

honey bee in Baltic amber, they colonized Europe, Africa, and Asia long before human existence. Humans documented their relationship with honey bees only within the last 5,000 years. Honey bee historian Dr. Eva Crane describes a rock painting of a honey gatherer from Barranco Fondo, Castellón, eastern Spain (Crane, 1983, 1999a) that is estimated to be 4,000 to 4,500 years old. Investigators also have found a stone bas-relief from Egypt dating from about 2400 BCE and a clearer tomb painting of Egyptians visiting hives from about 1450 BCE (Crane, 1999b).

Honey is the only known ancient source of abundant sugar. It was consumed as a sweetener and fermented into an alcoholic beverage called mead. Its medicinal properties led to its use internally and externally to heal many infirmities. Honey is especially good for treating wounds and burns because it accelerates healing and reduces scarring. Propolis, bee-collected plant resins, also has a history of medicinal uses, as its antiviral, antibacterial, and antifungal properties made it an inexpensive active ingredient for tinctures and salves.

It was not until 1851 that the American Lorenzo Lorraine Langstroth determined that an appropriate "bee space" would prevent the bees from connecting adjacent combs or fastening combs to hive walls. Now bees could be kept in movable frame hives, instead of hollow tree trunks, pottery vessels, straw skeps, and solid boxes. Removable frames allowed combs to be taken from the hives, uncapped, extracted by centrifugation, and returned to the bees.

Immediately following the bee space discovery, inventors rapidly developed beeswax comb foundation, the honey extractor, slotted queen excluders, and the bee escape. Since 1900 about the only advances in beekeeping have been refinements of preexisting equipment, transition from animal-powered to petroleum-powered vehicles, and substitution of plastics for wood and metal equipment and for comb foundation. Beekeepers also take advantage of modern antibiotics and pesticides to help subdue honey bee diseases, pests, and parasites.

Up to the 1900s, hive products were processed and consumed locally. The current global economy has brought those products to the world market. The cost of production of hive products in countries with high standards of living exceeds the world market price. International trade of hive products has become an active political issue. Subsidies, import quotas, import tariffs, locally advantageous quality standards, and phytosanitary considerations affect distribution to a greater extent than simple supply and demand.

#### BIBLIOGRAPHY

- Crane, Eva. *The Archaeology of Beekeeping*. London, 1983.  
 Crane, Eva. *The World History of Beekeeping and Honey Hunting*. London, 1999a.

Crane, Eva. "Recent Research on the World History of Beekeeping." *Bee World* 80.4 (1999b), 174-186.

ERIC C. MUSSEN

**APPRENTICESHIP.** A form of initiatory training under legal agreement in a trade, apprenticeship as a means for transmitting tacit skills is most closely associated with the craft guilds of medieval and early modern Europe. Children in premodern Europe normally were employed outside their homes, either by apprenticeship or by a work contract negotiated by a parent or a guardian, the latter arrangement distinguished from apprenticeship by its lack of an element of professional training. Large numbers of children were never apprenticed because they were trained within their parents' homes, or because some crafts (particularly those involving trade) did not require formal training. This fact accounts for the low number of apprentices with practicing masters relative to the number of trained masters and journeymen needed to reproduce trades over time, and for the low number of working girls recorded. Conversely, apprenticeship could exist outside guild structures although it faced the problem of enforcement outside a formal institutional framework. For these reasons and because of the nature of the skills involved, apprenticeship was mainly an urban, craft-based phenomenon, although in seventeenth- and eighteenth-century England it also was undertaken by the children of the rural poor under the remit of the national Poor Laws. Finally, apprenticeship was the prime means by which boys were trained to enter into the better-paying professions.

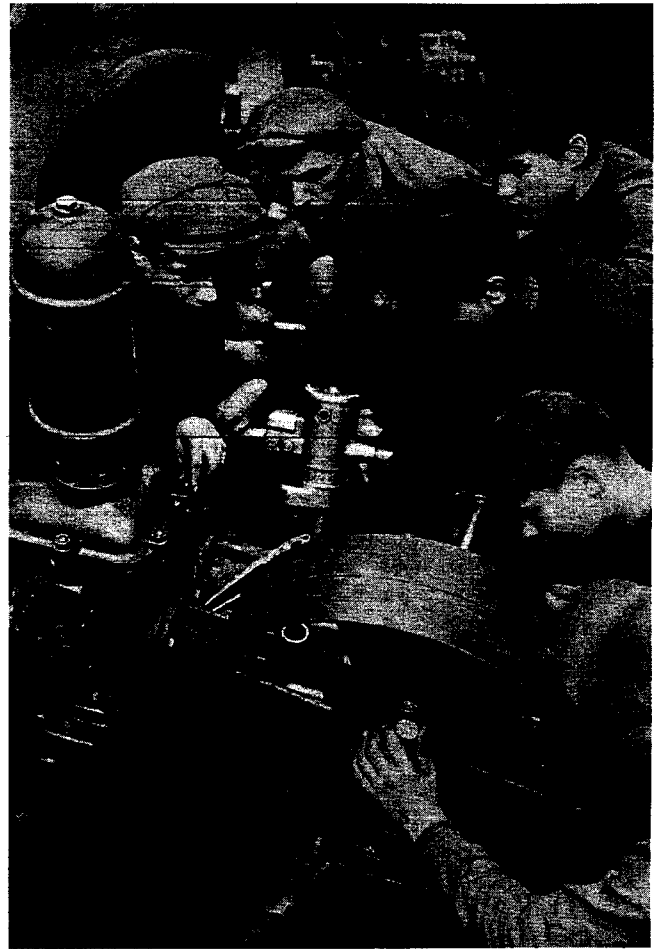
Parents or guardians, including people acting for religious foundling institutions, would present a child for apprenticeship between the ages of thirteen and fifteen; girls were apprenticed somewhat younger than boys. However, not all apprentices were adolescents, and guild statutes never specified the maximum age at which the indenture could begin. Most statutes specified the term of service, usually proportional to the craft's skill requirements and to its expected returns. The average length, which appears to have increased slowly over time, was variable; the English Statute of Artificers (1563, repealed 1814), which prescribed a national norm of seven years, terminating at age twenty-four or older, was unique. Even in England the actual length of service was negotiated individually on the basis of the apprentice's age and prior experience, the premium (if any) the parents could advance, and the master's reputation. Most statutes required longer terms for outsiders than for sons of members, who would have experienced some basic induction to the craft in their fathers' shops. Apprenticeship years could be bought out at a later date, or condoned if the trainee could demonstrate sufficient skills. The duration was further influenced by the

fact that, before the dissolution of craft guilds, apprenticeship was not just a traineeship for a skilled occupation but also a means for socializing children and adolescents into adulthood and the world of work, so that the younger the age at entry, the longer the term.

The duration of training does not capture the intensity of resources expended on it. Apprentices could learn only when their masters were working; so the ups and downs of the trade cycle affected the learning process. Nor should one underestimate the complexity of specific, transferable skills in preindustrial crafts and the difficulties of transmitting tacit, unformulated knowledge. Such factors help explain the three stages or components of premodern apprenticeship. Initially, apprentices were assigned menial tasks in the house, such as cleaning, serving, and running errands; after several months or years, they would be given small, marginal craft tasks; finally, they would be promoted to more skilled jobs, but often were not taught how to do them and had to learn in ad hoc ways (described in the sources as "stealing with one's eyes") or by getting journeymen to help them. Apprentices were nonetheless enjoined not to divulge the masters' secrets, and some masters went as far as forbidding their apprentices from working for another craftsman within a given geographic radius for some years after the term had ended. The practice of secrecy suggests that by the end of their term many apprentices would not achieve the skills needed to become full masters, and that apprentices trained in their fathers' shops with privileged access to the master craftsman would have had a strong technical advantage over outsiders.

The fact that the length of the apprenticeship generally exceeded the duration of actual learning became a source of controversy and misunderstanding among eighteenth-century political economists, who contended that the contract was long, expensive, and superfluous. Adam Smith, who understood that apprenticeship was the institutional base of the guild system, argued that since it was out of proportion to the requisite training, it must serve primarily to restrict job entry and thus to provide craftsmen with monopoly rents. However, although Smith implied that apprenticeship would wither away without legislative backing, its longevity in premodern Europe and its persistence and ubiquity in modern European industrial societies indicate that he may have underestimated apprenticeship's efficiency advantages in providing skills.

Recent analysis suggests that apprenticeship offered a solution to market failures arising from capital-market imperfections and skewed distributions of wealth. Since future human capital could not act as collateral, resource-poor but potentially able workers might be incapable of bearing the costs of their investment in training, leading to a socially suboptimal supply of skilled workers. Apprenticeship allowed trainees to indenture their labor in



APPRENTICES. Industrial workers learning the trade, Soviet Union, circa 1930. (David King Collection)

exchange for subsistence, that is, to exchange initially subsidized training for below-market wages for a period after training was concluded. However, if trainees were able to quit before repaying the training costs, firms still would supply suboptimal amounts of training because they could not capture the full return on their investment. Trainees with transferable skills (neither entirely general nor wholly specific to one firm) would be poached by firms that did not have to recover the training costs and could pay the trainees less than their marginal product but more than the wage paid by the original training firm. For apprenticeship to be viable, poaching must be constrained through legally enforceable indentures, allowing the firms that provided the training to appropriate the benefits in the immediate posttraining period. The decline of apprenticeship in postcolonial North America has been explained along these lines, in the absence of legislation enforcing contracts across state boundaries and with the presence of a large pool of immigrant skilled labor,

PDF

which was in effect being "poached" from its countries of origin.

Premodern European guilds appear from this perspective to have been essential in overcoming training externalities in transferable skills. Crafts registered apprenticeships and carried out periodic inspections of job performance, work conditions, and quality of instruction. They enforced binding contracts through a combination of statutory penalties, compulsory membership, and blackballing and boycott of poachers. They acted as guarantors and established a set of rights and duties for both parties, albeit strongly unbalanced in the master's favor. Live-in apprentices had the right to be lodged, fed, housed, clothed, and heated on a par with members of their master's family, but they were equally subjected to his disciplinary rule as a surrogate father. Even those apprentices who lived at their parents' home (which they did in increasing numbers from the late seventeenth century on) were expected to be unquestioningly obedient to the master's orders and to respect the craft's rules. The apprentices' minority status explains the universal ban on marriage, and why breaches of the rule were treated severely; and the contract's educational features explain why younger trainees were given longer terms. The master controlled the apprentices' work time, and could offer their labor to another guildsman; apprentices had to work to the master's benefit and profit, and the guild enforced the master's right to keep apprentices on after their training had been completed so as to repay the master's training costs.

Guilds were more effective in banning poaching by their members than in stopping apprentices from quitting before their terms ended. Masters attempted to raise trainees' cost of default by demanding entry fees (*de facto* bonds posted to ensure the apprentices' commitment for the full term), by setting apprentices' wages on a rising scale for the contract's duration, and by promising a payoff upon completion; but there was little they could do to stem the hemorrhage permanently. The rate of attrition in early modern England (the only country for which data currently exist) has been estimated at 30 to 50 percent in sixteenth- and seventeenth-century London, Bristol, and Norwich. Although a significant proportion of apprentices who quit early were simply unable to cope, were mistreated, or moved to another occupation, many left in search of work in rural and small-town provinces where skills requirements were lower than in larger towns; crafts in premodern towns acted as training centers for their regional or even, in the case of London and other capital cities, national hinterlands, which they provided with a constant flow of skilled and semiskilled labor. The practice of secrecy (described above) responded to a situation of moral hazard that underpinned the outflow of trainees from the workshops, namely, that the better the training provided, the more likely it was that the apprentice would leave before the contract's expiry.

Many departing apprentices had originally immigrated to the training site from the urban hinterland. Immigration gave rise to problems of adverse selection and asymmetric information, which guilds and governments addressed by stipulating entrance requirements that signaled the laborer's quality or provided surety against misbehavior, such as place of residence, family income, or father's occupation; the Statute of Artificers specified all three. In some highly specialized and cyclical industries, such as mining and iron making, shipbuilding, and high-quality masonry, skills training often was kept within closely knit kin networks, probably because the higher risks of those industries restricted the supply of apprentices.

Craft guilds also protected apprentices against the opportunism of masters. Like masters, apprentices had to be vested with appropriate rights (including a guarantee of proficiency and security of employment over at least one economic cycle) for them to invest their capabilities willingly. Masters could use protection of trade secrets as an excuse for providing poor training, possibly because undertrained workers were more productive to their current masters than elsewhere, whereas well-trained apprentices were more likely to quit early. Undertraining was also a way to exploit apprentices by paying them less than the current rate for generic labor, and discharging them before they had gained the agreed-upon skills; since they learned craft-specific skills within oligopsonistic labor markets, they suffered serious loss if they were discharged early or were poorly trained. The guilds passed rules to enforce adequate training and in extreme cases had the apprentice transfer to a new master; if the first master died, the guilds placed the apprentice with a new one. From the seventeenth century on, English, French, and German craft guilds began to enforce supralocal and supraregional systems of compulsory skill certification, sometimes including an examination to become a journeyman. On the other hand, the doubling or tripling of wages sometimes seen after the end of apprenticeship terms indicates that apprentices might have been exploited, and guild rules forbade masters from keeping apprentices beyond their statutory term.

Although formally indentured women generally comprised less than 5 percent of the labor force, and no women with the exception of masters' widows were allowed to keep apprentices, women had many ways to learn skills informally, either in male-controlled workplaces (as daughters and wives in family workshops where they learned by example, observation, and possibly direct employment) or more commonly in traditionally female work (housewifery). The lack of written records of indentures seriously underestimates the extent of skilled female labor employed by premodern crafts.

Despite the efficiency benefits of craft-based apprenticeship, regulation of entry was undeniably among its lesser

objectives. It was achieved by limiting the number of apprentices (usually one to three) a master could train at one time, by introducing employment moratoria, and, in seventeenth- and eighteenth-century France, by using the *alloué*, a youth who was similar to an apprentice in terms of training and skills but was forbidden to take up a mastership and thus fell outside guild restrictions. However, given the limits on the number of apprentices a normal craftsman could usefully employ and teach on his premises, the fact that the restrictions excluded the master's children and step-children, and evidence of widespread infringement by wealthy artisans that produced a constant buzz of hostility among skilled journeymen, the practical impact of these regulations must be questioned.

[See also *Craft Guilds and Journeymen*.]

#### BIBLIOGRAPHY

- Booth, Alison Lee, and Dennis J. Snower, eds. *Acquiring Skills: Market Failures, Their Symptoms, and Policy Responses*. Cambridge and New York, 1996. Theory and case studies in the economics of modern apprenticeship.
- Brooks, Christopher. "Apprenticeship, Social Mobility, and the Middling Sort, 1550–1800." In *The Middling Sort of People: Culture, Society, and Politics in England, 1550–1800*, edited by Jonathan Barry and Christopher Brooks, pp. 52–83. London, 1994. A detailed survey of apprenticeship in early modern England.
- Dunlop, O. J., and R. D. Denman. *English Apprenticeship and Child Labor: A History*. London and Leipzig, 1912. A classic study, from a legal-institutional angle.
- Elbaum, Bernard, and Nirvar Singh. "The Economic Rationale of Apprenticeship Training: Some Lessons from British and U.S. Experience." *Industrial Relations* 34.4 (1995), 593–622. A model of industrial apprenticeship based on nineteenth- and early-twentieth-century experience.
- Epstein, Stephan R. "Craft Guilds, Apprenticeship, and Technological Change in Preindustrial Europe." *Journal of Economic History* 53.4 (1998), 684–718. An interpretation of craft guilds in light of their contribution to skills training and technological progress.
- Hamilton, Gillian. "The Decline of Apprenticeship in North America: Evidence from Montreal." *Journal of Economic History* 60.3 (September 2000), 627–664.
- Kaplan, Steven. "L'apprentissage au XVIII<sup>e</sup> siècle: Le cas de Paris." *Revue d'histoire moderne et contemporaine* 40.3 (1993), 436–479. A model study.
- Krausman Ben-Amos, Ilana. "Failure to Become Freemen: Urban Apprentices in Early Modern England." *Social History* 16 (1991), 155–172.
- Nicholas, David. "Child and Adolescent Labour in the Late Medieval City: A Flemish Model in Regional Perspective." *English Historical Review* 110 (November 1995), 1103–1131. A general view of late-medieval northwestern Europe.
- Rappaport, Steve. *Worlds within Worlds: Structures of Life in Sixteenth-Century London*. Cambridge, 1989. Apprenticeship training in London, which supplied up to two-thirds of the skilled labor force in sixteenth-century England.
- Schulz, Knut. *Handwerksgesellen und Lohnarbeiter: Untersuchungen zur Oberrheinischen und Oberdeutschen Stadtgeschichte des 14. bis 17. Jahrhunderts*. Sigmaringen, 1985. Apprenticeship in the context of skilled-labor markets in central Europe.
- Steinfeld, Robert J. *The Invention of Free Labor: The Employment Relation in English and American Law and Culture, 1350–1870*. Chapel Hill and London, 1991. A fascinating analysis of the "feudal" and coercive aspects of medieval and early-modern labor contracts, including apprenticeship.
- Westermann, W. L. "Apprentice Contracts and the Apprentice System in Roman Egypt." *Classical Philology* 9.3 (1914), 295–315. An example from the classical world.

S. R. EPSTEIN

**ARABIA.** The first known civilization to arise on the Arabian Peninsula was that of the Sabeans, around 750 BCE, in the fertile region in Southwest Arabia (modern Yemen). Agriculture was highly developed, with complex irrigation systems and livestock breeding. The main crops were cereals, such as wheat, barley, and sorghum; corn, dates, and other fruits and vegetables; and frankincense and myrrh for export. In addition to its agricultural production, the Sabeans took advantage of its location along an overseas trade route connecting the East to the West. The peninsula, with the Persian Gulf on the east and the Red Sea on the west, provided access to the neighboring civilizations of the Nile and the Tigris and Euphrates. The Sabeans monopolized trade on the Red Sea, as pearls from the Persian Gulf; condiments, fabrics and swords from India; silk from China; and slaves, monkeys, ivory, gold, and ostrich feathers from Ethiopia passed through on the way to markets in the Mediterranean area. After the fall of the Sabeans in 115 BCE, the Himyarite kingdom ruled most of Arabia until 525 CE but lost the monopoly on Red Sea trading in the first century CE.

In the first century CE improved understanding of the patterns of the monsoon winds enabled an expansion of maritime commerce, overland trade declined, and port cities, such as Aden and Mocha, began to thrive. The Roman Empire exported textiles, metals, wine, oil, grains, and luxury items, such as gold and silver goods, in exchange for myrrh from Yemen as well as exotic animals, precious stones, wood, ivory, silk, spices, sugar, cotton, and fruit, which passed through Arabia on the way from China to Rome. Ships from Muza brought glassware, iron tools, and weapons to Africa in exchange for ivory and shells. After the fall of Rome, trade among Arab merchants declined until the Quraysh tribe unified the region.

Agriculture was centered on the southern part of the peninsula, present-day Yemen, Oman, and southern Saudi Arabia, while central Arabia prospered from trade routes. Other than in the coastal areas, harsh climate and desert terrain limited agriculture. Up until the growth of Islam in the seventh century, the population was primarily pastoral and nomadic. The people lived in small, isolated communities, raised camels, and migrated seasonally in search of pasturage. In the summer they camped near villages or oases, where they exchanged animal products for grains, dates, utensils, weapons, and cloth. Pastoral nomads had