ures. Strange but true, that so many should find it difficult to make any distinction between Sunday as a day of rest from pleasure, and Sunday as a day of rest from pain and work. You waltzers of six nights, you brain-weary with the wit and wisdom of literary *soirees*,—it may be very pleasant for you to find ever and anon a spot where mind may be soothed by serene discourse, or drowsy music. But surely a very vast difference must exist between your requirements and those of a factory girl in the matter of relaxation after duty. If we are to judge a man by his pleasures, the easier of access we make the noble ones of life, the better. Far from desiring the Art Gallery should supersede the church, one would recommend its being closed during morning service. But believe me, an afternoon passed in a picture gallery or museum, and an evening spent in listening to beautiful, comprehensible music of any kind, in a hall where strict silence and decorum should be maintained, would be of more profit to our servants and workmen than many of the ways in which life is wasted by them at present.

THE PROGRESS OF SCIENCE FROM 1836 TO 1836.

So much interest was manifested in Toronto last spring in Dr. Wallace's lectures at the University on the "Darwinian Theory and Colour in Nature," and the discussion on Evolution which resulted from the former, that a review of the progress of science during the last fifty years, abridged from the *Fortnightly*, may, it is hoped, not prove unacceptable.

Half a century ago there were many and distinct sciences, but hardly any conception of science at large, as a single-rounded and connected whole. It was a point of honour in fact with each particular department not to encroach on the territory of those that lay nearest to it. Within the realm of each separate study, in like manner, minor truths stood severely apart from one another; electricity refused to be at one with magnetism, and magnetism was hardly on speaking terms with the voltaic current. The sciences were each a huge collection of heterogeneous facts or unassorted laws; they waited the advent of their unknown Newtons to fall into systematic and organic order.

In the pride of our hearts we forget for the most part how very young science is. Among the concrete sciences, Astronomy, the eldest born, had advanced farthest; when our age was still young it had reached the stage of wide general laws and evolutionary aspirations. Geology had only just begun to emerge from the earliest phase of pureile hypotheses into the period of collection and arrangement of facts. Biology, hardly yet known by any better or truer name than natural history, consisted mainly of a jumble of half-classified details. Psychology still wandered disconsolate in the misty domain of the abstract metaphysician. The science of man, of language, of societies, of religion, had not even begun to exist. The antiquity of our race, the natural genesis of arts and knowledge, the origin of articulate speech or of religious ideas, were scarcely debatable questions. Chemistry still remained very much in the condition of Mrs. Jellaby's cupboard.

The great campaign of the unity and uniformity of nature was the first to be fought, and in that campaign the earliest decisive battle was waged over the bloodless field of geology. In 1837—to accept a purely arbitrary date for the beginning of our epoch—Lyell had already published his sober and sensible "Principles," and the old doctrine of recurrent catastrophes and periodical cataclysms was tottering to its fall in both hemispheres.

But even the uniformitarianism for which Lyell bravely fought and conquered was in itself but a scrappy and piecemeal conception side by side with the wider and far more general views which fifty years have slowly brought about. One has only to open the "Text-Book of Geology," by Lyell's far abler modern disciple, Archibald Geikie, in order to see the vast advance made in our ideas as to the world's history during the course of the last half century.

Evolution is not synonymous with Darwinism. The whole immensity exceeds the part. Darwinism forms but a small chapter in the history of a far larger and more comprehensive movement of the human mind. In its astronomical development Evolution had already formulated itself with perfect distinctness before the period with which we have specially to deal. Geology then took up the evolutionary parable, and, accepting on trust from Astronomy, the earth itself as a cooling spheroid of incandescent matter, it has traced out the various steps by which the crust assumed its present form, and the continents and oceans their present distribution. It is beginning to be possible by convergence of evidence, as the American geologists have shown, and as Geikie has exemplified, to re-write in part the history of continents and oceans, and to realise each great land mass as an organic whole, gradually evolved in a definite direction, and growing from age to age by regular accretions.

It would be impossible to pass over in silence, in however brief a notice, the special history of the glacial epoch theory—a theory referring indeed only to a single episode in the life of our planet, but fraught with such immense consequence to plants and animals and to man in particular, that it rises into very high importance among the scientific discoveries of our own era. Demonstration of the fact that the recent period was preceded by a long reign of ice and snow in the northern and southern hemispheres alike, we owe mainly to the fiery and magnetic genius of Agassiz; and the proof that this glacial period had many places of hotter and colder minor spells has been worked up in marvellous detail by James Geikie and other able coadjutors.

Upon the glacial epoch depend so many peculiarities in the distribution of plant and animal forms at the present day, that it has come to assume quite exceptional importance among late geological and biological theories. Standing at the very threshold of the recent period, the great ice age forms the fixed date from which everything in modern Europe and America begins—it is the real flood which stands to the true story of our continent and our race in the same relation as the Noachian deluge stood to the traditional world of our pre-scientific ancestors. Modern history begins with the glacial epoch.

Evolution on the organic side has been chiefly expounded in England by Darwin, Huxley, Spencer, and Wallace, and on the whole, though of world-wide acceptance, it has been a peculiarly English movement. Our age has discovered for the first time the cumulative value of the infinitesimal. "Many a little makes a mickle"—that was Lyell's key in geology, that was Darwin's key in the science of life. Herbert Spencer's "Principles of Biology," most fully sums up the whole aspect of evolution as applied to the genesis of organic beings. In 1837 the science of man, and the sciences that gather round the personality of man, had scarcely yet begun to be dreamt of. But evolutionism and geological investigation have revolutionised our conception of our own species, and of the place which it holds in the hierarchy of the universe. The impetus it has given to the sciences which specially deal with man, has been simply incalculable. Philology has been revolutionised. Language has told us a new story. Words, like fossils, have been made to yield up their implicit secrets. Anthropology and Sociology have acquired the rank of distinct sciences. Comparative mythology and folk lore have asserted their rights to a full hearing. Evolutionism has penetrated all the studies which bear upon the divisions of human life. Language, ethnography, history, law, ethics, and politics have all felt the widening wave of its influence. The idea of development has been applied to speech, to writing, to arts, to literature, nay even to coins.

In Psychology the evolutionary impulse has mainly manifested itself in Herbert Spencer, and to a less degree in Bain, Tully, Romanes, Croom, Robertson, and others of their schools. The development of mind in man and animal has been traced with the development of the material organism. Instinct has been clearly separated from reason; the working of intelligence and of moral feeling has been recognised in horse and dog, in elephant and parrot, in bee and ant, in snail and spider. But the evolutionary movement as a whole sums itself up most fully of all in the person and writings of Herbert Spencer, whose active life almost exactly covers and coincides with our half century.

Second only in importance to the evolutionary movement among the scientific advances of our own day must be reckoned the establishment of that profound fundamental physical principle, the Conservation of Energy. Starting from this settled point it soon became clear to physical thinkers that every species of energy was more or less readily convertible into every other; this principle was originally known under the name of the *Persistence of Force*; but as time went on the underlying distinction between force and energy came to be more definitely realised, and the phrase "Conservation of Energy" began to supersede the older and more erroneous terminology. These two great principles—Evolution and the Conservation of Energy—form the main bulk of our age's addition to the world's accumulated stock of knowledge. Among the separate sciences, however, many wonderful advances have also been made. Electricity had hardly got beyond the stage of an elegant amusement at the opening of our epoch; its connection with magnetism had not long been proved. The whole theory of electricity as a mode of energy has since been fully explored and expounded; the telephone and microphone have been introduced; secondary batteries have been formed and improved; the dynamo has become a common object in the country; and the electric light has grown under our very eyes into practical and extremely dazzling reality.

In physics the series of investigations which led up to the discovery of the law of conservation, has also illustrated many minor principles of the first importance. The true theory of heat and the laws of radiant energy have been divined and formulated. The undulatory theory of light—a theory of the previous quarter century—has been universally adopted and justified. Thermo-dynamics have been elevated into a great and increasing branch of science. The causes of glacier motion have been investigated and established. Photography has almost passed through an entire life cycle. The polarisation of light has been observed and studied. Spectrum analysis has come into the front rank as an instrument of research.

In Chemistry the advance has been more in detail than elsewhere. Chemical science alone still remains a somewhat fragmentary mass of individual facts, unilluminated as yet by the broad light of any great and all embracing general principles. Mathematics have also undergone a new development, scarcely capable of comprehensible reproduction. Railways slightly antedate the epoch; the telegraph is just coeval with it. The first submarine cable was in 1851; the first transatlantic in 1866. Electro-plating, the steam hammer, the Armstong gun and the Bessemer process, must not be forgotten. Among the concrete sciences Astronomy has made vast advances during the past half century. The invention of the spectroscope, and the rapid development of spectrum analysis, have placed in the hands of the astronomers a method and an instrument inferior in value only to the telescope. Our knowledge of the sun's constitution in particular has made great strides. We know our central luminary now as a mass of intensely heated gas, surrounded by a shell of luminous cloud; the photosphere formed by the cooling of condensable vapours at the surface where exposed to the cold of outer space. Nasmyth's observations on our own dead satellite, the moon, have given us a graphic and appalling picture of a worn-out world in the last stage of lifeless, waterless, and airless decrepitude. In the practical application of biological and physiological science to the wants and diseases of human life, two at least deserve