**Question:** The industrial revolution entailed changes in productive technology, business organization, management, labor, and social structures. Discuss.

The Industrial Revolution was characterized as the change from an agrarian, handicraft economy to one dominated by industry and machine manufacture. It marked the transition from a stable agricultural and commercial society to a modern industrial society that relied on complex machinery rather than simple tools. This transition was due to a number of changes in technology, which in turn led to changes in labor, productivity, business organization, and social structures.

The technological changes in the agricultural industry set the stage for the Industrial Revolution. The rotation of nitrogen-fixing and cereal crops brought about the necessity of leaving a third or half the lands fallow each planting. Jethro Tull popularized the importance of root crops. Tull's most original contribution was the seed drill.\(^1\) The seed drill allowed a much greater proportion of the seed to germinate by planting it below the surface of the ground out of reach of the birds and wind. This allowed a larger labor force, because they were better fed. The technological changes of the Industrial Revolution did not appear suddenly.

The textile industry had some special problems. It was mainly the process of growing, picking, and cleaning cotton in order to produce yarn, which was of greatest concern. One laborer picked 501 lbs. of cotton bolls, however when cleaned, it only produced 4 lbs. of lint and took 25 days. It took four spinners to keep up with one cotton loom, and ten persons to prepare yarn for one woolen weaver. Spinners were busy, but weavers often had to be idle for lack of yarn. Normally, long-staple cotton was being

---

\(^1\) As discussed per class lecture.
processed as opposed to short-staple, because of the difficulty in processing short-staple cotton. This difficulty in processing short-staple cotton was addressed by Eli Whitney’s invention of the cotton gin.\(^1\) Whitney’s gin allowed a more productive method of processing cotton, as well as, improving the quality of the cotton being produced. The cotton gin brought processing time from 25 days to 1/2 day.

The cotton could now be processed quicker, but the ratio of labor it took to spin the cotton into yarn, still needed to be improved. A few different inventors addressed this issue. Richard Arkwright invented the *spinning frame*,\(^2\) which allowed yarn to be produced more quickly. About the same time, James Hargreaves patented his *spinning jenny*,\(^2\) on which one operator could spin many threads simultaneously and in turn, produce much stronger yarn. Then, a person by the name of Samuel Crompton combined the jenny and the spinning frame in a machine known as the *spinning mule*,\(^2\) which produced quantities of fine, strong yarn. James Cartwright further improved the textile industry with his invention of the *power loom*.\(^2\) The yarn famine, so to speak, had come to an end.

The major problem that faced further industrialization at this time was a need to find something powerful enough to drive this new machinery. The biggest advancements were in steam power. James Watt began to make improvements on Newcomen's (original inventor) engine and changed it from an atmospheric to a true "steam engine."\(^2\) Steam power now began to be applied to the earlier mechanical devices, making their use more efficient and widespread. It facilitated the expansion of the textile industry as well as other enterprises. The invention of the steam engine now made long-distance railroad

---

\(^2\) As discussed per class lecture.
transportation possible. It allowed for a transition from carts to canals, to finally the invention of the steamboat, which gave way to increased shipping.

As mentioned above, the changes in the agricultural industry led to changes in the demand for labor. The Enclosure Act of 1760, which allowed land owners to take their land and fence off all tenants (labor), led to an even larger supply of landless labor. They found themselves traveling to the cities and the newly created factories to find work. Dramatic changes in the social and economic structure took place as technological innovations created the factory system of large-scale machine production and greater economic specialization. Women earned substantially less than males on these farmlands, and that created an incentive for women to travel to the urban city to find work in the factories. The American factories responded to the high price for male labor, by looking for alternative sources of labor i.e. women and children.

The demands by different industries for female and child workers were increased due to mechanization, and unskilled workers were substituted for skilled workers. Northern manufacturers were quick to adopt production methods that were more geared towards female and child workers. The need for women workers in the manufacturing sector increased their wages to a point that was beyond that of males. Women and children were now a large part of the work force. The presence of women was especially evident in the textile industry. In 1820, women accounted for more than 70% of all manufacturing workers. Often confined to routine operations and barred from many skilled or managerial positions, women workers bore a disproportionate share of the costs of industrialization.

---

3 As discussed per class lecture.
The system of child labor began with Rhode Island’s Slater Mill. The children ranged in age from seven to twelve years old. By 1830, 55% of the workers in Rhode Island were children. Children put in long hours for very low wages. Although many children were hired as adjuncts to their parents, their working lives were often marked by exploitation. They had long working days and the pace of work was unrelenting, leaving little time for relaxation and socializing. Work was not only long, monotonous, and fatiguing, it was also be dangerous. There was inadequate ventilation, poor diets, and periodic epidemics. Finally, in 1938, with the passage of the Fair Labor Standards Act, child labor was eliminated. While the life of workers during the Industrial Revolution was harsh, not all of the problems were the result of industrialization per se. The growth of industrial production was accompanied by rapid urbanization. The rapid growth of the urban population jammed people together, overwhelmed sanitation facilities, and created perfect conditions for the spread of disease. Life as a factory operative was hard, but life in the countryside was surely not what it is often made out to be. For many former rural dwellers, a factory job and an urban tenement represented an improved standard of living.

Before the Industrial Revolution, life’s necessities and luxuries were made by artisans whose energy was complemented by simple tools. Manufacturing workers went about their tasks as solitary, craftsmen, or in small groups. They developed their skills through apprenticeships, and in turn they passed on these skills to the next generation. In many instances, the workers banded together to form guilds that, among other things, controlled the way the work was done. Guilds limited the number of apprentices that a

---

5 “Samuel Slater, Father of the American Industrial Revolution” at: http://www.woonsocket.org/slater.html
6 “Samuel Slater, Father of the American Industrial Revolution” at: http://www.woonsocket.org/slater.html
master craftsman could have. Overall, manufacturing was a small-scale enterprise with few prospects for significant improvements in production and productivity.

In a few industries, production by independent artisans was supplemented or even replaced by what has been called the "domestic" or "putting-out" system. In this manner of production, the workers did not own their tools and the materials with which they worked; these were supplied by a "putter-out" or "factor," who paid the workers after collecting the finished products. This was not an altogether satisfactory arrangement for the putter-out, who ran the risk of being cheated by workers who sometimes sold the materials given them, replaced them with inferior ones, and pocketed the difference. It was also hard to maintain adequate quality standards when production workers labored in their own homes, free from direct supervision. New power sources allowed sizable increases to be made in the scale of production. Waterwheels, long used for certain industrial operations, became more powerful and efficient as a result of systematic improvement. The steam engine began to supply power to a number of industries, as mentioned above. The hydraulic turbine emerged as an important source of industrial power. There was also a development of mass production technologies. Machine tools like milling machines made possible the production of large numbers of identical parts, as demonstrated by Eli Whitney and his gun production with interchangeable parts.

All of these devices were gathered together in a new setting for productive work: the factory. The spread of the factory system meant that few manufacturing workers earned their living as self-employed artisans. Most workers were hired employees that were dependent on their employers for the tools they used, the facilities they worked in and of course, the wages that supported them and their families. The supervision and
coordination of these workers required new organizational methods. The face-to-face relationships typical of the craftsman's shop gave way to impersonal managerial methods. A prime example was in the Slater/Lowell case in which the Slater Mill was a “family firm” with all partners being connected through blood.\(^7\) It was a personal atmosphere, however, the lack of integration kept them constrained. In stepped Francis Lowell, who created an impersonal atmosphere through setting up managers to check operating efficiencies. He vertically integrated and the Lowell Mill became a private corporation, due to having partners who were just financiers not participants.\(^8\)

Written rules, clear definitions of responsibilities, the precise scheduling of work activities, and bureaucratic procedures formed the basic elements of factory organization. Steam engines or water turbines and the machinery that they powered were expensive items, and they had to be kept going for long hours if they were to pay off. As a result, workers often had working schedules that fitted poorly with the needs of their families. But technological imperatives are not the sole explanation for the rise of the factory. No less important was the factory's contribution to the imposition of managerial control. Within the walls of the factory, it was possible to supervise workers, control the pace of work, and prevent any deviations from standard procedures. The development of assembly-line manufacture intensified managerial control by making the factories that used them even more rigid in their work organization.

In closing, one could say that the Industrial Revolution was an assemblage of an economic revolution, a technological revolution, a social revolution, and a cultural

\(^7\) Chandler, Alfred “Samuel Slater, Francis Cabot Lowell, and the Beginnings of the Factory System in the United States” Case Study-Slater.pdf Note.

\(^8\) Chandler, Alfred “Samuel Slater, Francis Cabot Lowell, and the Beginnings of the Factory System in the United States” Case Study-Slater.pdf Note.
revolution. The changes produced by these revolutions interacted with one another in an exceedingly intricate fashion and transformed the vast majority of the world.