A

ACQUIRED IMMUNODEFICIENCY SYNDROME

SEE AIDS

AGENT-BASED MODELING

Agent-based modeling (ABM) is a technique used to build computer simulations. ABM allows for the creation of synthetic, but ultimately realistic, artificial geographic worlds in which events, phenomena, processes, and scenarios can be created and studied flexibly. ABM is an important tool in human geography employed in evaluating hypotheses and ideas that might not be easily experimented with, evaluating "what if" scenarios that cannot be tested otherwise, or relating to future conditions that cannot be sampled.

ABM is a part of a growing geographic methodology based on geocomputation and geosimulation. Both approaches mark a departure from traditional models focused on exchange of human geographic units between coarsely represented divisions of space. Newer models based on ABM are more likely to be built as simulations with massive amounts of intelligent geographic entities, each represented at the atomic scale, connected and interacting dynamically in space as complex adaptive systems.

Agent-based models belong to a family of models called automata. Automata have distinguished origins in pioneering work on digital computing during the 1930s and 1940s. Automata tools were first employed in geography as cellular models during the early 1970s, with the methodology evolving toward ABM during the 1990s. An automaton is a simple information processor just like the processors in digital watches and computers. Automata have some key properties that render them useful for model building. They have states that allow attributes to be encoded to them, changed, and stored. Automata have some representation of time that catches state conditions at discrete temporal points. They also contain transition rules that govern changes between states as time progresses. Rules are formulated as (computational or mathematical) functions that accept state information input from other automata, and this can be derived from neighboring automata within a specified local neighborhood of influence, as is characteristic with cellular automata.

Agent automata extend this basic framework, adding attributes borrowed from research on behavior and artificial intelligence. These attributes are very relevant for work in human geography. Agents are heterogeneous, contrasting with more traditional models that treat entities as "average individuals". Agents are also proactive and may act to realize a goal or set of goals. They may have perception—the ability to sense other agents and environments—often based on an internal cognitive model. Importantly, agent interaction may take many forms: communication, active and intentional querying of other agents, human–environment effects, and so on. Agents are also adaptive and may change their rules of behavior based on experience within a simulation.

Agent tools are used in a variety of applications in human geography: pedestrian and crowd motion, vehicular traffic, residential mobility, gentrification,

land use and land cover change, urban growth and sprawl, spatial epidemiology, civil violence, socio-spatial segregation, and economic geography.

During recent years, research in this area has focused on applying agent-based models to new phenomena in human geography, and a growing integration between ABM and geographic information systems (GIS) and geographic information science (GIScience). In particular, authors have begun to develop geography-specific methodologies and toolkits based on ABM but with geography as a central building block.

—Paul Torrens

See also GIS; Social Informatics

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AGGLOMERATION ECONOMIES

By clustering in close proximity to one another, firms can lower their production costs. This fact forms the basis of agglomeration economies, or the benefits derived from clustering together, one of the most important forces shaping the economic geography of different types of production. By forming dense webs of production and embedding themselves within them, firms usually can produce more efficiently and profitably.

Agglomeration economies take several forms. *Production linkages* accrue to firms locating near other producers that manufacture their basic raw materials. By clustering, distribution and assembly costs are reduced. *Service linkages* occur when enough firms locate in one area to support specialized support services. For example, the advertising industry in New York is concentrated within a short distance of Madison Avenue. By locating near one another in dense networks, firms can monitor up-to-date information and gossip on the latest trends, markets, clients, hires, and products. *Marketing linkages* occur when a cluster is large enough to attract specialized distribution services. For example, the firms of the garment industry in New York City have collectively attracted advertising agencies, showrooms, buyer listings, and other aspects of finished product distribution that deal exclusively with the garment trade. Firms within the cluster have a cost advantage over isolated firms that must provide these specialized services for themselves.

Agglomeration economies may be temporary, are found to different extents in different industries, and may offset through various forms of economic, technological, and geographic change. Typically, agglomeration economies reflect some kinds of firms' need for close interaction with clients and suppliers. Thus, they are most pronounced in vertically disintegrated types of production in which firms have many linkages "upstream" and "downstream" in the production process. (In contrast, vertically integrated firms, with relatively few external linkages, are less dependent on agglomeration.) Firms in markets with low degrees of uncertainty (usually due to slow rates of technical change, market structure, or the regulatory environment), in contrast, are less reliant on agglomeration to minimize costs and maximize profits. As firms grow, they often become more vertically integrated and more capital intensive, have fewer external linkages, and come to substitute economies of scale for agglomeration economies.

Because agglomeration economies provide powerful incentives for firms to locate in close proximity to one another, they are most heavily manifested in large metropolitan areas. The prime motivation behind the agglomeration of firms in metropolitan regions is the ready access they offer to clients, suppliers, and ancillary services, most of which is accomplished through face-to-face interaction. Often personal relationships of trust and reputation are of paramount significance. Thus, agglomeration maximizes access to information, much of which is irregular and unstandardized, and helps firms to minimize uncertainty. Firms in these locations have an advantage, within limits, over similar firms in more rural areas. Cities provide markets, specialized labor forces and services, utilities, and transportation connections required by manufacturing. *Urbanization economies,* therefore, are a combination of production, service, and marketing linkages concentrated at a particular location. Agglomeration forms the basis for the comparative advantage

of cities in forms of production that typically consists of relatively small, vertically disintegrated firms in highly competitive markets with high degrees of uncertainty and change.

Agglomeration economies have been manifested in different industries throughout the historical geography of industrial capitalism. They were critical during the early Industrial Revolution, when many small firms in industries such as watch making and gun manufacturing clustered in the cores of British cities. Since the emergence of post-Fordist "flexible production" during the late 20th century, the competitiveness of regions such as California's Silicon Valley, Italy's Emilia-Romagna, and Germany's Badden-Wurtenburg has relied heavily on agglomeration. Finally, producer services (business and financial services that cater primarily to other firms) rely heavily on agglomeration economies, often in "global cities", forming complexes of service firms comparable to other types of highly concentrated production.

—Barney Warf

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AGRICULTURE, INDUSTRIALIZED

Geographers have tended to study industrialization from an urban perspective, largely overlooking its relationship to rural landscapes. This urban bias limits our ability to see that urbanization could not have occurred without technological change in agriculture that allowed fewer farms to produce more food. This freed other farmers to become part of the urban working class. This entry describes the origins and impacts of industrialization on agricultural production and rural landscapes.

INDUSTRIALIZATION OF AGRICULTURE

Industrialization includes the mechanization of processes previously done by human hands. It also involves the reorganization of labor practices and the application of new energy and transportation technologies to increase the rate at which humans transform nature into goods. Increased output also requires new markets. Hence, the industrialization of agriculture involves widespread change in four areas: (a) supply of farmland, (b) public policy, (c) technological change, and (d) agribusiness consolidation along the value chain.

Prior to the 20th century, American farmers practiced an extensive form of agriculture. As demand for food increased, farmers expanded into new territory. New plows invented by John Deere made it easier to till fertile but heavy prairie soils. However, agricultural production increased because more acres were planted, not because yields per acre increased during this time. Conditions changed when the frontier closed at the end of the 19th century. With no new land to cultivate, output could grow only through increasing yields. This marked the beginning of intensive agriculture.

Public policy decisions created a foundation for industrial agriculture. The U.S. Department of Agriculture (USDA) was established in 1862. In the same year, the Morrill Act stipulated that each state should have one "land grant" college where agricultural sciences could be taught. During the early 20th century, political leaders noticed that American agricultural productivity lagged behind that of England and Germany. President Theodore Roosevelt launched the Country Life Commission, which concluded that productivity could increase only if the infrastructure of rural America was modernized. Recommendations included reforming rural schools to teach students agronomy and improving the road system to better transport produce to markets. The USDA continues to promote industrial agriculture through subsidies, research, and supply management, for example, by redistributing surplus commodities through the Food Stamp program.

Productivity increased dramatically through the mechanization of farms. In 1910, there were an estimated 1,000 tractors in use. By 1940, that number had risen to 1.6 million—a number that tripled to 4.8 million by 1965. Increasing horsepower and tractor versatility also contributed to productivity increases. Wheat and corn yields were 15.4 and 30.0 bushels per acre, respectively, in 1940. By 1970, the corresponding numbers had more than doubled to 31.8 and 80.8 bushels per acre. Productivity increases also occurred because of advances in genetic engineering, pesticides, and fertilizers, among other farm inputs.

Industrialization has transformed the agricultural sector beyond the farm as well. As a raw commodity

such as corn leaves the farm, it follows a so-called value chain that includes processing, distribution, and retail on its way to consumers. At each step, value is added to the commodity as it is transformed into products and moved closer to consumers. The problem for farmers is that large agribusinesses are working to control more and more of the value chain. Multinational firms (e.g., ConAgra, Cargill) sell inputs such as fertilizer, but they also process commodities. Under these increasingly monopolistic conditions, farmers have less bargaining power to affect the price of inputs they must buy or the crops they must sell. In the end, farmers earn a smaller portion of each dollar spent by consumers because the prices that farmers receive for their crops have stagnated, even though the prices that consumers pay continue to increase.

GEOGRAPHIC IMPLICATIONS

Commodity prices have stagnated because the industrialization of agriculture has increased the supply of farm commodities. Laws of supply and demand suggest that as farm productivity increases, the unit price for the commodity is going to drop. To remain profitable in the face of dropping prices and profit margins, some farmers will increase productivity by investing in new equipment, crop hybrids, or other inputs. To pay for these improvements, farmers are forced to amortize their costs over a larger farm area. This drives a tendency toward farm consolidation as larger, more successful farms take over smaller marginal operations. Consolidation is also driven by changes along the value chain as market pressures force marginal farmers out of business. The result is that farms are getting bigger while the total number of farms is decreasing. In 1940, there were more than 6 million farms with an average size of 180 acres. By 1970, that number had dropped to 2.9 million with an average size of 400 acres. The decline in farm numbers continues but has slowed. There are currently 2.2 million farms with an average size of 440 acres.

Farm consolidation contributes to rural depopulation and out-migration. There are rural counties in the Great Plains and Midwest with populations that peaked during the early 20th century and have slowly declined due in large part to farm consolidation. At the beginning of the 20th century, roughly 50% of Americans were directly involved in agriculture. That figure is now less than 2%. We live in an urban culture because the industrialization of agriculture contributed to a larger, more affordable food supply. However, these benefits have come at a price. Many farm communities struggle demographically and economically. There are also questions about the environment and the sustainability of the current system because of its heavy reliance on petrochemicals.

—Christopher D. Merrett

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AGRICULTURE, PREINDUSTRIAL

Throughout much of the world today, and throughout the bulk of human history (indeed, dating back to the Neolithic Revolution 8,000–10,000 years ago), societies fed themselves through an assortment of preindustrial agricultural systems. Preindustrial or nonindustrial agricultural systems differ from industrialized ones in a variety of respects. Perhaps most important, preindustrial systems do not use the inanimate sources of energy that are vital to industrialized agricultural systems (e.g., fossil fuels) and, therefore, are markedly less energy intensive in nature. Rather, work in preindustrial farming systems is accomplished entirely through human or animal labor power. Thus, these types of farming are much more labor intensive. In societies fed predominantly through preindustrial agriculture, the vast bulk of people are engaged as farmers or peasants. Second, because many preindustrial societies are not fully commodified (i.e., capitalist social relations have not come to dominate every aspect of production), preindustrial agricultural systems are generally organized around production for subsistence rather than production for profit. In other words, food is grown mostly for local consumption rather than for sale on a market.

Preindustrial agricultural systems played an enormous role in history, including the variety of slave-based and feudal social systems that unfolded across much of the world. For example, Roman *latifundia*—large estates worked by slaves—formed the backbone of agricultural production during the empire. The expansion of medieval agriculture into the dense soils of Northern Europe was made possible by the introduction of the heavy plow and, later, the three-field system. The manorial system that formed the social and economic basis of feudal Europe involved peasants and serfs who rented land from large land owners, paying rent with a fraction of their output. Variations of peasant-based production continue to be important in many contexts.

Today, there is a great diversity of types of preindustrial agricultural systems throughout the world, with large variations in the types of crops grown, the methods used, their productivity, and their relative vulnerabilities to drought or other hazards. Although Nomadic herding is not technically a form of agriculture, many observers classify it in this category; however, it involves only the domestication of animals, not crops. Typically, nomadic herders measure their wealth in terms of livestock (generally cattle, goats, or reindeer) and often follow their herds in annual migratory cycles such as transhumance, the movement between summer pastures in higher elevations and winter pastures in lower ones. Nomadic herding has been slowly vanishing throughout the world over the past two centuries, but contemporary examples include the Masai of East Africa, the Mongols of Mongolia and Northern China, the Tuareg of Northern Africa, and the Lapps of Northern Finland.

The best-known example of preindustrial agriculture is slash-and-burn, also known as swidden or shifting cultivation. This form is found only in tropical areas such as parts of Central America, the Amazon rain forest, West and Central Africa, and Southeast Asia, to which it is ideally suited. Roughly 50 million people continue to be fed this way in these regions. Due to heavy rainfall and the leaching of nutrients, tropical soils are generally quite poor and most nutrients are stored in the biomass. The first step in slash-and-burn, therefore, is to cut down existing trees and bushes in a given plot of land and to burn them, releasing nutrients into the soil through the ash. Crops are then planted for several years. However, because the rate of nutrient extraction exceeds the rate of replenishment, the site can be used for only a brief period—generally 2 to 6 years—before the farmers must move on to a new site. Abandoned sites may gradually recover with a sufficient fallow period. If rapid population growth occurs and fallow periods are reduced, the soil may permanently decline in fertility. This form of farming was widely practiced in the Mayan kingdoms prior to the Spanish conquest, and declining soil fertility may have played a role in the collapse of the Mayan states.

A third form of preindustrial agriculture is that of Asian rice paddy cultivation, which is widely practiced throughout a region stretching from Japan, Korea, and Southern China throughout Southeast Asia into Eastern India. This form may be partially or even completely commodified. Rice is the staple crop for billions of people in Asia, and its cultivation in this form goes back millennia. Young rice plants require standing pools of water, and to create spaces in which this occurs, Asian societies carved terraces out of hillsides, controlling the flow of water with vast networks of dikes and small levees. Furrows may be dug using water buffalos. Often small fish may be grown in these pools of water as a source of protein. The planting of rice is extremely laborious and is often associated with stereotypes of Asian peasants engaged in arduous labor in their fields. The supply of water may rely on monsoon rainfalls.

Preindustrial agricultural systems have functioned effectively for thousands of years and continue to do so in many parts of the developing world. In contrast to common stereotypes that such systems are stagnant or unchanging, Ester Boserup showed that rising populations in such places often stimulate productivity growth. In most places, preindustrial systems are marginalized or threatened by the expansion of globalized, capitalist, industrialized farming systems, including imports of subsidized grains from Europe or North America. However, preindustrial systems enjoy advantages of their own, including a diversity of crops (in contrast to industrialized monocultures) and freedom from a dependence on pesticides and petroleum. Thus, it may be helpful to view these systems not as backward remnant forms of food production but rather as historical adaptations to particular social and environmental contexts, that is, as nonindustrial rather than preindustrial.

—Barney Warf

See also Agriculture, Industrialized; Food, Geography of; Peasants

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AGRO-FOOD SYSTEM

The term *agro-food system,* sometimes called *agri-foods,* captures the increasingly long and complicated path that food takes to get to our table. Although we may like to think that the food we eat comes from a farm, that is only one place among many involved in the system that produces our food. Most farming is possible only with industrial inputs such as tractors, combines, and chemical inputs (e.g., fertilizers, pesticides). Farmers often require loans of money (called "capital") each season to buy what is needed to produce a crop. Farming is also dependent on energy to run the machines, pump water, produce fertilizer, and transport the finished product because most of the places where food is produced are not where consumers are located. Farmers need expert information on what and when to plant, how to diagnose and treat blights and pests, how to obtain and use weather information, and how to decide when and at what price to sell their crop. When we think about what goes into farming, we realize that farms are linked to and dependent on many other places such as places of industrial production, petrochemical and fuel production, banking centers, and universities and government where research and policy are created. Where and what is done with the outputs of farms is equally complicated.

Farm output can remain in its original form and simply be graded, washed, and shipped to consumers. But most food we consume in the developed world is not in an unprocessed or "raw" form. Most of the food we consume has been modified and transformed substantially by processing and been made durable through canning, freezing, or other methods. This is important because only with durable foods is long-distance trade possible. In fact, the distinction between agriculture and industry has become so blurred that many farm products transformed by an industrial process have become known by that industrial process, including *homogenized* milk, *pasteurized* cheese, and *refined* sugar. Agricultural products can be further industrialized by processing that breaks them down into their constituent parts. For example, a starch, a sweetener, oil, and protein can be extracted from grain. Processors attempt to break the product of the farm into as many parts as possible and then find profitable uses for them. These different "fractions" of whole farm products are then often used as generic inputs for manufactured foods or used in other industrial processes.

The producers of manufactured foods capture a greater part of the dollars spent on food and increasingly have an advantage over farmers. Manufactured food producers have flexibility in where they get their ingredients. For example, the manufactured food requires a sweetener, but not necessarily sugar from the sugarcane plant. It requires oil, but not necessarily oil from corn. It requires a starch, but that could be derived from a potato, wheat, or a number of other grains. The production of potato chips provides a good example of this substitution affect; producers can fry the chips in whatever oil is cheapest at the moment of production. This illustrates how producers of manufactured foods have flexibility in where they source their ingredients and how they can make places compete against one another and reduce farming into ingredient production for complexly constructed industrial foods. These characteristics of the agro-food system illustrate why farmers are at a disadvantage.

More toward the consumer end of the agro-food system is food distribution. Food reaches consumers via food wholesalers, food retailers, and the restaurant and catering industry. Powerful economic entities in food distribution can shape the agro-food system by their purchasing power such as when fast-food restaurant chains decide to fry their french fries in healthier oil or to add salads to their menus. Large grocery chains have a similar power when they decide to carry some items and not others.

At the end of the agro-food system are the final consumers. Food is unlike other commodities because we must eat daily to survive. Food is taken into our bodies and metabolized (used by our cells to provide energy). Our food choices affect our own bodies but also reverberate back and reshape the agro-food system. What we eat reflects demographic characteristics

such as the size and growth of the population, purchasing power, and social relations (e.g., the structure of the family). Consumers choices shape, but are also shaped by, the agro-food system. Obviously, advertising influences our food choices. But more subtly, the ever quickening pace of the economy and its demands have led to the proliferation of "fast" foods (those that can be consumed without utensils) and other convenience foods meant to be consumed "on the go", in the car, or at the desk.

The recent dietary trend of avoiding foods high in carbohydrates has reduced the consumption of potatoes, rice, bread, donuts, and orange juice (to name just a few) and has affected their places of production and sale. But these changing attitudes toward food also provide opportunity. For example, a food that is high in fat (e.g., fried chicken), criticized during the time when a healthy diet was thought to be a low-fat diet, can present itself as a healthier food choice now that the food trends have changed and carbohydrates are to be avoided.

The geographies of the agro-food system are continuing to change as food technologists attempt to bypass the farm altogether by creating "nonfood foods" or foods that are consumed but not metabolized by the body. These substances are made in the laboratory—not grown on the farm—and allow food producers to avoid the risks inherent in farming, such as unreliable weather, pests, and blights, while providing greater control over the production process. The most recent and visible nonfood foods are fat and sugar substitutes. More common in the agro-food system and growing in number are "functional foods" (also called "nutraceuticals") that attempt to marry foods and pharmaceuticals to create a substance consumed to create a desired effect in the body. Examples include oat-based breakfast cereals promoting themselves as "heart healthy", orange juice with added calcium for "strong bones", grape juice with added antioxidants to fight cancer, and "smart drinks" with added ginseng, caffeine, and vitamins. Functional foods blur the line between drugs and foods, and their producers know that foods that make health claims often have an advantage over their competitors in a competitive marketplace.

Not only does the changing agro-food system have impacts on our bodies, but also its changing technology and consumer choices have significant impacts in reshaping our geography.

—John Grimes

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AIDS

The geography of acquired immunodeficiency syndrome (AIDS) encompasses a number of spatial approaches to understanding the epidemic. More recent geographic studies of AIDS have focused less on the virus and macro diffusion patterns and more on the human geographies of risk and experience of AIDS. One category of investigation focuses on regionally specific contexts of human immunodeficiency virus (HIV) vulnerability. In these studies, social, economic, political, and cultural practices at multiple spatial scales are examined for their impact on individuals' vulnerability to HIV in particular regional locations. These place-specific investigations are critical to understanding micro patterns of transmission given the substantial evidence that factors driving transmission of HIV in one place do not necessarily explain transmission patterns and levels in another place. Clearer understandings of what makes people engage in risky behaviors and become vulnerable to HIV is, in turn, pivotal in implementing more effective prevention and treatment strategies.

Examining geographies of everyday life with HIV/AIDS constitutes another important part of a geography of AIDS. How and whether persons living with HIV and AIDS (PLWHAs) are able to access healthcare and other services are critical to providing the best treatment possible. Earlier geographic studies focused on mapping residence patterns with location of clinics and other services, but more recent studies have recognized that access is more complicated and includes, among other things, individuals' social networks, the degree of flexibility in the workplace, how much stigma individuals face in their lives, income levels, child care responsibilities, and quality of care

available. Other work has looked at the ways in which PLWHAs cope with reduced spaces and places in which they live their lives. This can be because stigma works to block access to particular places such as housing, jobs, countries, and individuals' homes or because deteriorating physical status reduces mobility. The ways in which people experience space and place when coping with AIDS are vital to implementing better outreach programs and services.

Earlier geographic studies of AIDS focused on the virus itself, investigating theories of HIV's origins and transmission patterns. Many scientists and social scientists thought that determining sites of the first HIV cases would assist in understanding where, when, and how HIV subsequently spread to the rest of the world. Much geography of AIDS during the 1980s consequently focused on mapping spatial routes of transmission over time, tracing likely patterns of HIV diffusion across continents using data of first known cases in each region together with travel and migration routes. Although none of these patterns was conclusive, they provided models for illuminating continued transmission of HIV as well as likely points of intervention. Critics of origin theories, however, contended that finding origins does little to understand current patterns of HIV transmission and instead generates negative consequences such as blame for causing a deadly epidemic. Focusing on large-scale geographic patterns also did little to further understanding about the complex network of behaviors and practices underlying transmission of HIV.

—Susan Craddock

See also Health and Healthcare, Geography of; Medical Geography

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ANIMALS

Animal geographers study the interplay among animals, culture, and society, exploring a broad range of human–animal concerns such as habitat loss and species endangerment, domestication, animal entertainment and display, and wildlife restoration. Animal geographies are essentially about nonhuman animals and their place in society, with *place* meaning both material borders (societal practices that shape the spaces where some animals are welcomed and others are not) and conceptual boundaries that call up questions of human identity and animal subjectivity. We can think in terms of three basic themes in contemporary animal geographies: (a) animals and the making of place, (b) human identity and animal subjectivity, and (c) the role of ethics and how humans ought to treat animals. These organizational themes are not independent of one another, and they frequently overlap and dovetail with concepts such as animal instrumentalism, anthropocentrism, and the human–animal continuum. Moreover, animal geographers recognize the fluidity of boundaries, emphasizing not only the distinctions but also the connections, overlaps, and similitudes between human and animal worlds.

MATERIAL BOUNDARIES: ANIMALS AND THE MAKING OF PLACE

Discussions in human geography about the social construction of landscapes have led to the exploration of how animals and their networks leave their imprint on places, regions, and landscapes over time. Animal geographers consider tangible places such as zoos, farms, experimental laboratories, and wildlife reserves as well as economic, social, and political spaces such as the worldwide trade of captive wild animals. Even a relatively new space through which animals are woven into human culture, the "electronic zoo", has been explored as an emerging form of animal display trading in digital images rather than animal bodies like traditional zoos and aquariums.

Animal geographers also study places characterized by the presence or absence of animals and how human–animal interactions create distinctive landscapes. Researchers have considered the impact of land use practices on wildlife survival in the Peruvian Amazon, the boundary-making policy conflicts between urban and rural New Yorkers over the proper

place of wolves, and the changing relationships between people and mountain lions in California. In addition, some animal geographers foreground the links between humans and other animals—those used for meat, medicine, clothing, and beauty products, for example—that go largely unseen in contemporary society given the distance engendered by modern commodity chains. Other researchers focus on domesticated animals that share the most intimate spaces with humans, including beloved family pets and service animals. Borderland communities, where humans and animals share public and/or private space and where some animals are loved, others are despised, and so many are unconsciously consumed, reveal the contingent and often contradictory ways in which humans and animals interact with one another.

Borderland communities can span various places and spaces. Investigating human–dolphin encounter spaces, for example, requires a look at the well-defined boundaries of zoos and aquariums, where dolphins are confined and cared for by humans, as well as natural habitats, where a growing number of tourism operators seek out dolphins to sell a "magical experience" to customers who wish to closely interact with, or even touch and swim with, wild dolphins. On the other hand, U.S. government officials strive for just the opposite, calling such activities illegal "harassment" and working to keep people a defined distance apart from all wild dolphins. And how do the dolphins encourage or defy the human ordering of these border waters? Each of these material places, from the zoo and the open ocean to the economic and policy arenas considered by investigating human–dolphin encounter spaces, helps illuminate the complex relationships between human and nonhuman worlds.

CONCEPTUAL BOUNDARIES: HUMAN IDENTITY AND ANIMAL SUBJECTIVITY

Breaking from the traditional geographic approach to animals, contemporary animal geographers think about nonhuman animals as more than simple biotic elements of ecological systems. Not only are animals appreciated as foundational to countless cultural norms and practices, they also are valued as individuals with mental and emotional lives. Thus, animal geographers call for a more theoretically inclusive approach to thinking about humans and animals; both are considered to be embedded in social relations and networks with others on whom their social welfare depends. Such thinking suggests a reconceptualization of the human–animal divide that portrays humans as vastly different from (and superior to) animals and points instead toward a continuum that allows for a "kinship" with animals while still acknowledging the differences between humans and other animals.

Animal geographies also encourage thinking about animal agency and subjectivity, recognizing that animals have intentions and are communicative subjects with potential viewpoints, desires, and projects of their own. For example, some animal geographers suggest that nonhuman animals are best seen as "strange persons" or as marginalized, socially excluded people. But because animals cannot organize and challenge human activities for themselves, animal geographers recognize that animals require human representatives to speak and act in their interests.

ETHICS, HUMANS, AND OTHER ANIMALS

Human relationships with animals have been and remain multifarious and deeply complex, ranging from magnificent to malignant. In every case, humans remain the regulators of whether animals are conceived of as either "in place" or "out of place", and it is moral sensibility that defines such orderings with significant ethical implications. In many cases, animal geographers attribute instances of instrumentalism, exclusion, and exploitation of the nonhuman world to a history of anthropocentric, or human-centered, thinking. Critical of such activities, much of the animal geographies literature is concerned with the ethical task of advancing the well-being of animals.

One way of advancing this unmistakably normative project is to explicate societal values, which certainly determine human treatment of animals. For example, some animal geographers have considered how an animal's position in the scientific community's hierarchy of value (as determined by the rarity of the species) can have a significant influence on its fate. A crocodile that belongs to a species that is included in a global conservation policy, for instance, is "protected" and therefore privileged over animals that are not included in such a policy. With a change in conservation policy, or the "downlisting" of a particular species from the rank of endangered species, the same crocodile once protected and perhaps flourishing in its natural habitat could very well be removed for human use to an impoverished (and shortened) life as a factory farm animal.

In striving to advance the well-being of both humans and animals, some animal geographers explicitly locate animals in the moral landscape, recognizing that ethical questions are present in all human and animal geographies. In these instances, animal geographers argue for the inclusion of animals in the moral community, valuing animals as ends in themselves (rather than as means to human ends). The practical consequences of such inclusion are considerable. For example, how are we to decide what is most important in environmental policymaking? And who, exactly, gets to decide? Especially when human–animal needs clash in a world of finite space, a framework of normative principles suggested by animal geographies—principles inclusive of animal interests and desires—can guide human–animal relations and resolve the moral dilemmas that relate to conflicting wants and needs of both humans and animals. This is where animal geography largely departs from the theoretical positioning in the contemporary nature–culture debates in geography that remain largely anthropocentric. Granting subjectivity and moral inclusion to animals requires an emphasis on the well-being of both humans and other animals. As such, animal geographies implicitly call for a social and environmental justice that is widened to include animal justice.

—Kristin L. Stewart

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ANTHROPOGEOGRAPHY

The term *anthropogeography* refers to a perspective and program in human geography with both major and minor traditions, expressions, and manifestations. Friedrich Ratzel (1844–1904) is credited with coining the term. His two-volume work, *Anthropogeographie* (published in 1882 and 1891), is usually cited as the founding document. The first volume, in which he offered an overview of human history as adaptation to physical environment, often has been misrepresented as an environmental determinist tract. It is true that many subsequent environmentalists, perhaps most famously Ellen Churchill Semple (1863–1932), interpreted Ratzel's anthropogeography in this light. These misreadings of Ratzel led to anthropogeography's major tradition—that of the study of the effects of the biophysical environment on human culture and history. By the time of Ratzel's death, an increasing number of geographers were producing studies that superficially could be attributed to Ratzel's example. This remained the case through the 1920s, but thereafter their industry and influence waned.

In North America, this eclipse was due in no small part to Carl O. Sauer's (1889–1975) attacks on environmental determinism in geography and Franz Boas's (1858–1942) condemnations from his base in anthropology. Sauer's critiques included alternative views of human–environment relations, ones that incorporated much of what Ratzel proposed for cultural geographic studies in the second volume of *Anthropogeographie.* According to Sauer, Ratzel pioneered the study of the distribution of culture traits, first stated the case for cultural diffusion as the prime process, and anticipated the culture area concept. This is all second-volume Ratzel. By the 1940s, when environmental determinism had been largely discredited and the term anthropogeography had fallen into disuse, Sauer began his rehabilitation of the term. He and some of his students, such as Fred Kniffen (1900–1993) and George Carter (1912–2004), used it to identify their approach to a cultural geography centered on locating cultural cores or hearths, tracing diffusions of culture traits, and more generally reconstructing the making and breaking of cultural landscapes through "all human time". By the 1950s, Sauer had begun to self-identify with anthropogeography explicitly. Although few have applied this appellation to Sauer's collective enterprise, the Berkeley School, it is perhaps the most apt way to encompass the problems, perspectives, and practices associated with this school. This then can be considered anthropogeography's minor, if explicitly antithetical, tradition.

One maxim of this minor tradition is that where cultural historical questions are concerned, "it is always earlier than you think." Accordingly, the origins of the term anthropogeography probably antedate Ratzel's deployment. The earliest detectable English use seems to be from the 1650s, when it appeared in alchemical

discourse pertaining to the symmetries and correspondences between the human body and the earth. Its most common current use resides in bibliothecal categories. The U.S. Library of Congress indexing system equates anthropogeography and human ecology and puts this major heading (GF) between environmental science (GE) and anthropology (GN). Future cross-fertilizations between disciplinary sectors of geography and anthropology may be expected to bring about new meanings of this adaptable term and concept.

—Kent Mathewson

See also Berkeley School; Cultural Geography; Culture Hearth

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ANTICOLONIALISM

Anticolonialism is a broad term used to describe the various resistance movements directed against colonial and imperial powers. The ideas associated with anticolonialism—namely justice, equality, and self-determination—commingled with other ideologies such as nationalism and antiracism.

Colonial rule assumed many different forms. Consequently, anticolonial movements likewise varied, influenced in part by the particularities of foreign rule. Whether the colony was ruled directly, through force, or indirectly would significantly determine how anticolonial movements originated and progressed. In Vietnam, for example, the anticolonial and communist organization known as the *Viet Nam Doc Lap Dong Minh Hoi* (League for the Independence of Vietnam [or Vietminh]) waged a lengthy anticolonial war against French colonial rule. Led by Ho Chi Minh, the Vietminh resorted to guerrilla warfare during the 1940s when France attempted to reassert its colonial rule following World War II. Likewise, in the former British and French colonies of Kenya and Algeria, respectively, anticolonial resistance movements used force to restore indigenous rule. For example, the Mau Mau in Kenya conducted a violent campaign to remove British colonists, and the *Front de Libération Nationale* (National Liberation Front [or FLN]) waged an 8-year war against French forces.

Some colonies were spared the violence and destruction of the decolonization process. The former British colony of Ceylon (present-day Sri Lanka) achieved independence relatively smoothly in 1948. The British had acquired the colony from the Dutch in 1815 following the Napoleonic Wars and granted the colony its independence following World War II.

It was not uncommon for simultaneous anticolonial movements to emerge in a single colony. For example, during the late 19th century, the Philippines, long a colony of Spain, was the site of two anticolonial movements. During the late 1800s, there first emerged a reform movement known as the *ilustrados.* Composed mostly of highly educated and wealthy Filipinos, these individuals, embodied in the Propaganda Movement, demanded moderate administrative and religious reforms such as greater political representation and the curtailment of the excessive power of the friars. Many of the ilustrados were Chinese mestizos who were schooled in Barcelona and Madrid, Spain. Concurrently, there emerged a more radical revolutionary movement that advocated the complete overthrow of the Spanish colonial government. Founded in 1892, the *Kataastaasan Kagalang-galang na Katipunan ng mga Anak ng Bayan* (Highest and Most Honorable Society of the Sons of the Country [or Katipunan]) was a secret society committed to overthrowing Spanish rule and replacing it with a Filipino nationalist government. The founder of the Katipunan was Andres Bonifacio. Unlike the ilustrados, Bonifacio grew up in poverty and was self-taught. The contrast between Bonifacio and the ilustrados conveys the importance of class and ethnic differences in anticolonial movements.

Anticolonial movements should not be viewed as isolated events; indeed, many anticolonial leaders and organizations learned from other movements. Ania Loomba, an English professor, noted that there were important political and intellectual exchanges between different anticolonial movements and individuals and that even the most rooted and traditional of these was shaped by a syncretic history.

Many of the classic writings associated with anticolonial movements continue to hold salience in contemporary society. For example, the works of Aimé Césaire, Frantz Fanon, and Kwame Nkrumah

resonate strongly in current antiglobalization movements. This continuity is testimony to the powerful ideas that embraced anticolonial movements, namely concerns with sovereignty, equality, and social justice.

—James Tyner

See also Colonialism; Imperialism; Postcolonialism

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APPLIED GEOGRAPHY

Many public policy problems facing society today have geographic components or dimensions. For example, redrawing boundaries during political redistricting, locating a new public housing project, identifying a suitable site for a sanitary landfill, and mapping coastal area vulnerability to flooding all could be conceptualized as geographic problems. Applied geography focuses on the use of geospatial information and research techniques to build perspective and knowledge that can be used to identify, understand, and solve human and environmental problems from local to global scales. Another characteristic of applied geography is that it extends the scientific method often used in academic geography to include the implementation and evaluation of geospatial information in addressing problems of social relevance in nonacademic settings. This extension often requires applied geographers to work as part of an interdisciplinary team and to collaborate with a variety of public and private sector decision makers.

The problem-solving approach of applied geography is further illustrated using the example of finding the best location to build a new municipal fire station. Here the applied geographer would use geospatial information and research techniques to answer the following four interrelated questions. Where are the existing fire stations located? What has been the spatial pattern for the type, number, and frequency of emergency calls received from across the service area? How and where is land use change taking place in the city that could influence future demands for emergency services? What is the current and planned municipal infrastructure, including transportation networks and utility availability? Answers to these questions could be presented visually through a series of maps and supporting information, enabling city officials, fire department representatives, and the general public to view different scenarios as part of the decision-making process.

Applied geography has a long and rich tradition as a subdiscipline or specialty area within American human geography. Some of the earliest work can be traced back to the land surveys of the American West during the middle 1800s. The writings of John Wesley Powell on the arid West and the need to develop reliable water sources for agricultural development contributed much to the passage of the Reclamation Act of 1902, which ushered in the involvement of federal agencies such as the Bureau of Reclamation in developing western water resources.

During the 1920s, cultural geographer Carl Sauer played a leading role in the Michigan Land Economic Survey, which emphasized the need for improved land management planning to offset environmental degradation caused by soil erosion and deforestation. During the Great Depression and New Deal period, geographers such as Harlan Barrows and Gilbert White were involved with multiple-purpose resource management agencies such as the Public Works Administration and the National Resource Planning Board. The contributions of geography and geographers to logistics and transportation planning, military intelligence, area and regional studies, and cartography during World War II are well documented.

The practice of applied geography in the private sector, particularly in business and marketing, began in earnest during the 1930s with the work of William Applebaum in the retail food distribution industry. Since then, applied geographers have made contributions in market area analysis, retail site selection, and shopping center development for a number of companies, including J. C. Penney, Kroger, and Stop and Shop.

Prior to the late 1970s, most applied geographers were employed by federal land management and environmental planning agencies, by city and regional planning organizations at the local and state levels of

government, and in the private sector. Although applied geography was recognized and practiced by some geographers working in universities and colleges, their efforts were not well recognized or coordinated. In 1978, those conditions began to change with the inception of the Applied Geography Conference. The purpose of this conference was to provide a forum for applied geographic research and curriculum issues and to serve as a venue for bringing together geographers from a variety of professional backgrounds. The Applied Geography Conference continues to bring together academic and nonacademic geographers to discuss mutual interests, share strategies and research agendas, and demonstrate the utility of applied geography in human and environmental problem solving.

A key factor in the development of the applied geography subdiscipline has been the increased capability to collect, analyze, and display geospatial information through the use of geographic information systems (GIS). These systems have evolved from an initial combination of computer cartography and database management to include remote sensing, global positioning systems, spatial statistics, visualization and simulation, and Web-based information access and sharing. As hardware and software capabilities continue to improve, the opportunity to better use geospatial information will also improve, making the potential for applied geographic research even greater. This potential is further enhanced by the GIS software becoming more user-friendly and therefore easier to implement in a wide range of user environments where the emphasis is on application.

The future of applied geography is promising and limited only by a lack of imagination as to how geospatial information can be used to better understand our world. Although some people would maintain that geography itself has become less relevant due to advances in telecommunications and computer technology, recent world events would argue otherwise and reinforce the idea that a better understanding of geography is critical to our well-being as individuals and as a nation. Natural hazards such as hurricanes continue to demonstrate how vulnerable coastal areas are to flooding, the destruction of property, and the loss of life. Environmental hazards caused by the misapplication of pesticides and herbicides and the disposal of nuclear waste remain public health concerns. There is a geography of terrorism, and understanding its historical roots, along with the temporal and spatial patterns of recent events, is important in developing our homeland security policy. Although each of these topics is complex and multifaceted, an applied geographic perspective is an important first step in determining how best to respond to these threats.

—Andrew Schoolmaster

See also Geodemographics; Gravity Model; GIS; Population, Geography of; Urban and Regional Planning

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ART, GEOGRAPHY AND

Geography has always been highly reliant on visual imagery—and not least art—to explain the patterns and processes that lie at the heart of the discipline. Although this often has meant that art has been used as nothing more than the straightforward representation of place or landscape, during the past 40 years historical and cultural geographers have cultivated the critical interpretation of art as a specialist interest in geography. This has brought with it distinctive methods and approaches that have followed the broader contours of human geography. Before examining these in more detail, it is important to grasp two important ideas. First, it is misleading to refer to art as a homogeneous entity; art embraces numerous practices and outputs and includes sketching, etching, lithography, painting, sculpting, printing, montage work, installation work, and performance art. Sometimes the distinctions among these practices are difficult to discern, and artists invariably combine more than one technique in the production of a piece of art. Second, when we differentiate among different forms of art, we tend to refer to the genre and aesthetic styles that have been defined by the discipline of art history. Again, some of the distinctions that are made here can be misleading, although they remain important in the interpretation of art because they allow us to refer to

key influences, primary practitioners, and broader cultural histories.

Although these ideas have been influential in shaping geography's interest in art, the discipline has also fashioned its own interpretive methods. These can be explained with reference to two significant developments in the study of art.

LANDSCAPE PAINTING AND REPRESENTATION

Geography's early attempt to interpret art was inspired by an overarching pursuit of generalizable rules about landscape taste and national identity. For David Lowenthal and Hugh Prince, John Constable's *The Haywain,* painted in 1821, exemplified an English devotion to rustic life and landscape. *The Haywain* was, and arguably still is, a depiction of quintessential England. However, Lowenthal and Prince argued that for every typical English landscape, there was always the aesthetic antithesis—the imposing demonic chimneyscapes of industry, as represented in L. S. Lowry's landscape art. Although Lowenthal and Prince's work on landscape art created important openings for geography, art was deemed to be not much more than a visual archive, a painted record of landscape artifacts. There was little consideration given to artistic style, technique, and genre.

The cultural turn in geography during the mid-1980s addressed this shortcoming in many ways and brought with it fresh insights to the interpretation of art. Inspired by the work of John Berger and Raymond Williams, among others, Denis Cosgrove and Stephen Daniels developed an intellectual history of the landscape concept in European art. They argued for an interpretive method they called "iconography" that allowed students and researchers of landscape to delve into the symbolical meanings represented in art. For Cosgrove and Daniels, it was not just the content of landscape art that was intriguing but also artists' use of color, texture, technique, perspective, and scale that allowed the links to be made between art and broader cultural histories. So, for example, in the interpretation of J. M. W. Turner's 1844 painting *Rain, Steam, and Speed,* Daniels argued that the artist was not interested in painting a factual local scene but instead was intent on endowing this landscape with ideas of a historical destiny shaped by the Industrial Revolution. Perhaps the most challenging aspect of iconography as an interpretive method is that it does not attempt to reveal a single truth about art; instead, it advocates multiple deconstructions of meaning. Art then becomes best understood as yielding a duplicity of meaning.

The work of Cosgrove and Daniels during the 1980s and 1990s has been inspirational to most geographers who have interpreted art during the past 15 years or so Importantly, Cosgrove and Daniels broadened the horizons for geography by demonstrating that geographers could make valuable contributions to debates on art. Indeed, geographers have established some important collaborations with artists and galleries. But iconography has been taken forward and adapted as a methodology during recent years as an interest in visual culture has emerged.

GEOGRAPHY, ART, AND VISUAL CULTURE

Geographers are beginning to consider art in relation to visual culture. For Gillian Rose, there is an implicit set of power relations in the production and reception of visual imagery. That is, power relations are forged in the representation of an object *and* in its interpretation. For example, the female nude in Western art represents women as unclothed, passive. and a spectacle for the male gaze. This tells us much about the representation of subordinated women in Western art. It also tells us much about how masculine identities are constructed in the viewing of this art. Formulating an interpretation of art that addresses these two concerns allows us to think about the social conditions and effects of art. As a clear extension of these interests, geographers have begun to explore the spatialities of artistic practice where artistic practice, and not just the artwork, is deemed to be meaningful in its own right. In this sense, artistic practice not only is a means by which art is produced but also constitutes particular sociospatial networks.

There have been clear limitations to geography's well-established interest in art. There has been a reluctance to engage with abstract art, "non-Western" art, or art in a medium other than paint, and the art gallery as a social space remains a relatively unexplored subject matter. These areas of untapped interest suggest a potentially rich and diverse future for geography and art.

—Rob Bartram

See also Cultural Geography; Cultural Turn; Photography, Geography and; Spaces of Representation; Vision

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AUTOMATED GEOGRAPHY

Geography is the science and humanity of knowing about people and places. Automated geography is the modern, computer-assisted version of that quest. Formally, it is defined as the eclectic application of geographic information systems (GIS), digital remote sensing, the Global Positioning System, quantitative spatial modeling, spatial statistics, and related information technologies to understand spatial properties, explain geographic phenomena, solve geographic problems, and formulate theory. Its relationship to geographic information science (GISci) is analogous to the relationship that geography maintained with cartography for centuries and with remote sensing for decades, long before the advent of computers and satellite sensors.

Geographers have practiced their craft for at least 2,500 years, but their brand of analysis has always been extremely difficult due to the enormous volumes of data required to represent three-dimensional places and features, both physical and cultural. Thus, automated geography represents a historic leap forward for geographers and for society at large. During ancient times, one person could know and process a significant portion of all knowledge. The explosion of information generated by specialized disciplines during and after the Renaissance left geographers with three disappointing options. Those who studied large areas were limited to such coarse data that they often were dismissed as generalists. Those who insisted on detailed understanding were limited to such small areas that hardly anyone cared about their results. And those who limited themselves to a topical specialty sacrificed much of the holism that distinguishes geography from other disciplines. Today, automated geography restores geographers' ability to know and process a greater portion of all that is known. It enables them to study complex phenomena over large areas with sufficient spatial, temporal, and topical detail to reveal deep insights and generate new theories.

Collectively, GIS, remote sensing, and related geographic information technologies constitute a macroscope. Just as the microscope enabled people to see smaller things and the telescope enabled them to see farther, the macroscope enables them to see large phenomena in fine detail. Will this new scientific instrument turn out to be as powerful as those earlier ones? Will it generate revolutionary new theories in rapid succession as they did? Many conventional theories, developed in isolation by specialized disciplines with little thought for geographic relationships, spatial logic, or integration, have stood unchallenged for decades. The time is right for geographers and geographic information scientists to enter the fray. Automated geography ensures that they have much to offer.

—Jerome E. Dobson

See also GIS; Social Informatics

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