very eagerly so soon as he learnt that his little nephew (Louis XVII) was dead in the Temple. He was gouty and clumsy, not perhaps ill-disposed, but the symbol of the ancient system; all that was new in France felt the heavy threat of reaction that came with him. This was no liberation, only a new tyranny —a heavy and inglorious tyranny instead of an active and splendid one.

Was there no hope for France but this? The Bourbons showed particular malice against the veterans of the Grand Army, and France was now full of returned prisoners of war, who found themselves under a cloud. Napoleon had been packed off to a little consolation empire of his own, upon the island of Elba. He was still to be called Emperor and keep a certain state. The chivalry or whim of Alexander had insisted upon this treatment of his fallen rival. The Habsburgs had taken away his Habsburg empress—she went willingly enough —to Vienna, and he never saw her again.

After eleven months at Elba, Napoleon judged that France had had enough of the Bourbons; he contrived to evade the British ships that watched his island, and reappeared at Cannes in France for his last gamble against fate. His progress to Paris was a triumphal procession; he walked on white Bourbon cockades. Then for a hundred days, "the Hundred Days," he was master of France again.

His return created a perplexing position for any honest Frenchman. On the one hand there was this adventurer who had betrayed the republic; on the other the dull weight of old kingship restored. The Allies would not hear of any further experiments in republicanism; it was the Bourbons or Napoleon. Is it any wonder that, on the whole, France was with Napoleon? And he came back professing to be a changed man; there was to be no more despotism; he would respect the constitutional regime.

He gathered an army, he made some attempts at peace with the Allies; when he found these efforts ineffectual, he struck swiftly at the British, Dutch and Prussians in Belgium, hoping to defeat them before the Austrians and Russians could come up. He did very nearly manage this. He beat the Prussians at Ligny, but not sufficiently; and then he was hopelessly defeated by the tenacity of the British under Wellington at Waterloo (1815), the Prussians, under Blücher, coming in on his right flank as the day wore on. Waterloo ended in a rout; it left Napoleon without support and without hope. France fell away from him again. Everyone who had joined him was eager

now to attack him, and so efface that error. A provisional government in Paris ordered him to leave the country, was for giving him twenty-four hours to do it in.

He tried to get to America, but Rochefort, which he reached, was watched by British cruisers. France, now disillusioned and uncomfortably royalist again, was hot in pursuit of him. He went aboard a British frigate, the *Bellerophon*, asking to be received as a refugee, but being treated as a prisoner. He was taken to Plymouth, and from Plymouth straight to the lonely tropical island of St. Helena.

There he remained until his death from cancer in 1821, devoting himself chiefly to the preparation of his memoirs, which were designed to exhibit the chief events of his life in an attractive light; and two of the men with him recorded his conversations and set down their impressions of him.

These works had a great vogue in France and Europe. The Holy Alliance of the monarchs of Russia, Austria, and Prussia (to which other monarchs were invited to adhere) laboured under the delusion that in defeating Napoleon they had defeated the Revolution, turned back the clock of fate, and restored Grand Monarchy for evermore. The cardinal document of the scheme of the Holy Alliance is said to have been drawn up under the inspiration of the Baroness von Krüdener, who seems to have been a sort of spiritual director to the Russian emperor. It opened, "In the name of the Most Holy and Indivisible Trinity," and it bound the participating monarchs, "regarding themselves towards their subjects and armies as fathers of families," and "considering each other as fellow-countrymen," to sustain each other, protect true religion, and urge their subjects to strengthen and exercise themselves in Christian duties. Christ, it was declared, was the real king of all Christian peoples, a very Merovingian king, one may remark, with those reigning sovereigns as his mayors of the palace. The British king had no power to sign this document, the Pope and the sultan were not asked; the rest of the European monarchs, including the king of France, adhered. But the king of Poland did not sign because there was no king in Poland; Alexander, in a mood of pious abstraction, had annexed the greater part of Poland. The Holy Alliance never became an actual legal alliance of states; it gave place to a real league of nations, the Concert of Europe, which France joined in 1818, and from which Britain withdrew in 1822.

There followed a period of peace and oppression in Europe. Many people in those hopeless days were disposed to regard even Napoleon with charity, and to accept his claim that in some

inexplicable way he had, in asserting himself, been asserting the Revolution and France. A cult of him, as of something mystically heroic, grew up after his death.

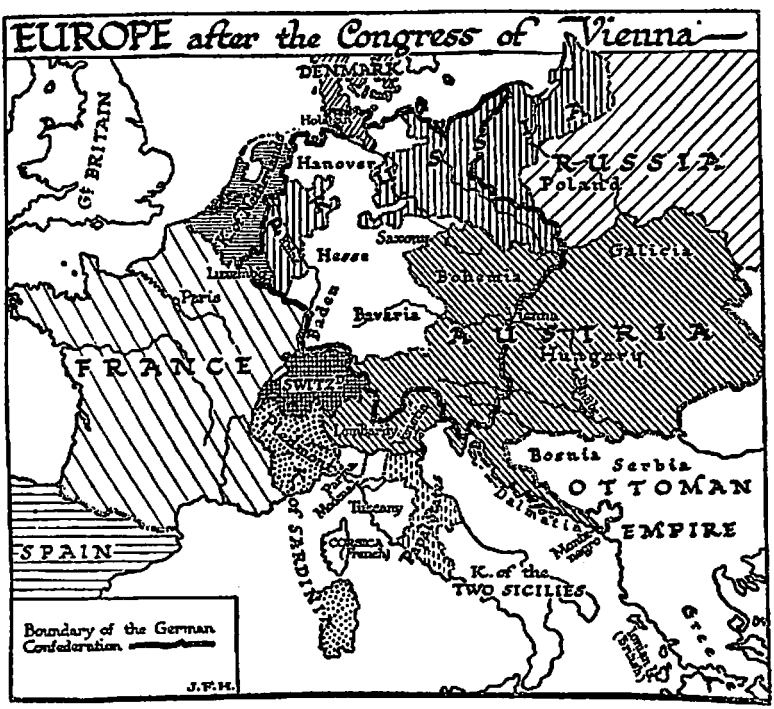
§ 6

The Map of Europe in 1815.

For nearly forty years the idea of the Holy Alliance, the Concert of Europe which arose out of it, and the series of congresses and conferences that succeeded the concert, kept an insecure peace in war-exhausted Europe. Two main things prevented that period from being a complete social and international peace, and prepared the way for the cycle of wars between 1854 and 1871. The first of these was the tendency of the royal Courts concerned towards the restoration of unfair privilege and interference with freedom of thought and writing and teaching. The second was the impossible system of boundaries drawn by the diplomatists of Vienna.

The disposition of monarchy to march back towards past conditions was first and most particularly manifest in Spain. Here even the Inquisition was restored. Across the Atlantic the Spanish colonies had followed the example of the United States and revolted against the European Great Power system, when Napoleon set up his brother Joseph upon the Spanish throne in 1810. The Washington of South America was General Bolivar. Spain was unable to suppress this revolt, it dragged on much as the United States' War of Independence had dragged on, and at last the suggestion was made by Austria, in accordance with the spirit of the Holy Alliance, that the European monarchs should assist Spain in this struggle. This was opposed by Britain in Europe, but it was the prompt action of President Monroe of the United States in 1823 which conclusively warned off this projected monarchist restoration. He announced that the United States would regard any extension of the European system in the Western Hemisphere as a hostile act. Thus arose the Monroe Doctrine, which has kept the Great Power system out of America for nearly a hundred years, and permitted the new states of Spanish America to work out their destinies along their own lines. But if Spanish monarchism lost its colonies, it could at least, under the protection of the Concert of Europe, do what it chose in Europe. A popular insurrection in Spain was crushed by a French army in 1823, with a mandate from a European congress, and simultaneously Austria suppressed a revolution in Naples.

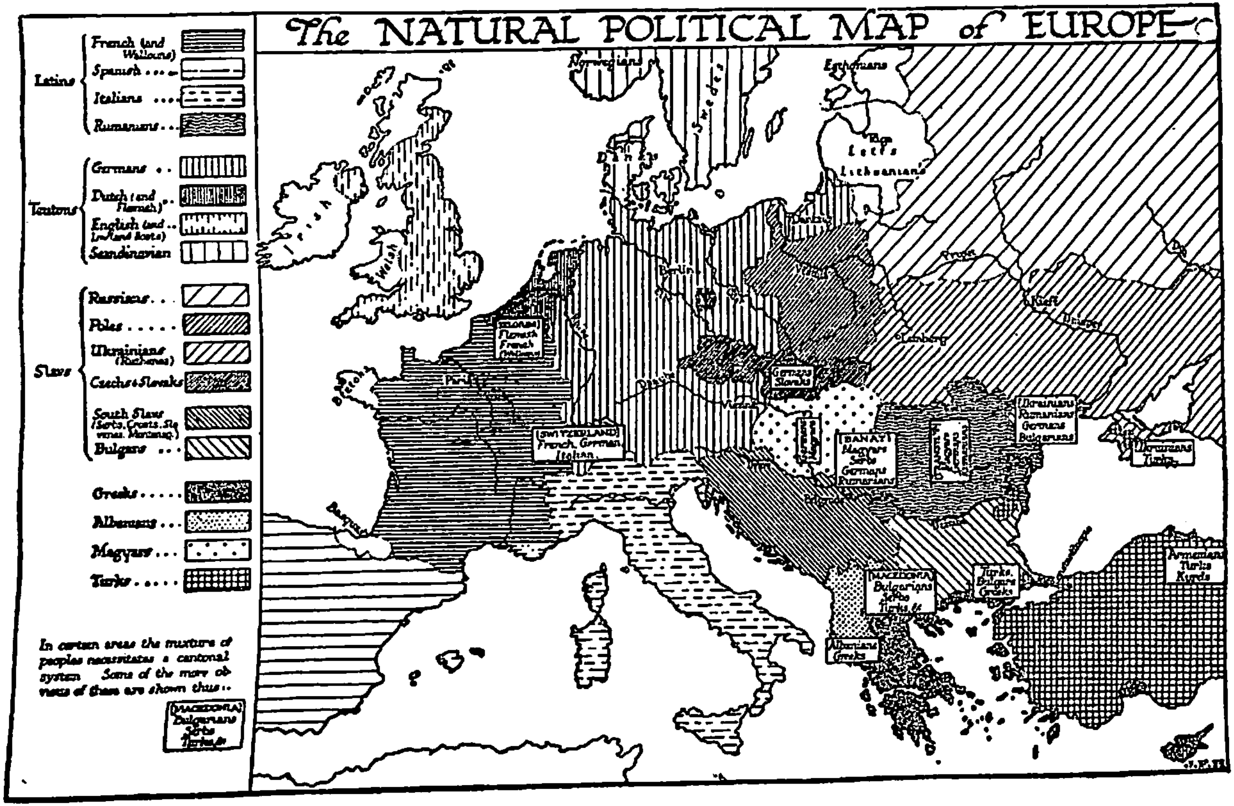
In 1824 Louis XVIII died, and was succeeded by that Count d'Artois whom we have seen hovering as an *émigré* on the French frontiers in 1789; he took the title of Charles X. Charles set himself to destroy the liberty of the Press and universities, and to restore absolute government; the sum of a billion francs was voted to compensate the nobles for the château-burnings and sequestrations of 1789. In 1830 Paris rose against this embodi-



ment of the ancient regime, and replaced him by Louis Philippe, the son of that Philip, Duke of Orleans, who was executed during the Terror. The other continental monarchies, in face of the open approval of the Revolution by Great Britain and a strong liberal ferment in Germany and Austria, did not interfere in this affair. After all, France was still a monarchy. This young man, Louis Philippe (1830–48), remained the constitutional king of France for eighteen years. He went down in 1848, a very eventful year for Europe, of which we shall tell in the next chapter.

Such were the uneasy swayings of the peace of the Congress

of Vienna, which were provoked by the reactionary proceedings of the monarchists. The stresses that arose from the unscientific map-making of the diplomatists gathered force more deliberately, but they were even more dangerous to the peace of mankind. It is extraordinarily inconvenient to administer together the affairs of peoples speaking different languages and so reading different literatures and having different general ideas, especially if those differences are exacerbated by religious disputes. Only some strong mutual interest, such as the common defensive needs of the Swiss mountaineers, can justify a close linking of peoples of dissimilar languages and faiths; and even in Switzerland there is the utmost local autonomy. Ultimately, when the Great Power tradition is dead and buried, those Swiss populations may gravitate towards their natural affinities in Germany, France, and Italy. When as in Macedonia, populations are mixed in a patchwork of villages and districts, the cantonal system is imperatively needed. But if the reader will look at the map of Europe as the Congress of Vienna drew it, he will see that this gathering seems almost as if it had planned the maximum of local exasperation. It destroyed the Dutch Republic, quite needlessly it lumped together the Protestant Dutch with the French-speaking Catholics of the old Spanish (Austrian) Netherlands, and set up a kingdom of the Netherlands. It handed over not merely the old republic of Venice but all of North Italy as far as Milan to the German-speaking Austrians. French-speaking Savoy it combined with pieces of Italy to restore the kingdom of Sardinia. Austria and Hungary, already a sufficiently explosive mixture of discordant nationalities, Germans, Hungarians, Czechoslovaks, Yugoslavs, Roumanians, and now Italians, was made still more impossible by 1772 and 1795. The Catholic and republican-spirited Polish people were chiefly given over to the less civilized rule of the Greek-Orthodox Tsar, but important districts went to Protestant Prussia. The Tsar was also confirmed in his acquisition of the entirely alien Finns. The very dissimilar Norwegian and Swedish peoples were bound together under one king. Germany, the reader will see, was left in a particularly dangerous state of muddle. Prussia and Austria were both partly in and partly out of a German confederation which included a multitude of minor states. The King of Denmark came into the German confederation by virtue of certain German-speaking possessions in Holstein. Luxembourg was included in the German confederation, though its ruler was also king of the Netherlands, and though many of its peoples talked French. Here was a complete disregard of


The NATURAL POLITICAL MAP of EUROPE
Latins
French (and Walloons)
Spanish
Italians
Rumanians
Teutons
Germans
Dutch (and Flemish)
English (and Lowland Scots)
Scandinavian
Slavs
Russians
Poles
Ukrainians (Ruthenes)
Czechs & Slovaks
South Slavs (Serbs, Croats, Slovenes, Montenegr.)
Bulgars
Greeks
Albanians
Magyars
Turks
In certain areas the mixture of peoples necessitates a cantonal system. Some of the more obvious of these are shown thus..
MACEDONIA Bulgarians Serbs Turks &c
Norwegians
Swedes
Danes
Esthonians
Letts
Lithuanians
Irish
Welsh
Bretons
Basques
Danzig
Berlin
Paris
Vienna
Danube
Kieff
Dnieper
Lemberg
Germans Slovaks
SWITZERLAND French, German Italian
BANAT Magyars Serbs Germans Rumanians
Ukrainians Rumanians Germans Bulgarians
Ukrainians Turks
MACEDONIA Bulgarians Serbs Turks &c
Turks, Bulgars Greeks
Albanians Greeks
Armenians Turks Kurds
Belgrade
J.F.H.

the fact that the people who talk German and base their ideas on German literature, the people who talk Italian and base their ideas on Italian literature, and the people who talk Polish and base their ideas on Polish literature, will all be far better off and most helpful and least obnoxious to the rest of mankind if they conduct their own affairs in their own idiom within the ring-fence of their own speech. Is it any wonder that one of the most popular songs in Germany during this period declared that wherever the German tongue was spoken there was the German Fatherland?

Even to-day men are still reluctant to recognize that areas of government are not matters for the bargaining and interplay of tsars and kings and foreign offices. There is *a natural and necessary political map of the world* which transcends these things. There is *a best way possible* of dividing any part of the world into administrative areas, and a best possible kind of government for every area, having regard to the speech and race of its inhabitants, and it is our common concern to secure those divisions and establish those forms of government quite irrespective of diplomacies and flags, "claims" and melodramatic "loyalties," and the existing political map of the world. The natural political map of the world insists upon itself. It heaves and frets beneath the artificial political map like some misfitted giant. In 1830 French-speaking Belgium, stirred up by the current revolution in France, revolted against its Dutch association in the kingdom of the Netherlands. The Powers, terrified at the possibilities of a republic or of annexation to France, hurried in to pacify this situation and gave the Belgians a monarch, Leopold I of Saxe-Coburg-Gotha. There were also ineffectual revolts in Italy and Germany in 1830, and a much more serious one in Russian Poland. A republican government held out in Warsaw for a year against Nicholas I (who succeeded Alexander in 1825), and was then stamped out of existence with great violence and cruelty. The Polish language was banned, and the Greek Orthodox church was substituted for the Roman Catholic as the State religion. . . .

An outbreak of the natural political map of the world, which occurred in 1821, ultimately secured the support of England, France, and Russia. This was the insurrection of the Greeks against the Turks. For six years they fought a desperate war, while the governments of Europe looked on. Liberal opinion protested against this inactivity; volunteers from every European country joined the insurgents, and at last Britain, France, and Russia took joint action. The Turkish fleet was destroyed by

the French and English at the Battle of Navarino (1827), and the Tsar invaded Turkey. By the treaty of Adrianople (1829) Greece was declared free, but she was not permitted to resume her ancient republican traditions. A German king was found for Greece, one Prince Otto of Bavaria—he gave way to delusions about his divine right, and was ejected in 1862—and Christian governors were set up in the Danubian provinces (which are now Roumania) and Serbia (a part of the Yugoslav region). This was a partial concession to the natural political map, but much blood had still to run before the Turk was altogether expelled from these lands.

A little later the natural political map was to assert itself in Italy and Germany.

§ 7

Empire Style.

The Napoleonic attempt to restore the Roman Empire was reflected with extreme fidelity in the architecture, dress, furniture, and painting of the period. In all these things there was an attempt to revive the actual forms and spirit of Imperial Rome. Women's head-dresses and costumes seemed to have flitted out of the museums into the streets; the colonnade, the triumphal arch, swaggered back to the commanding positions of all the great cities. Paris gained her Arc de Triomphe, and London, duly imitative, her Marble Arch. The baroque, the rococo developments of Renaissance building vanished in favour of austerer façades. Canova, the Italian, was the great sculptor of the period. David, the painter, delighted in heroic nudes, Ingres immortalized Bonaparte princesses as Roman matrons and Roman goddesses. The public statues of London present the respectable statesmen and monarchs of the period as senators or emperors. When the United States chose a design for its great seal, it was natural to select an eagle and put in its claws the bolt of Jove.

CHAPTER 37

THE REALITIES AND IMAGINATIONS OF THE NINETEENTH CENTURY

§ 1

THE career and personality of Napoleon I bulks disproportionately in the nineteenth-century histories. He was of little significance to the broad onward movement of human affairs; he was an interruption, a reminder of latent evils, a thing like the bacterium of some pestilence. Even regarded as a pestilence, he was not of supreme rank; he killed far fewer people than the influenza epidemic of 1918, and produced less political and social disruption than the plague of Justinian.

Some such interlude had to happen, and some such patched-up settlement of Europe as the Concert of Europe, because there

was no worked-out system of ideas upon which a new world could be constructed. And even the Concert of Europe had in it an element of progress. It did at least set aside the individualism of Machiavellian monarchy and declare that there was a human or at any rate a European commonweal. If it divided the world among the kings, it made respectful gestures towards human unity and the service of God and man.

The permanently effective task before mankind which had to be done before any new and enduring social and political edifice was possible, the task upon which the human intelligence is, with many interruptions and amidst much anger and turmoil, still engaged, was, and is, the task of working out and applying a Science of Property as a basis for freedom and social justice, a Science of Currency to ensure and preserve an efficient economic medium, a Science of Government and Collective Operations whereby in every community men may learn to pursue their common interests in harmony, a Science of World Politics through which the stark waste and cruelty of warfare between races, peoples, and nations may be brought to an end and the common interests of mankind brought under a common control, and, above all, a world-wide System of Education to sustain the will and interest of men in their common human adventure.

The real makers of history in the nineteenth century, the people whose consequences will be determining human life a century ahead, were those who advanced and contributed to this fivefold constructive effort. Compared to them, the foreign ministers and "statesmen" and politicians of this period were no more than a number of troublesome and occasionally incendiary schoolboys—and a few metal thieves—playing about and doing transitory mischief amidst the accumulating materials upon the site of a great building whose nature they did not understand.

And while throughout the nineteenth century the mind of Western civilization, which the Renascence had released, gathered itself to the task of creative social and political reconstruction that still lies before it, there swept across the world a wave of universal change in human power and the material conditions of life that the first scientific efforts of that liberated mind had made possible.

The prophecies of Roger Bacon began to live in reality. The accumulating knowledge and confidence of the little succession of men who had been carrying on the development of science, now began to bear fruit that common men could understand. The most obvious firstfruit was the steam-

engine. The first steam-engines in the eighteenth century were pumping engines used to keep water out of the newly opened coal mines. These coal mines were being worked to supply coke for iron-smelting, for which wood-charcoal had previously been employed. It was James Watt, a mathematical instrument maker of Glasgow, who improved this steam pumping-engine and made it available for the driving of machinery. The first engine so employed was installed in a cotton mill in Nottingham in 1785.

In 1804 Trevithick adapted the Watt engine to transport, and made the first locomotive. In 1825 the first railway, between Stockton and Darlington, was opened for traffic. The original engine (Locomotion No. 1, 1825) still adorns Darlington platform. By the middle of the century a network of railways had spread all over Europe.

Here was a sudden change in what had long been a fixed condition of human life, the maximum rate of land transport. After the Russian disaster, Napoleon travelled from near Vilna to Paris in 312 hours. This was a journey of about 1,400 miles. He was travelling with every conceivable advantage, and he averaged under five miles an hour. An ordinary traveller could not have done this distance in twice the time. These were about the same maximum rates of travel as held good between Rome and Gaul in the first century A.D., or between Sardis and Susa in the fourth century B.C.

Then suddenly came a tremendous change. The railways reduced this journey for any ordinary traveller to less than forty-eight hours. That is to say, they reduced the chief European distances to about a tenth of what they had been. They made it possible to carry out administrative work in areas ten times as great as any that had hitherto been workable under one administration. The full significance of that possibility in Europe still remains to be realized. Europe is still netted in boundaries drawn in the horse and road era. In America the effects were immediate. To the United States of America, sprawling westward, it meant the possibility of a continuous access to Washington, however far the frontier travelled across the continent. It meant unity, sustained on a scale that would otherwise have been impossible.

The steamboat was, if anything, a little ahead of the steam-engine in its earlier phases. There was a steamboat, the *Charlotte Dundas*, on the Forth and Clyde Canal in 1802; and in 1807 an American named Fulton had a paying steamer, the *Clermont*, with British-built engines, upon the Hudson River above New

York. The first steamship to put to sea was also an American, the *Phœnix*, which went from New York (Hoboken) to Philadelphia. So, too, was the first ship using steam (she also had sails) to cross the Atlantic, the *Savannah* (1819). All these were paddle-wheel boats, and paddle-wheel boats are not adapted to work in heavy seas. The paddles smash too easily, and the boat is then disabled.

The screw steamship followed rather slowly. Many difficulties had to be surmounted before the screw was a practicable thing. Not until the middle of the century did the tonnage of steamships upon the sea begin to overhaul that of sailing-ships. After that the evolution in sea transport was rapid. For the first time men began to cross the seas and oceans with some certainty as to the date of their arrival. The Transatlantic crossing, which had been an uncertain adventure of several weeks—which might stretch to months—was accelerated, until in 1910 it was brought down, in the case of the fastest boats, to under five days, with a practically notifiable hour of arrival. All over the oceans there was the same reduction in the time and the same increase in the certainty of human communications.

Concurrently with the development of steam transport upon land and sea a new and striking addition to the facilities of human intercourse arose out of the investigations of Volta, Galvani, and Faraday into various electrical phenomena. The electric telegraph came into existence in 1835. The first underseas cable was laid in 1851 between France and England. In a few years the telegraph system had spread over the civilized world, and news which had hitherto travelled slowly from point to point became practically simultaneous throughout the earth.

These things, the steam railway and the electric telegraph, were to the popular imagination of the middle nineteenth century the most striking and revolutionary of inventions, but they were only the most conspicuous and clumsy firstfruits of a far more extensive process. Technical knowledge and skill were developing with an extraordinary rapidity, and to an extraordinary extent, measured by the progress of any previous age.

Far less conspicuous at first in everyday life, but finally far more important, was the extension of man's power over various structural materials. Before the middle of the eighteenth century iron was reduced from its ores by means of wood-charcoal, was handled in small pieces, and hammered and wrought into shape. It was material for a craftsman. Quality and treatment were enormously dependent upon the experience and sagacity of the individual ironworker. The largest masses of iron that

could be dealt with under those conditions amounted at most (in the sixteenth century) to two or three tons. (There was a very definite upward limit, therefore, to the size of cannon.) The blast furnace arose in the eighteenth century, and developed with the use of coke. Not before the eighteenth century do we find rolled sheet iron (1728) and rolled rods and bars (1783). Nasmyth's steam hammer came as late as 1839.

The ancient world, because of its metallurgical inferiority, could not use steam. The steam-engine, even the primitive pumping-engine, could not develop before sheet iron was available. The early engines seem to the modern eye very pitiful and clumsy bits of ironmongery, but they were the utmost that the metallurgical science of the time could do. As late as 1856 came the Bessemer process, and presently (1864) the open-hearth process, in which steel and every sort of iron could be melted, purified, and cast in a manner and upon a scale hitherto unheard of. To-day in the electric furnace one may see tons of incandescent steel swirling about like boiling milk in a saucepan.

Nothing in the previous practical advances of mankind is comparable in its consequences to the complete mastery over enormous masses of steel and iron and over their texture and quality which man has now achieved. The railways and early engines of all sorts were the mere first triumphs of the new metallurgical methods. Presently came ships of iron and steel, vast bridges, and a new way of building with steel upon a gigantic scale. Men realized too late that they had planned their railways with far too timid a gauge, that they could have organized their travelling with far more steadiness and comfort upon a much bigger scale.

Before the nineteenth century there were no ships in the world much over 2,000 tons burthen; now there is nothing wonderful about a 50,000-ton liner. There are people who sneer at this kind of progress as being a progress in "mere size," but that sort of sneering merely marks the intellectual limitations of those who indulge in it.

The great ship or the steel-frame building is not, as they imagine, a magnified version of the small ship or building of the past; it is a thing different in kind, more lightly and strongly built, of finer and stronger materials; instead of being a thing of precedent and rule-of-thumb, it is a thing of subtle and intricate calculation. In the old house or ship, matter was dominant—the material and it needs had to be slavishly obeyed; in the new, matter has been captured, changed, coerced. Think of the coal and iron and sand dragged out of the banks and pits,

wrenched, wrought, molten and cast, to be flung at last, a slender, glittering pinnacle of steel and glass, six hundred feet above the crowded city!

We have given these particulars of the advance in man's knowledge of the metallurgy of steel and its results by way of illustration. A parallel story could be told of the metallurgy of copper and tin, and of a multitude of metals, nickel and aluminium to name but two, unknown before the nineteenth century dawned.

It is in this great and growing mastery over substances, over different sorts of glass, over rocks and plasters and the like, over colours and textures, that the main triumphs of the mechanical revolution have thus far been achieved. Yet we are still in the stage of the firstfruits in the matter. We have the power, but we have still to learn how to use our power. Many of the first employments of these gifts of science have been vulgar, tawdry, stupid, or horrible. The artist and the adapter have still hardly begun to work with the endless variety of substances now at their disposal.

Parallel with this extension of mechanical possibilities the new science of electricity grew up. It was only in the eighties of the nineteenth century that this body of inquiry began to yield results to impress the vulgar mind. Then suddenly came electric light and electric traction; and the transmutation of forces, the possibility of sending *power*, that could be changed into mechanical motion or light or heat as one chose, along a copper wire, as water is sent along a pipe, began to come through to the ideas of ordinary people. . . .

The British and the French were at first the leading peoples in this great proliferation of knowledge; but presently the Germans, who had learnt humility under Napoleon showed such zeal and pertinacity in scientific inquiry as to overhaul these leaders. British science was largely the creation of Englishmen and Scotchmen[1] working outside the ordinary centres of erudition.

We have told how in England the universities after the Reformation ceased to have a wide popular appeal, how they became the educational preserve of the nobility and gentry, and the strongholds of the established church. A pompous and unintelligent classical pretentiousness dominated them, and they dominated the schools of the middle and upper classes. The only knowledge recognized was an uncritical textual knowledge

[1] But note Boyle and Sir Wm. Hamilton as conspicuous scientific men who were Irishmen.

of a selection of Latin and Greek classics, and the test of a good style was its abundance of quotations, allusions, and stereotyped expressions.

The early development of British science went on, therefore, in spite of the formal educational organization, and in the teeth of the bitter hostility of the teaching and clerical professions. French education, too, was dominated by the classical tradition of the Jesuits, and consequently it was not difficult for the Germans to organize a body of investigators, small indeed in relation to the possibilities of the case, but large in proportion to the little band of British and French inventors and experimentalists. And though this work of research and experiment was making Britain and France the most rich and powerful countries in the world, it was not making scientific and inventive men rich and powerful. There is a necessary unworldliness about a sincere scientific man; he is too preoccupied with his research to plan and scheme how to make money out of it.

The economic exploitation of his discoveries falls very easily and naturally, therefore, into the hands of a more acquisitive type; and so we find that the crops of rich men which every fresh phase of scientific and technical progress has produced in Great Britain, though they have not displayed quite the same passionate desire to insult and kill the goose that laid the national golden eggs as the scholastic and clerical professions, have been quite content to let that profitable creature starve. Inventors and discovers came by nature, they thought, for cleverer people to profit by.

In this matter the Germans were a little wiser. The German "learned" did not display the same vehement hatred of the new learning. They permitted its development. The German business man and manufacturer, again, had not quite the same contempt for the man of science as had his British competitor. Knowledge, these Germans believed, might be a cultivated crop, responsive to fertilizers. They did concede, therefore, a certain amount of opportunity to the scientific mind; their public expenditure on scientific work was relatively greater, and this expenditure was abundantly rewarded.

By the latter half of the nineteenth century the German scientific worker had made German a necessary language for every science student who wished to keep abreast with the latest work in his department, and in certain branches, and particularly in chemistry, Germany acquired a very great superiority over her western neighbours. The scientific effort of the sixties and seventies in Germany began to tell after the eighties, and the

Germans gained steadily upon Britain and France in technical and industrial prosperity.

In an Outline of History such as this it is impossible to trace the network of complex mental processes that led to the incessant extension of knowledge and power that is now going on; all we can do here is to call the reader's attention to the most salient turning-points that finally led the toboggan of human affairs into its present swift ice-run of progress.

We have told of the first release of human curiosity, and of the beginnings of systematic inquiry and experiment. We have told, too, how, when the plutocratic Roman system and its resultant imperialism had come and gone again, this process of inquiry was renewed. We have told of the escape of investigation from ideas of secrecy and personal advantage to the idea of publication and a brotherhood of knowledge, and we have noted the foundation of the British Royal Society, the Florentine Society, and their like as a consequence of this socializing of thought. These things were the roots of the mechanical revolution, and so long as the root of pure scientific inquiry lives that revolution will progress.

The mechanical revolution itself began, we may say, with the exhaustion of the wood supply for the ironworks of England. This led to the use of coal, the coal mine led to the simple pumping-engine, the development of the pumping-engine by Watt into a machine-driving engine led on to the locomotive and the steamship. This was the first phase of a great expansion in the use of steam. A second phase in the mechanical revolution began with the application of electrical science to practical problems and the development of electric lighting, power-transmission, and traction.

A third phase is to be distinguished when, in the eighties, a new type of engine came into use, an engine in which the expansive force of an explosive mixture replaced the expansive force of steam. The light, highly efficient engines that were thus made possible were applied to the automobile, and developed at last to reach such a pitch of lightness and efficiency as to render flight—long known to be possible—a practical achievement.

The work of the Wright brothers in America was of primary importance in this field. A flying-machine—but not a machine large enough to take up a human body—was made by Professor Langley, of the Smithsonian Institute of Washington, as early as 1897. His next effort, a full-size aeroplane, failed on its early trials, but after very extensive alterations was successfully

flown by Curtiss a few years later. By 1909 the aeroplane was available for human locomotion.

There had seemed to be a pause in the increase of human speed with the perfection of railways and automobile road traction, but with the flying machine came fresh reductions in the effective distance between one point of the earth's surface and another. In the eighteenth century the distance from London to Edinburgh was an eight days' journey; in 1918 the British Civil Air Transport Commission reported that the journey from London to Melbourne, half-way round the earth, would probably, in a few years' time be accomplished in that same period of eight days.

Too much stress must not be laid upon these striking reductions in the time distances of one place from another. They are merely one aspect of a much profounder and more momentous enlargement of human possibility. The science of agriculture and agricultural chemistry, for instance, made quite parallel advances during the nineteenth century. Men learnt so to fertilize the soil as to produce quadruple and quintuple the crops got from the same area in the seventeenth century. There was a still more extraordinary advance in medical science; the average duration of life rose, the daily efficiency increased, the waste of life through ill-health diminished.

Now, here altogether we have such a change in human life as to constitute a fresh phase of history. In a little more than a century this mechanical revolution has been brought about. In that time man made a stride in the material conditions of his life faster than he had done during the whole long interval between the palæolithic stage and the age of cultivation, or between the days of Pepi in Egypt and those of George III. A new gigantic material framework for human affairs has come into existence. Clearly it demands great readjustments of our social, economical, and political methods. But these readjustments have necessarily waited upon the development of the mechanical revolution, and they are still only in their opening stage to-day.

§ 2

Relation of the Mechanical to the Industrial Revolution.

There is a tendency in many histories to confuse together what we have here called the *mechanical revolution*, which was an entirely new thing in human experience arising out of the development of organized science, a new step like the invention

of agriculture or the discovery of metals, with something else, quite different in its origins, something for which there was already an historical precedent, the social and financial development which is called the *industrial revolution*.

The two processes were going on together, they were constantly reacting upon each other, but they were in root and essence different. There would have been an industrial revolution of sorts if there had been no coal, no steam, no machinery; but in that case it would probably have followed far more closely upon the lines of the social and financial developments of the later years of the Roman republic. It would have repeated the story of dispossessed free cultivators, gang labour, great estates, great financial fortunes, and a socially destructive financial process.

Even the factory method came before power and machinery. Factories were the product, not of machinery, but of the "division of labour." Drilled and sweated workers were making such things as millinery, cardboard boxes, and furniture, and colouring maps and book illustrations, and so forth, before even water-wheels had been used for industrial processes. There were factories in Rome in the days of Augustus. New books, for instance, were dictated to rows of copyists in the factories of the booksellers. The attentive student of Defoe and of the political pamphlets of Fielding will realize that the idea of herding poor people into establishments to work collectively for their living was already current in Britain before the close of the seventeenth century. There are intimations of it even as early as More's *Utopia* (1516). It was a social and not a mechanical development.

Up to past the middle of the eighteenth century the social and economic history of Western Europe was, in fact, retreading the path along which the Roman State had gone in the last three centuries B.C. America was in many ways a new Spain, and India and China a new Egypt. But the political disunions of Europe, the political convulsions against monarchy, the recalcitrance of the common folk, and perhaps, also, the greater accessibility of the Western European intelligence to mechanical ideas and inventions, turned the process into quite novel directions. Ideas of human solidarity, thanks mainly to Christianity, were far more widely diffused in this newer European world, political power was not so concentrated, and the man of energy anxious to get rich turned his mind, therefore, very willingly from the ideas of the slave and of gang labour to the idea of mechanical power and the machine.

The mechanical revolution, the process of mechanical invention and discovery, was a new thing in human experience, and it went on regardless of the social, political, economic, and industrial consequences it might produce. The industrial revolution, on the other hand, like most other human affairs, was and is more and more profoundly changed and deflected by the constant variation in human conditions caused by the mechanical revolution. And the essential difference between the amassing of riches, the extinction of small farmers and small business men, and the phase of big finance in the latter centuries of the Roman Republic on the one hand, and the very similar concentration of capital in the eighteenth and nineteenth centuries on the other, lies in the profound difference in the character of labour that the mechanical revolution was bringing about.

The power of the Old World was human power; everything depended ultimately upon the driving power of human muscle, the muscle of ignorant and subjugated men. A little animal muscle, supplied by draft oxen, horse traction, and the like, contributed. Where a weight had to be lifted, men lifted it; where a rock had to be quarried, men chipped it out; where a field had to be ploughed, men and oxen ploughed it; the Roman equivalent of the steamship was the galley with its banks of sweating rowers.

A vast proportion of mankind in the early civilizations was employed in purely mechanical drudgery. At its onset, power-driven machinery did not seem to promise any release from such unintelligent toil. Great gangs of men were employed in excavating canals, in making railway cuttings and embankments, and the like. The number of miners increased enormously. But the extension of facilities and the output of commodities increased much more. And as the nineteenth century went on, the plain logic of the new situation asserted itself more clearly. Human beings were no longer wanted as a source of mere indiscriminated power. What could be done mechanically by a human being could be done faster and better by a machine. The human being was needed now only where choice and intelligence had to be exercised. Human beings were wanted only as human beings. The *drudge*, on whom all the previous civilizations had rested, the creature of mere obedience, the man whose brains were superfluous, had become unnecessary to the welfare of mankind.

This was as true of such ancient industries as agriculture and mining as it was of the newest metallurgical processes.

For ploughing, sowing and harvesting, swift machines came forward to do the work of scores of men. Here America led the Old World. The Roman civilization was built upon cheap and degraded human beings; modern civilization is being rebuilt upon cheap mechanical power. For a hundred years power has been getting cheaper and labour dearer. If for a generation or so machinery has had to wait its turn in the mine, it is simply because for a time men were cheaper than machinery. In Northumberland and Durham, in the early days of coal-mining, they were so cheaply esteemed that it was unusual to hold inquests on the bodies of men killed in mine disasters. Trade Unionism was needed to alter that state of affairs.

But this general trend towards the supplementing and supersession of manual labour by machinery was a change-over of quite primary importance in human affairs. The chief solicitude of the rich and of the ruler in the old civilization had been to keep up a supply of drudges. There was no other source of wealth. As the nineteenth century went on, it became more and more plain to the intelligent directive people that the common man had now to be something better than a drudge. He had to be educated—if only to secure "industrial efficiency." He had to understand what he was about.

From the days of the first Christian propaganda, popular education had been smouldering in Europe, just as it has smouldered in Asia wherever Islam has set its foot, because of the necessity of making the believer understand a little of the belief by which he is saved, and of enabling him to read a little in the sacred books by which his belief is conveyed. Christian controversies, with their competition for adherents, ploughed the ground for the harvest of popular education.

In England, for instance, by the thirties and forties of the nineteenth century, the disputes of the sects and the necessity of catching adherents young had produced an abundance of night schools, Sunday schools, and a series of competing educational organizations for children, the "undenominational" British schools, the church National schools, and even Roman Catholic elementary schools.

The earlier, less enlightened manufacturers, unable to take a broad view of their own interests, hated and opposed these schools. But here again needy Germany led her richer neighbours. The religious teacher in Britain presently found the profit-seeker at his side, unexpectedly eager to get the commonalty, if not educated, at least "trained" to a higher level of economic efficiency.