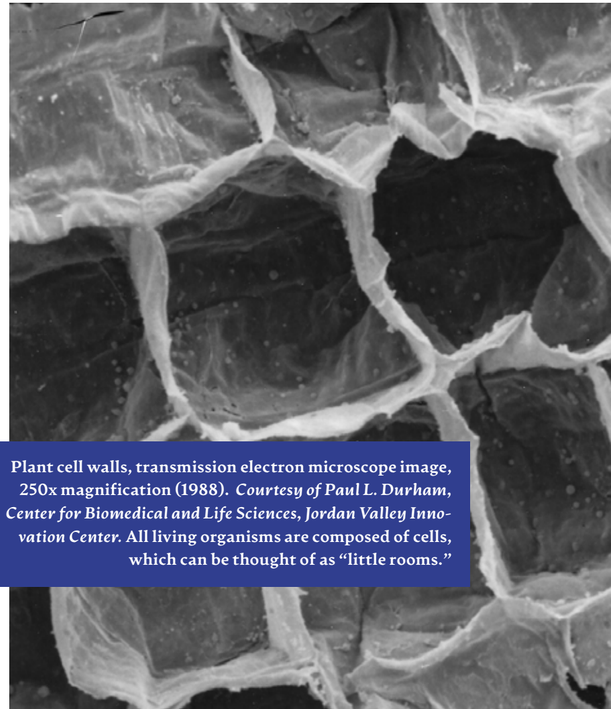
A Different Perspective on Life:

A Cell Biologist Looks Through the Microscope

Paul L. Durham

Recently I was asked what I do as a profession. Without much thought I responded, "I'm a cell and molecular neuroscientist and director for the Center for Biomedical and Life Sciences at Missouri State University." What I should probably have said to prevent the blank stare was, "I'm a biology professor," which typically elicits the response, "Oh, so you study animals—that's cool." I don't think too much about what it means to be a scientist. There really aren't many of us in the Ozarks. Unfortunately, most of the time the word "mad" is included in our titles, since Hollywood has done a good job making money on movies portraying (and promoting) the "mad scientist" character type. My personal feeling is that these films were produced by students who didn't do so well in their high school or college science courses. In truth, I am a biological scientist who studies how nerve cells get excited and then send pain signals to your brain. I work to discover ways to quiet the nerve cells involved in causing migraine, trigeminal neuralgia, and jaw pain—known as temporomandibular disorders or TMD, mistakenly referred to as TMJ (which is actually the name of the joint).

Being a scientist takes perseverance and a deep desire to want to know the answers to important questions; however, I've found that being a scientist also requires humility and a sense of humor, given how little we really know and understand about the natural world and even about the functioning of our own cells. As a cell biologist, I want to understand how cells perform their myriad tasks; to do this, I have to use the lab instruments available to me, including—and especially—the varieties of microscopes. The naked eye is a powerful instrument in itself, but it needs help peering into the smallest structures of life. The cells that I study are so small, hundreds of them can fit on the sharpened tip of a pin; the pinhead can hold many thousands. Fortunately, each innovation in microscopy has multiplied our vision: fivefold at first, soon tenfold, then more than a hundredfold, now many thousands of times more than before. English scientist Robert Hooke (1635-1703) was among the first to describe the "little worlds" or *microcosmi* revealed by means of the earliest microscopes; the etchings in

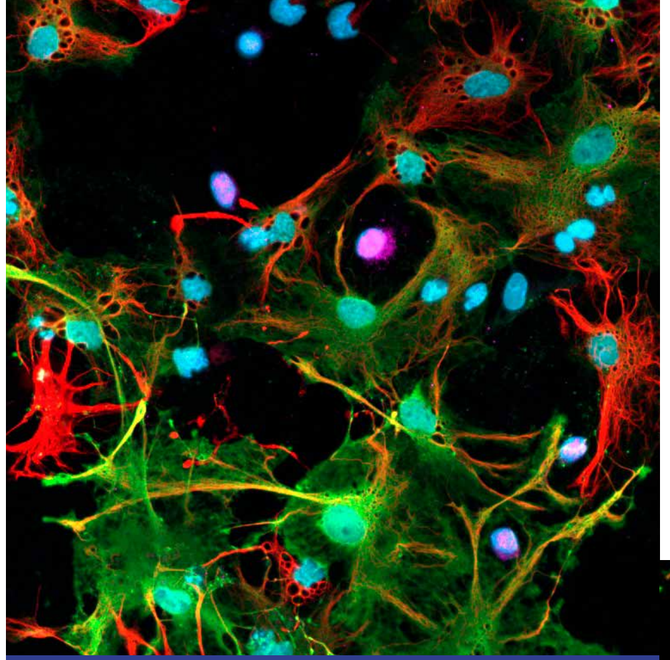


Plant cell walls, transmission electron microscope image, 250x magnification (1988). *Courtesy of Paul L. Durham, Center for Biomedical and Life Sciences, Jordan Valley Innovation Center.* All living organisms are composed of cells, which can be thought of as "little rooms."

his *Micrographia* (1665) remain monuments of early technoscience and are admired still for their artistry and accuracy. Aided by a single-lens candle-lit microscope, Hooke's drawing of the plant material cork reinvented our understanding of biological structure: He is credited with using the word "cell" to describe what appeared to be "little rooms" or *cellulae*, similar to those inhabited by monks. In comparison, here's an image that I captured early in my career, using a scanning electron microscope (SEM) far more powerful than Hooke's old instrument: Clearly it illustrates why the term "cell" is used in biology.

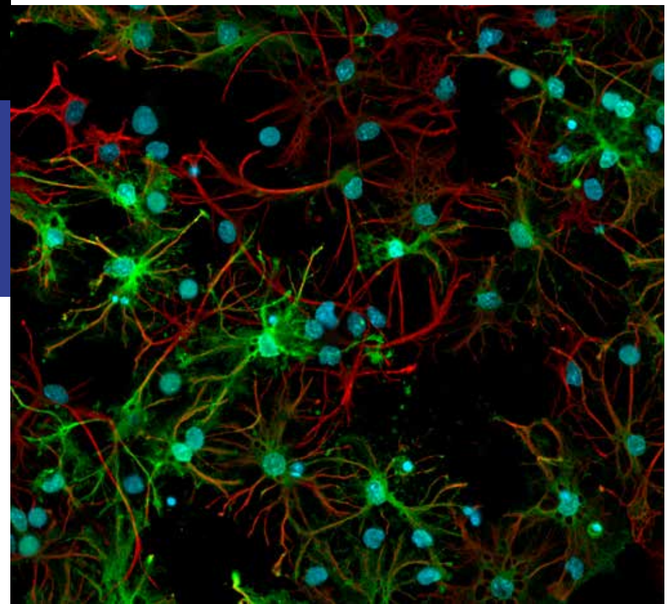
In my laboratory today, I study the activity of cells with the aid of a fluorescent microscope, which allows me to see changes in the level of proteins; these are the molecules that "perform the work" in a cell. To give you some sense of the challenge and excitement of understanding how cells perform their myriad tasks, here's an analogy from the game of baseball. In this model, proteins are the players, each assigned specific functions that allow the team as a whole to perform efficiently. Now, pretend that you have to describe to a total novice the essence of baseball in all of its rules and strategies, but you can only show that person single pictures (snapshots) of the dynamic, ever-changing game. How many pictures would it take to ensure that someone unfamiliar with the game of baseball understands the overall goal and how each individual player contributes to the team effort? In a typical major league game, there are nine position players on the field at any one time, along with several umpires. Honestly, is there a single person alive who knows *all* the rules that govern major league baseball? As complex as the game of baseball is for the average fan to understand, in our world of cells, the game of life is infinitely more complicated; and that's because there are literally thousands of players (remember, we're calling them proteins) in each cell.

Adding to the complexity of our analogy, let's say



▲ **Cultured hippocampal cells, fluorescent microscope images, 200x magnification (2016). *Courtesy of Paul L. Durham.* Cells have been stained with fluorescent dyes to visualize internal cellular structures. Information gained from these images allows us literally to see changes in response to a neurological disease or in response to a novel drug.** ▶

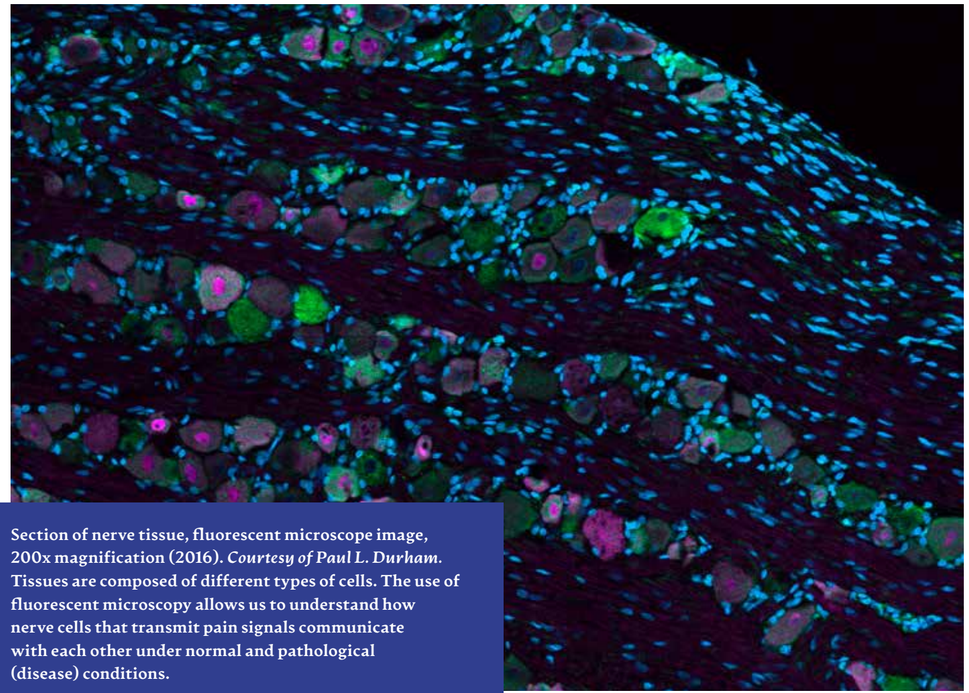
that you've been successful in helping your friend understand the rules and teamwork involved in the game of baseball; in which case, you've managed to describe *how one single cell functions in your body*. There are, however, several hundred different kinds of cells in the human body. So, now you have to explain how each cell is uniquely different from other cells—which is like explaining how baseball is different from basketball, cricket, hockey, soccer, football, etc. And all of these teams (cells) with their specialized players (proteins) are using the same field—basically, you! And they're all playing at the same time, though they have to coordinate their games—that is, their cellular activities. Hence, all the different cells of the body are all talking to each other to coordinate their functions to maintain your health and allow you to perform the myriad activities involved in your daily life. This is the challenge that cell biologists face every day: By observation and experiment, we have learned many of the actions and functions involved in biological life at the cellular level. We're in better shape than that novice, whom you tried to teach baseball. But, going back to the early history of microbiology, *we scientists were the novices* trying to learn "the rules of the game" by mere snapshots. And we're still learning. To state the obvious, our world of cells is very complicated. But that is what makes studying them so exciting: For a cell biologist, discovering a new function of a protein is like discovering a new planet—or *microcosmos*, as Robert Hooke might have termed it.



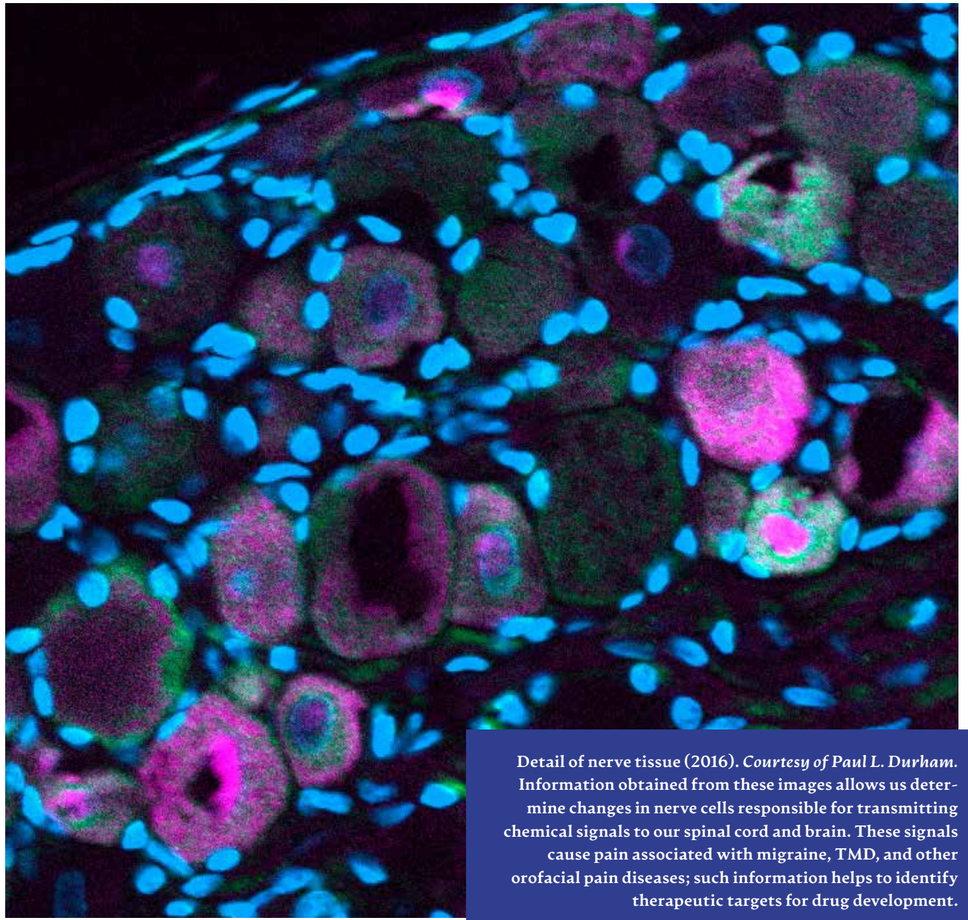
Much has changed in the thirty years that I have been photographing cells. Back in 1984, when I first became a researcher at the University of Iowa, there was not a computer in every lab and I did not own a personal computer. In fact, I did not even own an electric typewriter but used the manual typewriter that my mom had used in the 1960s. To capture images of cells, I made use of a manual-focus microscope and F200 and F400 Kodak black-and-white film. Sometimes I used color; either way, the film had to be developed. I'd take the photos based on manual settings for aperture and exposure time and then have someone from a local camera shop pick up the film and develop it within twenty-four hours (there was an upcharge for faster processing). I still remember the excitement of holding the roll of negatives up to the light to see if any of the images were usable. The process was incredibly laborious, since you could spend hours taking photographs of cells only to discover that the exposure time was not correct and the images were either too bright or too dark. After viewing the film negatives and determining whether there were some useful images, I'd then spend hours in the darkroom perfecting the art of "burning and dodging" to get the textbook 4" x 6" print for publication.

Thankfully, my days of having to capture images of cells manually were short-lived. Today, our laboratories in Temple Hall and in the JVIC Center for Biomedical and Life Sciences are equipped with state-of-the-art digital microscopes; these allow us to capture amazing images and greatly aid in our understanding of how cells in our nervous system function to cause disease and respond to therapies.

Similar to scientists in other disciplines, I am, first and foremost, an adventure seeker who is driven to discover and learn something new each day. I want to unlock the mystery of how cells in the nervous system function so that I can better understand the pathways that lead to development of chronic pain and identify novel ways to prevent, manage, and possibly cure the incredible burden—physical, emotional, social, economic—caused by diseases of the head and face. After thirty years of being a trained cell biologist, I still get a natural high from learning something that no else knows and then sharing that information with scientific communities via conferences, lectures, posters, and publications and then on to the general public, oftentimes with help from public media. I hope that these images help you to appreciate the beauty and mystery of the incredible cellular world that I have the privilege of studying each day.



Section of nerve tissue, fluorescent microscope image, 200x magnification (2016). *Courtesy of Paul L. Durham.* Tissues are composed of different types of cells. The use of fluorescent microscopy allows us to understand how nerve cells that transmit pain signals communicate with each other under normal and pathological (disease) conditions.



Detail of nerve tissue (2016). *Courtesy of Paul L. Durham.* Information obtained from these images allows us determine changes in nerve cells responsible for transmitting chemical signals to our spinal cord and brain. These signals cause pain associated with migraine, TMD, and other orofacial pain diseases; such information helps to identify therapeutic targets for drug development.

dicted developments is an anticipation of their arrival: We look forward to the advances and potential of these products and technologies.

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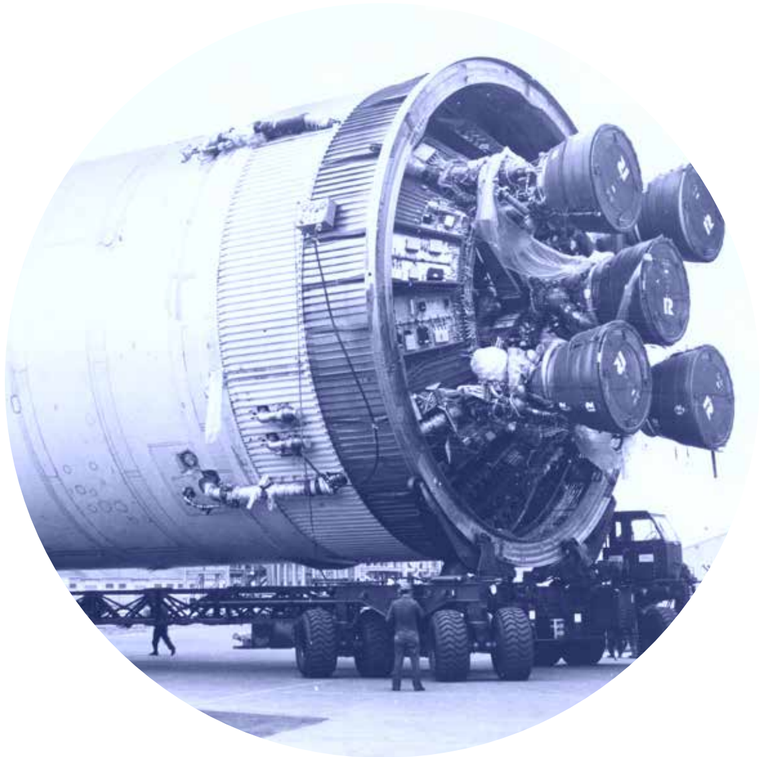

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Foreword
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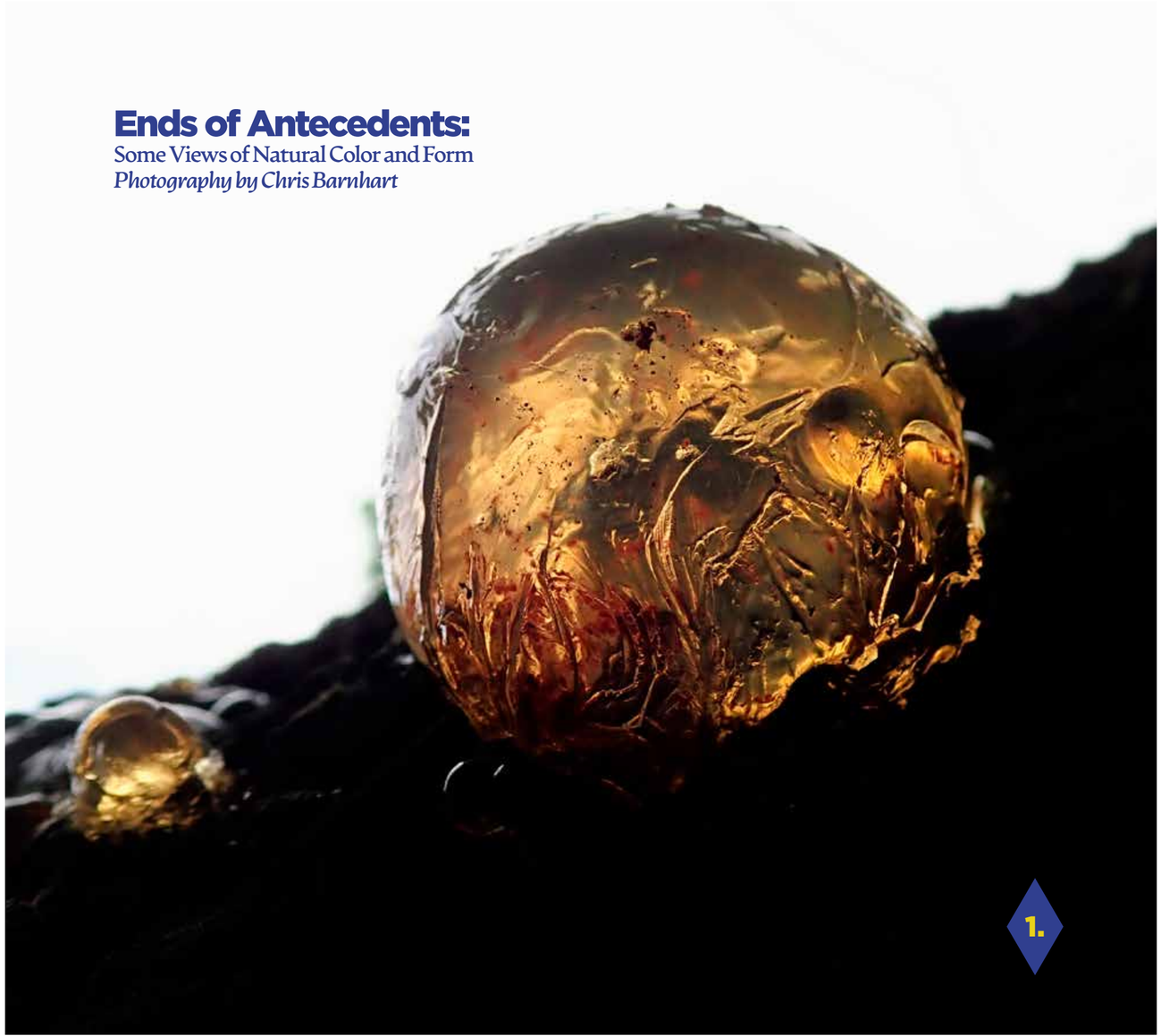
The Ozarks Studies Institute of
Missouri State University
Springfield, Missouri
2019

Ends of Antecedents:

Some Views of Natural Color and Form

Photography by Chris Barnhart



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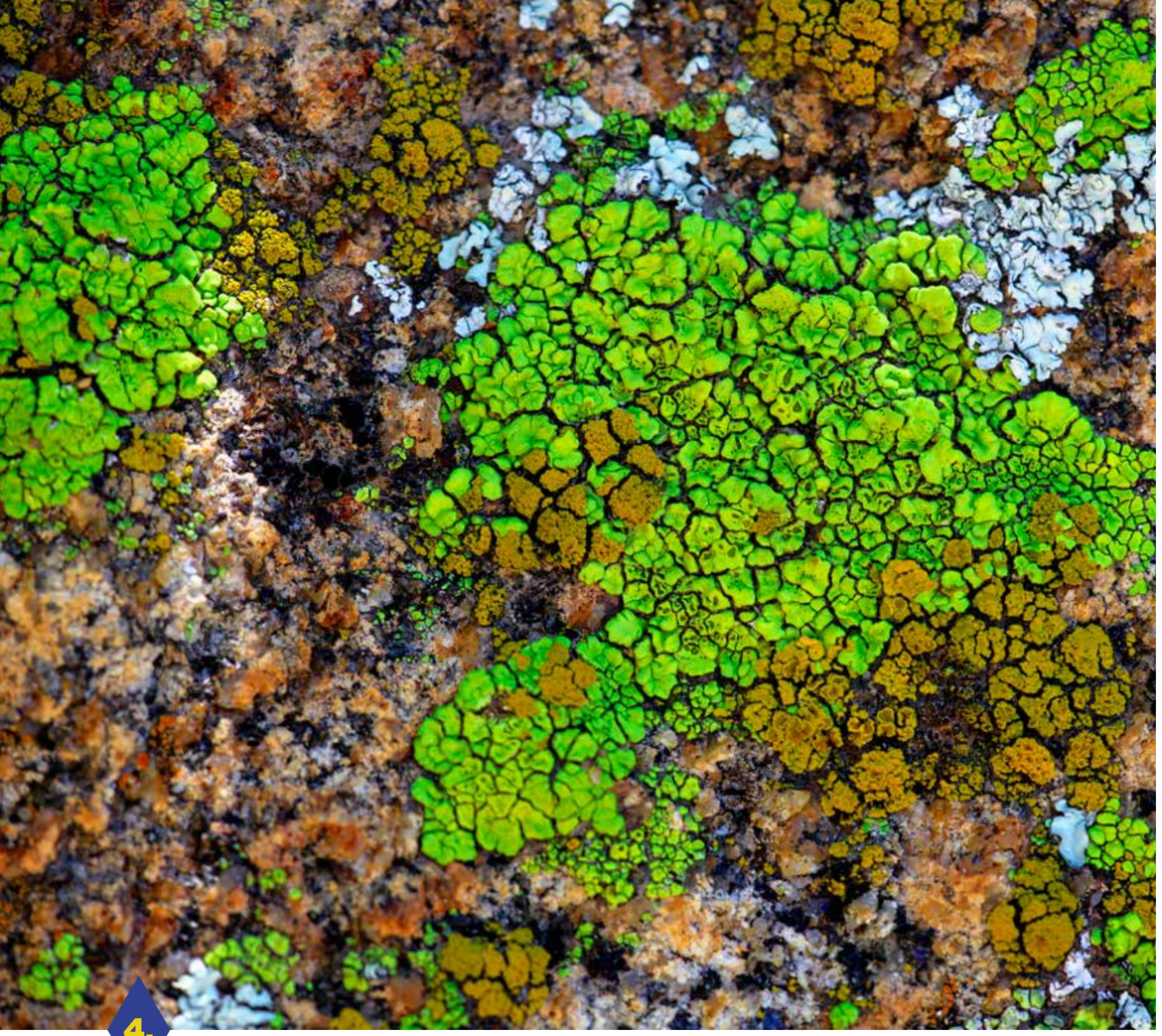

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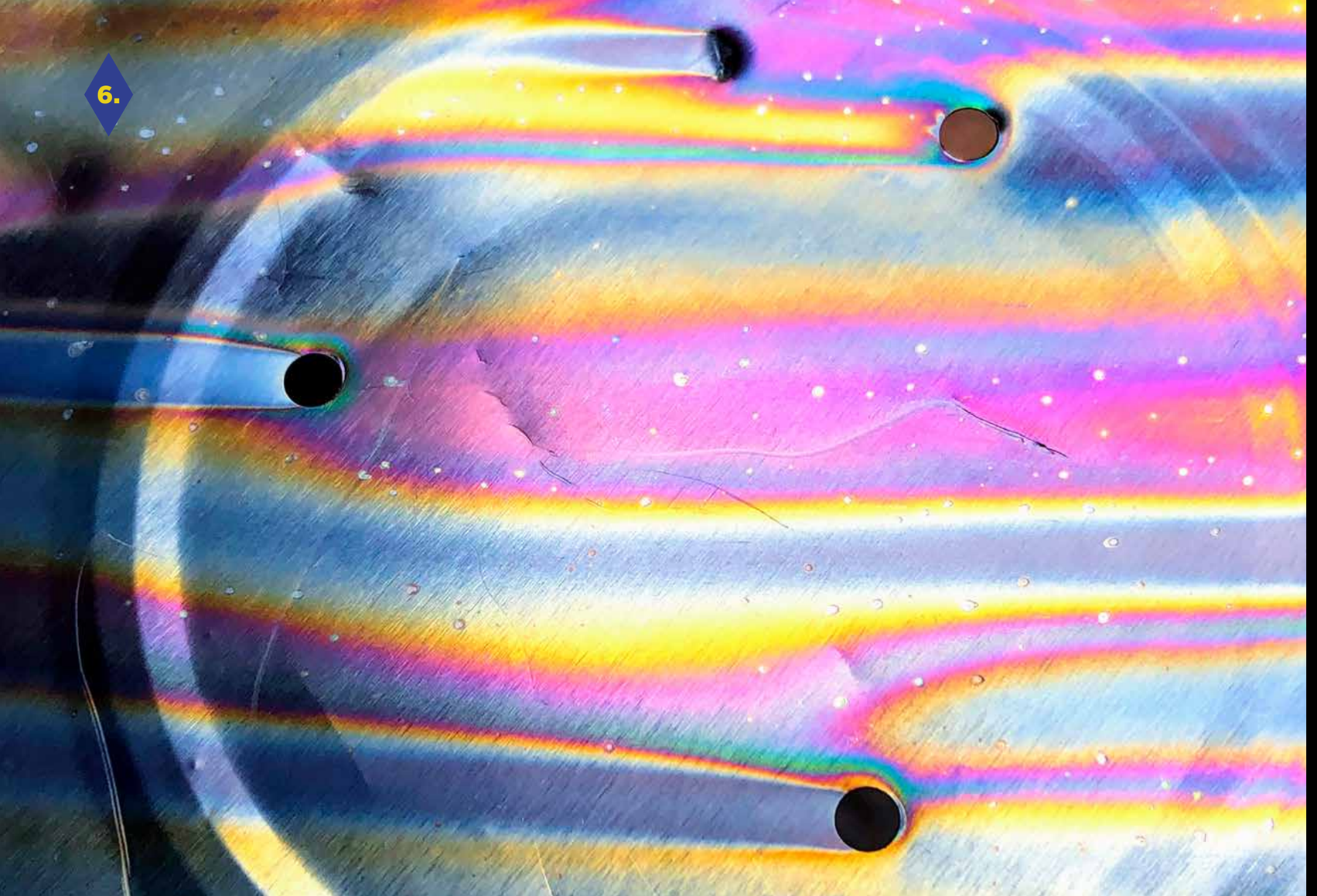
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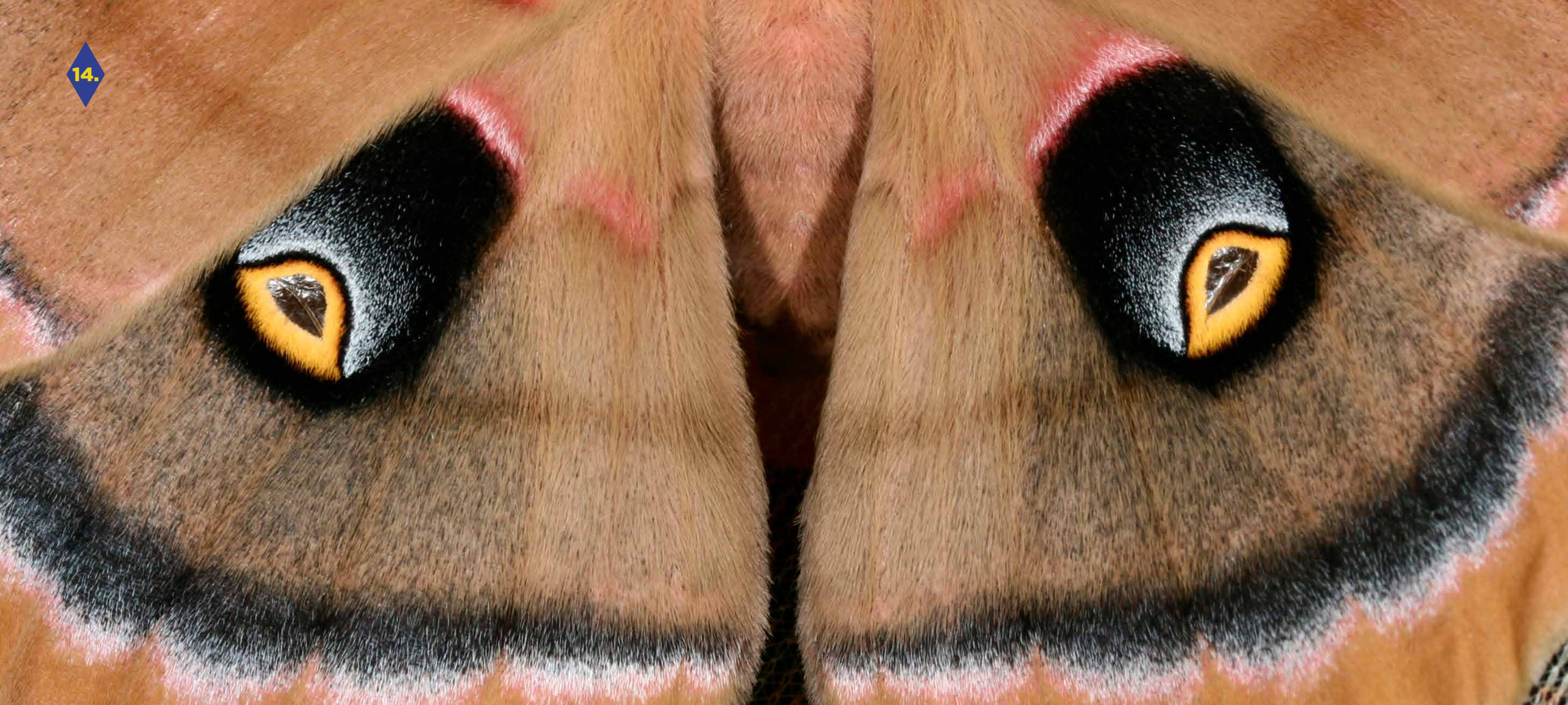

14.

Images

1. Cherry gum (2017).
The resin exuded by cherry trees for defense anticipated chewing gum and gummy bears.

2. The logarithmic shell-spiral of a moon snail (2004).
“Seek not for ends, but for antecedents.” —D’Arcy Thompson

3. Lichen on stone in the Boston Mountains (2009).
Lichens are teams of algae and fungus, combining their talents to colonize bare rock.

4. Colonies of crustose lichens (2009).
In a two-dimensional surface world, competition creates sharp boundaries between species.

5. Decomposers hard at work on an Ozark forest floor (2009).
“Into every empty corner, into all forgotten things and nooks, Nature struggles to pour life, pouring life into the dead, life into life itself.” —Henry Beston

6. Pie pan after the dishwasher (2018).
Oxide layers create the prismatic effects, and the streaks result from patterned flow around holes and dents.

7. Frost framing a window in January (2014).
The crystalline forms of frozen water result from cohesion of the tetrahedral molecules—a wonderful balance of rule and randomness.

8. Water grass and reflected sky (2017).
One of the photographer’s favorites, promising worlds above and below.

9. Carp at Fellows Lake (2009).
An iconic and voracious invasive species, though introduced intentionally from Asia as sport fish.

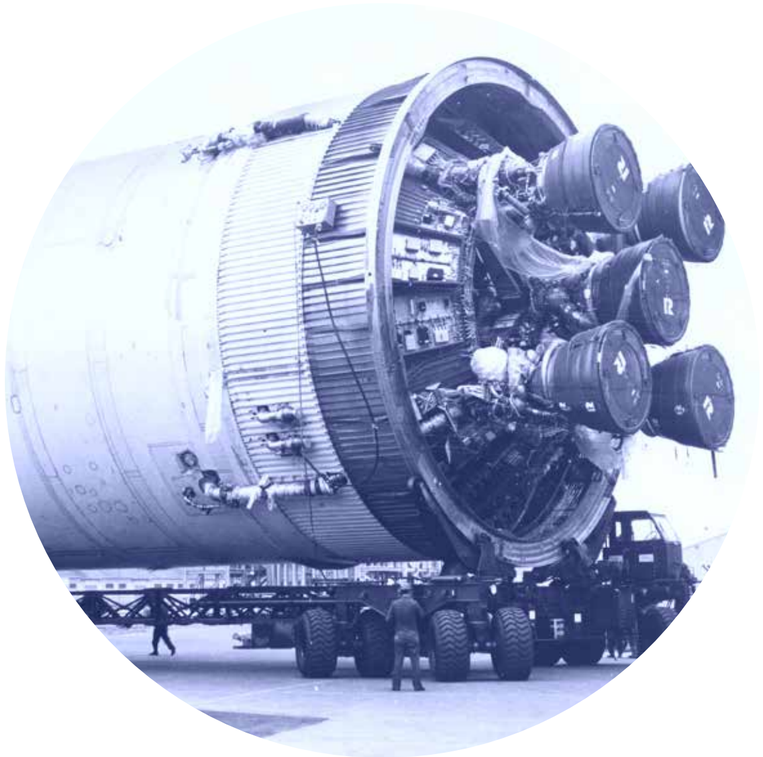
10. Caterpillar of small-eyed sphinx moth, on wild cherry stained by leaf-spot fungus (2013).
The unseen artists in this composition are the birds that overlook well-camouflaged meals, generation after generation.

11. Water striders skating on the surface of a pond (2012).
“If there is magic on this planet, it is contained in water.” —Loren Eisley

12. Eggs of pipevine swallowtail butterfly (2013).
All of its life stages contain toxins from its host plant, and the adult swallowtail is mimicked by other species for protection from predators.

13. Pumpkin spider (2017).
This colorful form of the marbled orb-weaver is inconspicuous among fall foliage and berries.

14. Polyphemus moth (2006).
A native Missourian, its dramatic “eyes” may startle potential predators when the moth raises its wings.



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Open(ing) Access:

On Building a Digital Commons at Missouri State University

Rachel Besara

The Ozarks region is relatively rural, with many of its institutions founded comparatively recently. (For example, the region's Fourth District Normal School—state-funded precursor to MSU—was established in 1905.) And the terrain made travel challenging. Accordingly, access to research information, and research data, was rare. In the past, scholarly publications (particularly academic journals) were to be found almost exclusively on the shelves of colleges and universities, with only a few, mainly students and academic researchers, having complete, easy access. The general public was welcome; but the infrastructure required to hold large collections of print publications was such that, in practice, only the university community and exceptionally driven members of the public could take advantage of the scholarly literature. With the poor roads and rugged terrain (even into the 1960s, many rural roads were dirt and gravel), this meant that, historically, even fewer residents of the region were able to take advantage of published scholarship.

With the advent of the internet and online journals, one might think that the problem of access has been solved once and for all. This, unfortunately, is not (yet) the case, given concurrent changes that have taken place in scholarly publishing. Schools that once subvented scholarly journals underwent rounds of budget cuts; given rising print costs, scholarly organizations could no longer pay for their journals by membership dues alone. Commercial companies, such as Elsevier, Wiley, and Springer, bought out many of these scholarly associations' journals, making them available in print and online. But, once in possession of these journals, the commercial companies began to charge high fees, inflating yearly far beyond the cost of living, and putting the online literature available outside of the library behind a high paywall. With the Ozarks being a poorer region of the country, this has kept access beyond the means of many, even if they know how to find the literature and have the technical means to access and download the titles.

Despite widespread computer use/storage, raw research data for investigation have been even harder to get. The data used for scientific or other research projects remained locked on paper, available only on the hard drives of a lab or work computer or, perhaps, available in the cloud locked behind one or two accounts. While the researchers gathering data recognized the value of its information, it was not easy for them to share their work in any way other than distilled into a journal article, report, or book; and even these remained relatively difficult to access, requiring travel to a library and at least a basic knowledge of how to search for the desired information. Despite the advent of the internet, the size, complexity, and infrastructure of data sets made them difficult to distribute and to be decoded by others. This was complicated by the fact that, due to the historical limitations of data distribution, researchers rarely even considered how to manage and describe the data they produced in ways that would make them discoverable and usable by others. At best, this might happen in a limited way if, at the end of one's career, a researcher's papers were donated to an archive; but, most often, these items would not be able to be found or used unless the searcher already knew of the work that had been done in the past. Furthermore, the data searcher would have to be able to travel to wherever the archive was located and spend time sifting through the paper documents

or old computer files. This meant that a great deal of potential knowledge was lost.

This is changing, however, for the Ozarks and the nation. There is now a growing expectation that publicly funded research data—such as those produced by Missouri State University, the University of Arkansas, the Missouri Institute of Science and Technology, and other institutions—will be made publicly available and open to all. The infrastructure is now in place for this to be done, not just in theory but in practice. The following paragraphs will discuss the key drivers of many of these changes, as well as the role that Missouri State University is playing in opening up public access to scholarly publications and research data, here in the Ozarks and beyond.

A key value of libraries is making information as available as possible to the communities they serve and to the public at large. Within the last thirty years, with the rise of the internet, there has been a much stronger push to make information openly available, openly accessible, to all. To understand why this did not become standard practice when the infrastructure first allowed it, the traditional cycle in disseminating scholarly information needs briefly to be discussed. Traditionally, a scholar or researcher at a university would do research, which would be distilled into a paper. This paper would then be sent to a publisher, often sponsored by a scholarly or professional association, whose editor would review the paper, send it to other experts in the field for evaluation and improvement (all on a voluntary basis); and then, if the paper was deemed worthy, it would be published. The scholarly or professional organization was most often run at relatively low profit margin, and, to limit liability, the standard practice was for authors to sign over the copyright to their work for free in exchange for publication. The publication would then be sold at reasonable cost (to encourage the widest dissemination), most often to academic libraries which, in turn, would make it widely discoverable and accessible, enabling further creation of new knowledge. The performance of an academic researcher and, often, one's continued employment would be determined by the number and quality of publications produced (and by the reputation of the presses/journals one's work was published in), all of which would be decided by this process.

But when commercial, for-profit presses bought out the scholarly presses, the price of journals began to increase. Libraries and universities had no choice but to pay the hyper-inflating prices in order to stay competitive by making sure their students, instructors, and researchers had access to up-to-date information.

Not surprisingly, many university faculty and librarians found this new model problematic. They answered by joining the open access movement. Participants in the open access movement would do what they could to make the publications from their research as widely accessible as possible. For example, a mathematician might post a preprint version of a paper in a discipline-based repository, such as arXiv (Cornell, 2019), in order to make that paper widely available. While this is laudable, many publishing companies would try to suppress practices of this type, being detrimental to their business model. Or, an author might publish in an open access journal—for example, one supported by the Public Library of Science (Public, 2019)—which doesn't charge readers to access its content. Unfortunately, since these will be relatively new venues, they might not have earned the same reputation as established journals. These challenges were (and still are) compounded by the performance review model for faculty, which remains bound to the review/publication/press reputation cycle; and, since an increasing number of established journals has been bought out by commercial publishers, a university's faculty—its junior faculty, especially—remain under significant pressure to conform to the model of the major commercial publishers.

A major breakthrough occurred in 2013, when the White House Office of Science and Technology

Typing at the keyboard: computing in Meyer Library. ***MSU Photographic Services.***

established guidelines that federally funded science be made publicly available (Holdren, 2013). This does not just cover the traditional journal publication that sums up a phase of a project; it covers the gathered data that are analyzed to form the conclusions as well. Failure to comply will lead to denial of future public funding. This created a challenge for all publishers of scientific research. If what they were publishing was required to be publicly accessible, how could they profit? Who would buy publicly available information? This has led to a scramble for different business models, and the outcome from that standpoint is still unclear. Many of the publishers are now trying to get payment in advance of publication through author page fees, where an author has to pay the publisher a set fee per page published, rather than charging the university through library subscription fees after publication.

Missouri State University, through its Libraries, has addressed this issue and contributes to the university's Public Affairs mission by building a digital commons, called BearWorks. Established in 2016 (Peters, 2017), BearWorks creates "a record of publication, research, and scholarship at Missouri State University" (Missouri, 2019). While this started with the gathering and entering of past research in theses and dissertations, BearWorks also provides the university with an avenue to meet the requirements for public access of federally funded research. Authors can deposit their articles and research data in BearWorks, where anyone in the world can access them for free—unlike the licensing terms restricting so many of the resources to which the Libraries now subscribe, since these allow the public access only if one is within Meyer Library. This means that someone living in Shannon County can access the same resource as a student living in the Blair-Shannon House on the MSU campus, and this is something that was not possible before. It is as simple as the author checking and working with the publisher to ensure that a copy of the research article or other work can be placed in BearWorks.

The challenges facing the deposit of research data are more substantial than those facing standard research outputs, such as journal publications. But these challenges lead to the current cutting edge of the open access movement. From the beginning of a research project, the data involved must be gathered, recorded, documented, and described in such a way that others can use it. While this is an achievable goal, it poses greater difficulty because researchers, in many cases, have not had to document their data for future use by others. In situations involving the use of human subjects in research, the way forward becomes even more challenging: What are the ethics of sharing human subject data long-term with the public? How does it change the practices going forward? Many of the social science fields are just beginning to tackle these issues, which biology and medicine have been struggling with over the last five years.

BearWorks allows MSU to provide ethical, sustainable leadership in accessing new knowledge, in

the form of publications or data created by its faculty and students. It opens up access to new perspectives to the larger community. It allows for feedback and interaction from the community to the researchers and opens up possibilities for new types of collaboration between the university and the community. For example, new approaches to community-based science are now possible because the community can see and can contribute to data-gathering in MSU-led research. This could lower the barriers to undertaking "citizen science" movement projects, where scientists, data managers, and citizens collaborate to uncover new knowledge across the traditional boundaries dividing the university from the broader community. These initiatives could lead to a far greater understanding of the Ozarks region's environment, cultures, and ecologies. The impact of BearWorks as a digital commons of open Ozarks data has yet to be measured, but the potential is enormous.

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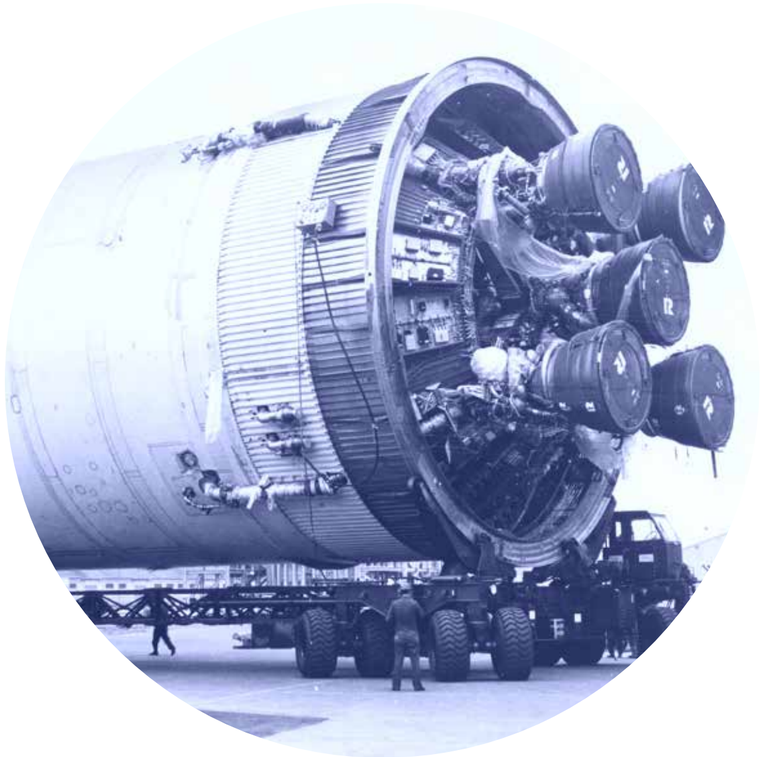

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The Digital Auto de Fe of 1601 Project:

Modeling Cultural Competence and Global Research Collaboration in the Virtual Reality Classroom of the Future

John F. Chuchiak IV, Antonio Rodríguez Alcalá, Justin Duncan, Argelia Segovia Liga, Dulce Martínez Roldán, María del Carmen Rodríguez Viesca, Hans B. Erickson, María Fernanda Barrón, Wendy Arcos, Andrea Flores Navarrete, Ledis Molina, Michaela Šimonová, and Sarah Powell

> "Which is better? To believe and say you do not believe, or not to believe and say you believe?"
> —Words of Mariana Núñez de Carvajal, Crypto-Jewish woman sentenced to be burned at the stake after an *auto de fe* in Mexico City (March 25, 1601)

Missouri State University and the MSU Honors College—in conjunction with our international partner, *Universidad Anáhuac Mayab* in Mérida, Yucatán, México—are using new digital technology in virtual and augmented reality to make global connections and contributions to research and pedagogy. From exploring molecular models in three dimensions to traveling back in time to early 17th century Mexico, Missouri State University and its Meyer Library stand on the cutting edge of the digital revolution in collaborative interdisciplinary research in virtual and augmented reality.

In 2017, the Meyer Library created a dedicated space for the development and beta testing of virtual and augmented reality technology. The digital tools for this revolution in interactive classroom technology are found in the Library's *Achievement Studio: Promoting Interdisciplinary Research and Education* (ASPIRE), which serves as a workspace for faculty, international exchange partners, and students to pursue projects in interdisciplinary working groups.

Within the new fields of digital humanities, the use of virtual reality simulations and interdisciplinary re-creations of historical Virtual Worlds offer powerful tools for active leaning. These new technologies give access to the world at large, expanding students' experiences of cultural, historical, and religious difference. By bringing faculty, students, and international researchers together collaboratively in global projects of research, such re-creations help model for all involved a respect for multiple perspectives and cultures—the sort of respect that underlies cultural competence, one of the pillars of Missouri State's Public Affairs mission.

Committed to open access and digital humanities research, the *Digital Auto de Fe of 1601* gives the Ozarks region access to an entire Virtual World of colonial Mexico. Using the UNREAL® virtual reality software developed by Epic Games, Inc., the project re-creates the Mexican Inquisition's 1601 *auto de fe* as a historical simulation, featuring an interactive high-fidelity videogame-like visualization in a high-resolution format. Through an open access website (https://www.auto-defeinnewspain1601.com), the project aims, additionally, to make the Virtual World simulation available to all without cost. The *Digital Auto de Fe* can be used in middle and secondary schools, in college classrooms, and by humanities researchers interested in the complex and polemical history of the Spanish Inquisition.

The ultimate goal is to develop a virtual research environment for the study of the public performance of the Mexican Inquisition's celebrations of the *auto de fe*.

The *auto de fe*, or "act of faith" in English, served as the most elaborate public spectacle in what was otherwise the most private and secretive action of an Inquisitorial Tribunal. Although most previous scholars have identified the *auto de fe* as ostensibly a form of religious ritual, more recent scholarship has begun to understand that the Spanish Inquisition's *auto de fe* ceremonies served not only religious, but also political, cultural, and didactic purposes.[165] Combining the politics of both the secular and the religious and imbuing its ceremony with hierarchical and political messages—messages that concerned the nature and structure of social and racial hierarchies—the Inquisitorial *auto de fe* served to warn the Catholic faithful of the dangers of heresy. It also served to delineate the proper hierarchical social and cultural spaces of what the Catholic Church and the Spanish Crown believed were the natural order of Spanish colonial society.[166]

The innovative use of digital technology enables a multidisciplinary re-creation of the setting, sounds, sights, and events related to the public celebration of one of the better documented *autos de fe* in New Spain: the *auto de fe general* of 1601. To achieve this, the project combines the interdisciplinary skills of historians, costume designers, historical architects, illustrators, computer programmers, and digital designers. Drawing on the available visual and textual primary source records as well as on archaeological evidence, it utilizes software for architectural modeling and acoustic simulation. The result is a reconstruction, as accurate as possible, of the setting, events, and public pageantry of this awe-inspiring event.

Creating a Virtual World of 17th Century Mexico City to Study the Mexican Inquisition and its Lived Human Experiences

> We understand that the past did not happen in 2D and that it cannot be effectively studied or taught as a series of disconnected static images.
> —Donald H. Sanders, "Why Do Virtual Heritage?" (2008)

Using historical simulations and virtual reality to teach is not a new concept; however, it is only now emerging as a viable way to teach history.[167] Recently, groups have used historical documents to create simulations, immersive environments, and virtual worlds that serve to provide historically accurate information to students and to draw interest.[168] The idea for the *Digital Auto de Fe* came out of a master's thesis by Justin Duncan. Duncan's thesis focused on the spatial representation of power by the Inquisition.[169] The project has attempted to answer several historical questions that seem simple but are very difficult to assess if only the methods of traditional humanities research and textual analysis are used. Only by re-creating the events, scenes, sights, and sounds of the *auto de fe* held in Mexico City on March 25, 1601 in a real-time 3D virtual world can the viewer (student/scholar) come to appreciate the frightening process of organized public terror created by an Inquisitorial *auto de fe*.

To date, most efforts in the re-creation of what scholars have termed Virtual Worlds or Virtual Cultural Heritage have aimed at accurate representations of historic structures, cultural objects, or artifacts.[170] In most historical uses of virtual reality technology, little attention has been paid to how human actors and human institutions interacted with the built environment. Similarly, little time is spent in examining how the human aspects of daily life shaped the cultural heritage or built environments under study. The virtual reconstruction of the life of the buildings, objects, or artifacts and their "human story" have remained intangible for the most part, though these life stories and human aspects of the (re)built historical environments are the "'intangible heritage' to which contemporary people can actually relate."[171]

Digital historical models of buildings and spaces offer only a glimpse at one aspect of the past—a snapshot in time—albeit a glimpse with some sense of precision, given the use of new technologies in combination with historical archival and archaeological and architectural methods of accurate reconstruction. The human usage of the spaces of the built environments of the past, and the human attitudes and cultural traditions which occurred in relationship to or within these built historical structures, are far more difficult to re-create than the physical manifestations of historic buildings, cities, states, etc. The human element of historical actors of the past and of their interactions with the historically reconstructed space remains a gap in current research. As scholars have lamented, these so-called Virtual Heritage Environments or Virtual Worlds "suffer from the lack of 'thematic interactivity' due to the limited cultural content and engaging modules largely used in photorealistic video gaming systems."[172]

The first phase of our joint international research project, *The Digital Auto de Fe*, has sought to integrate the human aspect of the real lives and experiences of people who encountered the repressive apparatus of the Mexican Inquisition—whether as accused heretics, as officials of the Holy Office, or as spectators (drawn from the general public) at a major public event of punishment known as an *auto de fe*. By examining the spatial nature of the *auto de fe* and the dis-

165. For the major historiography on the *Auto de Fe*, see Francisco Bethencourt, "The Auto de Fe: Ritual and Imagery," *Journal of Warburg and Courtald Institutes* Vol. 55 (1992): 155-168; Alejandro Caneque, "Theater of Power: Writing and Representing the Auto de Fe in Colonial Mexico," *The Americas* vol. 52 no. 3 (1996): 321-343; and Maureen Flynn, "Mimesis of the Last Judgment," *Sixteenth-Century Journal* vol. 22 no. 2 (1991): 281-297.

166. For the best discussion of the symbolism and significance of public spectacle in colonial Mexico, see Linda Curcio Nagy, *Great Festivals of Colonial Mexico City: Performing Power and Identity* (Albuquerque, NM: University of New Mexico Press, 2004).

167. See Jeremiah B. McCall, *Gaming the Past: Using Video Games to Teach Secondary History* (New York: Routledge, 2011). The epigraph above cites Donald H. Sanders, "Why Do Virtual Heritage?" in *Archaeology: A Publication of the Archaeological Institute of America* (March 13, 2008), retrieved June 1, 2019 (https://archive.archaeology.org/online/features/virtualheritage/).

168. For just a few of the recent similar projects, see the following:

- *Pox in the City* (http://loki.stockton.edu/~games/PoxFinal/Pox.html): *Pox* is a digital roleplaying game in the history of Medicine.
- *Virtual Paul's Cross Project*: A Digital Re-Creation of John Donne's Gunpowder Day Sermon, London1622 (https://vpcp.chass.ncsu.edu/): This VR project recreates the experience of hearing John Donne, the English Dean of St. Paul's Cathedral, deliver his sermon commemorating the failed Gunpowder Plot (November 5, 1622) in the Cathedral courtyard in London.
- *Virtual Harlem* (https://www.evl.uic.edu/aej/papers/cga-harlem.pdf): This VR project "lets students experience the Harlem Renaissance of the 1920s and 1930s as a cultural field trip," allowing a single-player avatar to move freely around, giving an immersive experience of the city streets and sights.
- *Romelab* (http://hvwc.etc.ucla.edu/): UCLA's *Romelab* is a multidisciplinary research group whose work uses the physical and virtual city of Rome in studying the interrelationship between historical phenomena and the spaces and places of the ancient city.

169. Justin Duncan, "Performing Theaters of Power: The Holy Office of the Inquisition's General Autos de Fe in Spain and Spanish America and the Visual and Physical Representation of Inquisitorial Power, 1481-1736" (2014), M.A. Thesis, Missouri State University (https://bearworks.missouristate.edu/theses/1170).

170. See Mohamed Gamal Abdelmonem, Gehan Selim, Sabah Mushatat, and Abdulaziz Almogren, "Virtual Platforms for Heritage Preservation in the Middle East: The Case of Medieval Cairo," *Archnet-IJAR* vol. 11 no. 3 (2017): 28-41.

171. Abdelmonem et al., "Virtual Platforms for Heritage Preservation," p. 28.

172. Abdelmonem et al., "Virtual Platforms for Heritage Preservation," pp. 28-29.

tribution and use of public space in early 17th century Mexico City, this project has taken what some have called the "spatial turn" in the digital humanities.[173] Thus, this phase of the project focuses on the interactions of historical personages with the built environment of the 17th century Palace of the Mexican Inquisition; it focuses as well on the relationships of these historical actors with the functions of the institution of the Inquisition, and on their interactions and experiences within, outside, and around the re-created ritual, cultural, and judicial space of an Inquisitorial Palace.

Modeling Cultural Competence and Teaching Empathy in a Digital Humanities Context

One of the primary goals of this project is to emphasize the relevance of humanistic and historical scholarship on religious intolerance in the past to contemporary debates over modern issues of religious and racial persecution. By examining the nature of religious intolerance and persecution through the story of one young Jewish woman's ordeal and forced participation in the *auto de fe* of 1601, we explore ways of creating empathy in modern audiences, encouraging tolerance and mutual understanding through historical simulation: By this means, we aim to counter the recent, increase in anti-Semitism and other alarming trends of religious intolerance.

As we have noted, recent scholarship has come to understand the political, cultural, and didactic purposes of the Inquisition's *auto de fe* ceremonies. Our challenge, therefore, is to re-imagine how its sermons and public sentences, being social and political as well as religious gatherings, functioned to bring together church, state, and people for punishment, instruction, inspiration, and the creation of a common cultural identity. The project will provide detailed information about 17th century architecture, dress, religious symbolism, and common processionary procedure of the time period, all of which will enhance our current knowledge of the human experience of life in 17th century New Spain.

Another major goal of this project is to demystify the institution of the Inquisition. The project will provide access to a vast amount of information about the structure, organization, and day-to-day activities of the Inquisition—information that will be made available to the general public for the first time. The project also re-creates in detail the major buildings and architectural features of the streets along the processional route. First among these historical re-creations of 17th century Mexico City is the virtual reality reconstruction of the Mexican Inquisition Palace and its developmental stages: By bringing the architecture of Mexico City in 1601 alive for the interactive viewer, it offers both students and scholars the rare opportunity to experience a major 17th century city in its splendor. A team of architectural historians have helped with the re-creation and design of historically accurate buildings and built environments, offering an intensively researched focus on the utility and usage-flows of these buildings by real historical actors.

To create empathy and encourage tolerance—two important aspects of humanistic studies of the past—the *Digital Auto de Fe* project attempts to design and implement several interactive and 3D digital re-creations that visually and interactively portray for the scholar, teacher, and student the human experiences, pains, shame, and public punishments related to these acts of religious intolerance.

The basic research questions that the project team hopes to address with this re-creation of the Virtual World of Mexico City in 1601 are as follows:

173. For a good discussion of the "spatial turn" in digital humanities, see Richard White, "What Is Spatial History?" (Stanford University Spatial History Project, 2010).

What would a penitent have actually seen and experienced during the procession of an *auto de fe*?

With an avatar-style approach, the viewer (student/scholar) will be given a direct point-of-view access to the experience of any one of the actual historical actors who participated in the *auto de fe* of 1601.

Placing the viewer "inside" the persona of a convicted heretic will help create empathy and better understanding and a personal connection to the past.

Dialogues, conversations, and speeches can be experienced in either 17th century Spanish or in English translation, with virtually accurate acoustically re-mastered sounds, music, and other visual and audio stimuli that might have been experienced by a spectator of the event.

These types of virtual visualizations and re-creations can also help highlight the painful nature of anti-Semitism, highlighting the problems and pains involved with religious and racial and ethnic intolerance—problems very much at the center of the human condition even today.

How would a lower-class or mixed-race *casta* resident of Mexico City have perceived and experienced the event of the *auto de fe*?

What would the view of various spectators have been, based on their varying positions, social class, and/or racial caste?

How and in what way would the Inquisitors and highest-ranking members of the religious and political elite manifest their power through the spatial creation and manipulation of height, position, and religious and political symbolism?

By viewing the staging and event from the visage and point of view of an Inquisitor, the scholar and student can come to understand issues relating to the spatial representation of power, and also understand the hierarchically stratified nature of the society in New Spain.

By modeling and analyzing these and other research questions, the *Digital Auto de Fe* will serve as a useful tool in examining issues of gender, race, class, status, and political position in colonial Latin American society. With further applications and usefulness beyond the virtual re-creation of the *auto de fe* itself, this project will offer the viewer the chance to delve deeper into the society, culture, and race relations of colonial Mexico City at the turn of the 17th century.

Encountering Culture in a Virtual World: Teaching Race, Caste, and Class through Virtual Simulations

Another goal of the *Digital Auto de Fe* is to portray the relationships among clothing, social status, and caste identity. The dress and costumes of the period represented the power and authority that individuals held within their social and racial position.[174] Each type of dress and accessory held a specific meaning, portraying either the status or power of the wearer or the lack thereof. Many groups of people participated in the ceremony, from the poor to the wealthy and powerful.

174. Royal sumptuary laws prohibited certain *castas* from wearing various types of textiles. For an example of the role of the Inquisition in policing these laws, see Martha Sandoval Villegas, "Indecencia, vanidad y derroche en algunos trajes novohispanos de fines del siglo XVII: Conceptualización del mal a través de la indumentaria," in Erik Velásquez García (ed.), *Estética del mal, memorias del coloquio Internacional de Historia del Arte* (UNAM, 2013),pp. 49-83.

The Viceroy of New Spain, Gaspar de Zuñiga y Acevedo (1596?). *Courtesy of Museo Nacional de Historia, Mexico City.*

Clothing and costumes served as an essential means in Mexican society of distinguishing social groups from one another. Therefore, not only will the project re-create the dress of the time period, but there will be an array of information on the specific symbolism of the clothing and designs used by the characters (see Fig. 1).

Figure 1. The Viceroy of New Spain, Gaspar de Zuñiga y Acevedo. *Character created by MSU Student, Ledis Molina.*

The project aims to show era-specific clothing for each participant in the ceremony, as well as the clothing of the general populace that witnessed the event along the street. Each character is fully interactive and their dress, race, caste, and social status are explained in detail. The racial and social makeup of Mexico City in 1601 will be portrayed proportionately, based on the available census and population documents known as *padrones*. In this manner, the relative number and ethnic identities of characters and bystanders will represent an approximated view of the varied racial and *casta* makeup of Mexico City in the early 17th century (see Figs. 2-3).

Illustration and design work involving several of the major characters used in the Virtual World have been mocked up by graphic artists Dave Gibbon,

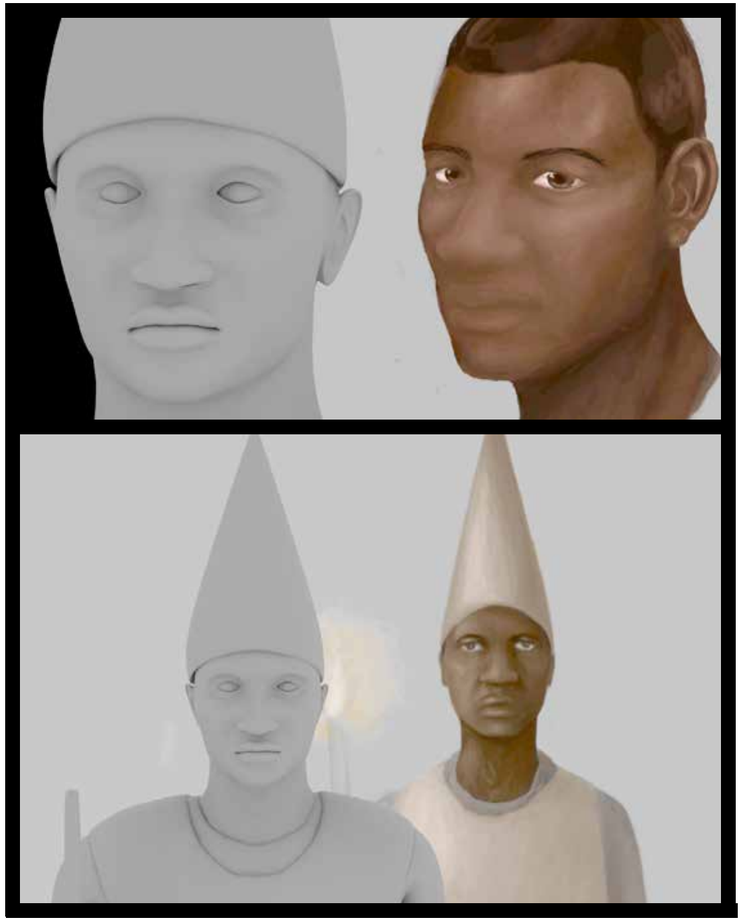


Figure 2. Concept art for the initial facial design of the African Slave, Juan Mozambique, assistant of the chief jailor of the Mexican Inquisition. *Concept art by Michaela Šimonová, digital conversion by Ledis Molina.*

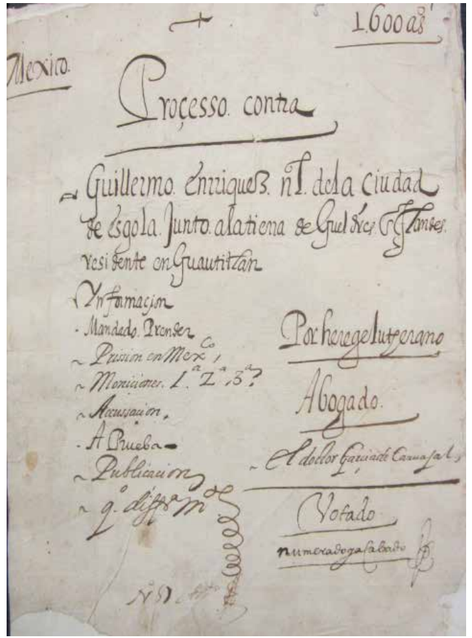
Figure 3. African Slave, Juan Mozambique. *Concept art by Michaela Šimonová, digital conversion by Ledis Molina.* Mozambique was tried for illegally taking secret notes to the prisoners and processed in the *auto de fe* of 1601.

Ledis Molina, and Andrea Flores Navarrete. Michaela Šimonová and a separate team from the Comenius University of Bratislava, working in conjunction with MSU Honors student Sarah Powell and other student artists, are currently aiding in the creation of more concept art; designs for further digital characters are in various stages of development.

Spanish language transcription, translation, and analysis of the original archival primary sources of the Mexican Inquisition form the core of the historical documentation. Dr. Argelia Segovia Liga leads the team of historians and students who are currently accessing, analyzing, and transcribing materials from one of the largest and most complete surviving archives of any Inquisition Tribunal, the Mexican Inquisition's surviving documentation from the *Archivo General de la Nación* in Mexico City. A significant number of original sources are also found in private libraries and museum collections in the United States, such as in the Conway Collection at the Helmrich Center for American Research (part of the Gilcrease Museum and Collections in Tulsa, Oklahoma); taken together, these offer a very intimate and minutely documented look at the past of this repressive institution and its historical actors, officials and, in many cases, its victims. One set of documents (to be discussed in a separate digital publication in BearWorks Digital Commons) will be the trial transcripts of the case against Guillermo Enríquez, a Flemish sailor and one-time privateer.

Studying Human Interactions with the Built Space: Virtual Reality Re-Creation of the Palace of the Mexican Inquisition

In the execution of these goals, the *Digital Auto de Fe* focused in its first phase on the central *traza* or grid plan of the 17th century Mexican capital city in general and, more specifically, on the plaza of Santo Domingo,



"Inquisition trial against Guillermo Enríquez, native of Flanders for heresy" (1600). *Conway Collection of the Helmrich Center for American Research, Gilcrease Museum.*

whose centrally located palace complex once held the Tribunal of the Holy Office of the Inquisition (see Fig. 4). In studying more than just the built environment, this project has investigated and incorporated numerous historical, cultural, archaeological, and architectural methods, sources, and interpretations, in order to offer a historically supported virtual re-creation of the cultural heritage of 17th century Mexico City.

Figure 4 : Plaza de Santo Domingo in Mexico City, with view toward the Palace of the Mexican Inquisition as it appeared *ca.* 1655. *Virtual re-creation by Dulce Martinez Roldán.*
Interactive visualization can be seen here: https://kuula.co/post/7PHQJ

In 2016, after extensive preliminary work on the themes and initial digital character designs, an opportunity arose in the MSU Honors College to expand its international partnerships with the *Universidad Anáhuac Mayab*. A specialized research exchange program created in 2017 between the two institutions launched the second phase of this project under the co-direction of Dr. Antonio Rodriguez Alcalá (professor of Architecture and Virtual Cultural Heritage reconstruction at *Anáhuac Mayab*), who now serves as the project's chief architectural consultant, and Dr. John F. Chuchiak IV (MSU professor of Colonial Latin American History), who serves as chief historical consultant in conjunction with historian and Springfield Public School teacher, Justin Duncan.

With an international collaborative research agreement in place, the MSU Honors College and the School of Architecture at *Anáhuac Mayab* began a fruitful research and student exchange program focusing on expansion of the project's second phase. Incorporating at this stage intensive research by students of architecture from Mérida, Mexico, and Honors College students from MSU in the fields of history, language, linguistics, art and design, and several other disciplines, this interdisciplinary international working group began its re-creation of the 17th century Palace of the Mexican Inquisition. As the project has developed, a much larger international interdisciplinary research team evolved: Following the Fulbright Research Fellowship at MSU of Dr. Milan Kováč (professor of Ethnology and Cultural Anthropology at Comenius University), students and concept artists from Comenius University of Bratislava, Slovakia have added their own skills, talents, and expertise, with Dr. Kováč's students joining the various research teams.

The symbiosis of research fields and disciplinary methods is being applied in a research project whose main purpose is to bring back to life some of the key

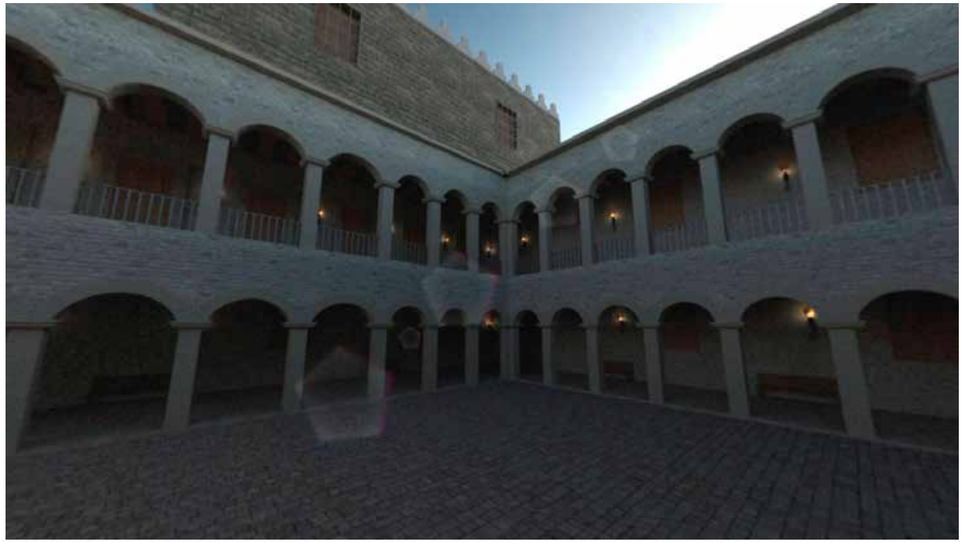
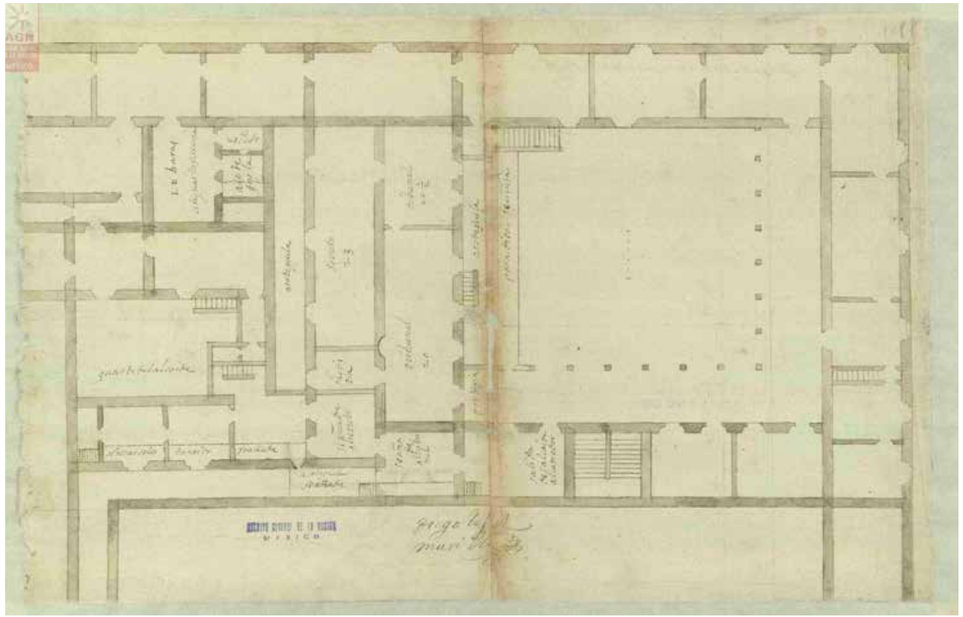


Figure 5. Interior central patio of the Mexican Inquisition Palace (*ca.* 1655). *Virtual re-creation by Dulce Martinez Roldán.* Interactive visualization can be seen here: https://kuula.co/post/7PH9j

elements in the development of the institution known as the Tribunal of the Holy Office of the Inquisition. Through the combination of (and interactions between) the humanities and information technologies, this second phase has focused on the virtual reconstruction of two of its most representative spaces: the Second Audience Chamber of the Mexican Inquisition Tribunal, and the Secret Archive and Library Room of the Holy Office. The richness of the historical subject and its surviving documents allows the integration of research outcomes from several disciplines (using historical documentation, virtual architectural and artistic reconstruction, virtual museum spaces, and the study of the evolution of the built environment) all in the same project (see Fig. 5).

Due to the nature of the available information and surviving inventories (which contain descriptions of equipment, furniture, provisions of elements, the flow of historical human actors, and their user-flows within the palace structure), it has been possible to create a historically documented and visually enriched Virtual World. The integration of the digital technology and its methods became the next step, which consisted of moving this 2D historical documentation into the digital realm of three-dimensionality. That is, the reconstruction phase began with the use of



Map and plan of the interior of the Palace of the Mexican Inquisition (*ca.* 1655). *Archivo General de la Nación, Mexico City.*

two-dimensional drawing software to re-create the architectural plans of the Inquisitorial spaces within the Mexican Inquisition Palace; this reconstruction was based on a 1655 plan of the architect Diego López Murillo, which exists in the collections of the National Archives in Mexico City.

Subsequently, the team modeled the interiors based on the architectural typologies of the time, using standard types of masonry walls, wooden coffered ceilings, and wooden doors, among other aspects of the built space. Within the model, a rigorous system of notation was maintained, leading to a uniform system of codes to document evidence and the sources of historical, architectural, and archaeological information used in the historical reconstructions.

The placement phase of the integration of art assets of the Virtual World was rigidly regulated by historical documentation, which included detailed inventories, descriptions, and visitation records of the Mexican Tribunal, all of which indicated with great

Figure 6. Preliminary version of the Sala del Secreto, or the Secret Archives of the Mexican Inquisition. *Virtual re-creation by Antonio Rodriguez Alcalá, with material and cultural objects designed by María del Carmen Rodríguez Viesca.* Interactive visualization can be seen here: https://kuula.co/post/7PHzs

precision the location of each official and their equipment and accoutrements, as well as the placement of their furniture, cultural materials, etc. Environmental elements, such as the placement of Inquisition trial files on the shelves of the Secret Archive, were incorporated by taking into account the characters involved and historical descriptions of the layout of the Secret Archives of the Inquisition (see fig. 6).

The environmental conditions were also replicated with care: Since many of the interior rooms were dark interior spaces without windows, they remained totally occluded from natural lighting and required the creation and placement of candles, lamps, and other historically accurate materials and means of lighting; these provided the rebuilt space with the physical and ambient characteristics of the actual surroundings (see Fig. 7). The privacy and secrecy demanded in the audience chambers of the Mexican Inquisition required the use of re-created lighting based on candles and other torches mounted on chandeliers which, when incorporated, offered a more realistic re-creation, impressing upon the viewer the fear and terror that a suspect might experience when brought into one of the smaller, dimly lit audience chambers of the Inquisition.

The contrast of the darkness of the Inquisition Tribunal's interior chambers with the light and open patio plan of the main entrance areas (and even with

Figure 7. Preliminary version of the Sala de la Audiencia "de los retratos" of the Mexican Inquisition, with ambient lighting as the chambers would have appeared in the 17th century. *Virtual re-creation by Antonio Rodriguez Alcalá, with material and cultural objects designed by María del Carmen Rodríguez Viesca.* Interactive visualization can be seen here: https://kuula.co/post/7PH9j

the patio of the secret prison section of the palace) is stark, serving as a reminder that Inquisitorial imprisonment was meant more for holding prisoners for the duration of their trials than for long-term imprisonment as a form of punishment (see Fig. 8).

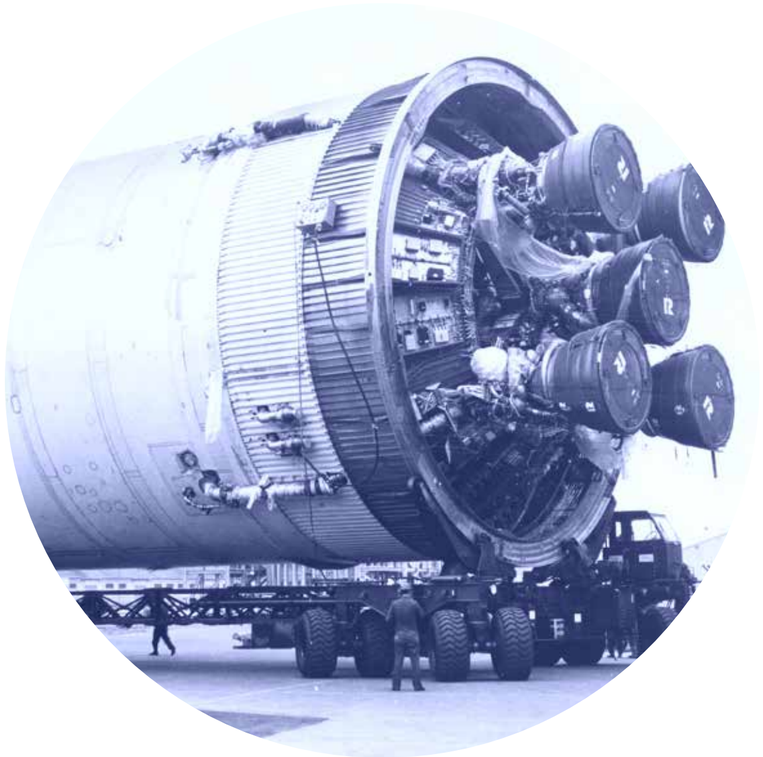
The Pedagogical and Ultimate Research Results of the Project

In targeting its audience, the *Digital Auto de Fe* aims to attract more than just scholars and advanced researchers. The principal goal is to educate the public about the Inquisition's *auto de fe*, as well as to illustrate aspects of life in colonial Mexico. Professors and teachers worldwide teach courses on the Inquisition, and this project seeks to increase the instructors' and students' knowledge through Virtual World re-creation. The technology allows teachers to show the simulation in class to a whole group, to make it an individual class assignment, or to assign the simulation to be watched and interacted with at home. In addition, resources will be provided for teachers and students to assess understanding and learning objectives.

As a Virtual World of Mexico City in 1601, the project offers advanced scholars the ability to engage with the simulation as a research tool. Scholars of both the Inquisition and of colonial Mexico will find in the

Figure 8. Interior courtyard patio of the secret prisons of the Mexican Inquisition.
Virtual re-creation by Dulce Martinez Roldán.
Interactive visualization can be seen here: https://kuula.co/post/7lK49

materials and reconstructions of the built environment, as well as in the representation of the social, racial and ethnic backgrounds and costumes of the characters, a wealth of information for research purposes. The linked primary sources, images, maps, and other historical documents and archaeological artifacts will offer advanced scholars a virtual museum filled with materials both textual and physical to work with and utilize in their research and pedagogy.



*Techn*Ozarks:

Essays in Technology, Regional Economy, and Culture

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The Ozarks Studies Institute of
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Springfield, Missouri
2019

Droning the Ozarks:

Innovations in 3D Topography

Toby Dogwiler

Valley Water Mill Dam: 3D point cloud showing dam and profile. *Courtesy of Toby Dogwiler, MSU Department of Geography.*

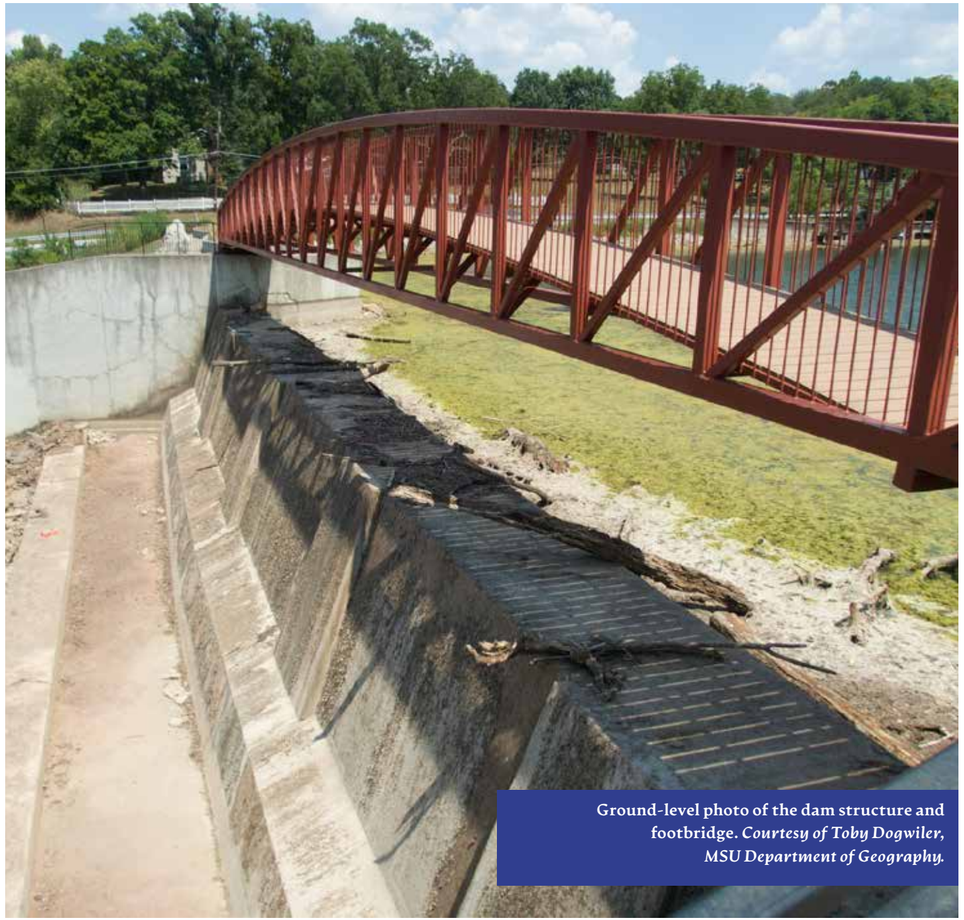
A confluence of technologies—of drones, digital photography, and computer modeling software—are revolutionizing research and teaching in geography and related disciplines. The following are some local examples of drone photography and photogrammetry prepared by faculty and students in the MSU Department of Geography, Geology, and Planning.

Imaging the Valley Water Mill Dam

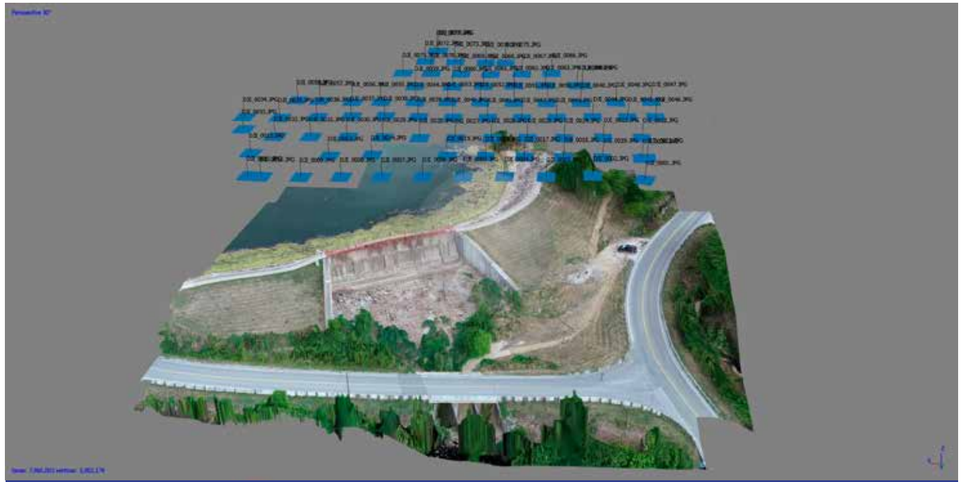
At the northern edge of Springfield just to the east of N. Farm Rd. 171 lies Valley Water Mill Park. The Watershed Committee of the Ozarks is headquartered by the pond that is created by the dam that is shown in 3D above. This three-dimensional model was generated through a process called structure-from-motion photogrammetry. A series of overlapping photos taken by drone are combined to create a three-dimensional representation of the landscape. The following is one of seventy-seven orthogonal photos used to construct the model.

In the composite image that follows, the blue squares hovering over the model indicate the location where each photo was taken. The mission planning software that controls the drone ensures that each photo overlaps about 80% with adjacent photos at the top and sides. The resulting three-dimensional model has a resolution of approximately a centimeter per pixel; its accuracy, similarly, lies within a centimeter.

Valley Water Mill Dam: orthogonal photo taken by drone. *Courtesy of Toby Dogwiler, MSU Department of Geography.*



Ground-level photo of the dam structure and footbridge. *Courtesy of Toby Dogwiler, MSU Department of Geography.*



Valley Water Mill Dam: 3D mapping software. *Courtesy of Toby Dogwiler, MSU Department of Geography.*

In the "old days" of traditional plane surveying, it would have been impossible to obtain such high-resolution topographic data. Drone-based photogrammetry allows small areas such as this to be mapped rapidly—within an hour or two. For photogrammetry, most time in the field is spent surveying ground control points; these are used to geospatially calibrate the 3D model, ensuring that subsequent model-based measurements and analyses are accurate in terms of distance, area, and volume.

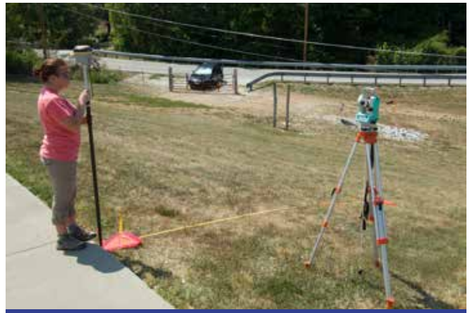
In a photo on the facing page, a student holds a real-time kinematic (RTK) GPS that receives satellite positioning data, while the theodolite (to the student's right) measures variations of distance and elevation in terrain. Through a combination of RTK and theodolite data, the orange triangle at her feet—a ground control point for calibrating the three-dimensional model—can be accurately georeferenced with respect to latitude, longitude, and elevation. (Again, the accuracy achieved by these technologies falls within a centimeter.)

Surveying Flood Damage on the North Fork of the White River

While the Valley Water Mill Dam proved a useful exercise in technology, this next project proved far larger in scope.

In April 2017, heavy rains led to devastating floods throughout the Ozarks. Some of the worst flooding occurred on the North Fork of the White River in Mark Twain National Forest. Given the dense forest and underbrush, much of this area is difficult to

Drone and triangles used as ground control points. *Courtesy of Toby Dogwiler, MSU Department of Geography.*



Geology student with RTK GPS and triangle. *Courtesy of Toby Dogwiler, MSU Department of Geography.*

access. In assessing the damage, my colleagues and I gathered data on the river's riparian zone through some old-school on-the-ground observations and surveys combined with drone-based photography and three-dimensional modeling.

As the following photos attest, it's by drone that one appreciates the full extent of damage to the North Fork's once-forested riparian zone.

In the first photo below, note the toppled bridge pier in the stream and the bridge deck removed by floodwaters, deposited several hundred feet downstream. The second photo is an orthogonal image of the same area, with the drone camera pointed straight down, perpendicular to the land surface. The third photo shows the awesome power of floodwaters: Prior to flooding, the forest covered the full zone up to the river's edge.

Clearly, drone-based photography provided the broadest perspective of the flood damage. As well as base maps for our ground-level observations, the drone images also enabled computer-generated mapping and analysis of areas that would have proved too large for field personnel to visit and assess efficiently.

Being a science of observation and measurement, geography has gained some powerful new tools: Already, they are changing the way we see the Ozarks.

Drone photography of flood damage, North Fork of the White River (2017). *Courtesy of Toby Dogwiler, MSU Department of Geography.*

Drone photography of flood damage, North Fork of the White River (2017). *Courtesy of Toby Dogwiler, MSU Department of Geography.*

Drone photography of flood damage, North Fork of the White River (2017). *Courtesy of Toby Dogwiler, MSU Department of Geography.*