

zonally pieces of cane of a length from two to three joints. If the ground has previously been under cultivation, the methods differ. The ground must first of all be ploughed, and furrows are then made in which entire canes are stretched *à chorros*; that is to say, end to end horizontally. The plants are then covered with earth. The sugar-cane is frequently planted in the spring, but many planters are of opinion that plantations in Cuba sown in winter give a much better yield. The young plants are allowed to shoot for ten or eleven months if they have been planted in the spring, for fourteen or sixteen months if planted in the winter, and the harvest then takes place. There are in the island several varieties of sugar-cane,—the white or Otaheite cane, the twisted white cane, the twisted violet cane, and the so-called black cane. The first two varieties are the only ones cultivated at Cuba. The white cane is prepared for planting in virgin soil, and gives a good yield. The crystalline is reserved for old plantations: it is better adapted to resist the long drought than the white variety. The cultivation of the last three species of sugar-canes has been abandoned on account of their insufficient yield. Before the abolition of slavery, the planters themselves cultivated their fields; since that period, however, they have experienced the greatest difficulty in obtaining a sufficient number of hands to harvest their canes. Many planters, in consequence, deemed it advisable to divide their labor between a certain number of colonists, who are bound to cultivate each his plot of ground, to plant the canes, to cut them at harvest time, and to carry them to the factory, where they receive, after the sugar is turned out, a certain proportion of the quantity of the sugar extracted from the canes harvested on their allotments. Cuban sugar is generally prepared for export. The special quality intended for home consumption is clearer and finer than that shipped abroad.

THE UNIT MEASURE OF TIME.¹

I DESIRE at the opening meeting of this section of the Royal Society to bring to your attention a subject of some general importance.

For a number of years past attempts have been made on both sides of the Atlantic to effect a reform in the method of reckoning time. The degree of success which has attended the movement is a matter of surprise when we consider that the changes involve a departure from the usages of society, and are in opposition to the customs of many centuries.

The modern introduction of rapid means of communication has created conditions of life different from those of preceding generations. It may be said that until a few years back, localities separated by a few miles of longitude were assumed to have distinct and separate notations of time. When many localities were first brought into close relations by the establishment of a line of railway, the different local times (so called) with which the railway authorities had to deal produced much confusion. In order to attain security for life and property in operating the line, and likewise to promote the convenience of the public using it, it became necessary to observe a uniform notation, which received the name of "railway time;" that is to say, the many local reckonings which prevailed at the numerous points between the two termini were reduced to a single reckoning common to the many localities.

As lines of railway multiplied, the unification of the reckoning of time became more indispensable, and it early came to be seen that the benefits to result from unification would be in proportion to the extent of territory embraced within its operations. At length it became obvious that uniformity of reckoning might with advantage be extended to a whole continent or the whole globe. Investigation also established that such an extension would contravene no law of nature, or principle of science.

The proposal to supersede the numberless local times by a single notation, synchronous in every longitude, had a somewhat Utopian aspect. Many, indeed, regarded it as a revolutionary innovation, for it came into direct conflict with the customs and the

habits of thought which had descended from a remote antiquity. Nevertheless, the potent agencies steam and electricity, which have co-operated in making astonishing transmutations in human affairs, have forced on our attention the investigation of time and its notation, and demanded some change to meet the altered circumstances of daily life.

If we consider the nature and attributes of that which we know as time, we will find that it is wholly independent of material bodies, and uninfluenced by space or distance; that it is essentially non-local and an absolute unity; that it is not possible for two times to co-exist, or for time to be divided into two parts having a separate entity, in the sense that material things can be divided. This view of time incontrovertibly established, there is no ground for the theory that there are many local times. We may therefore sweep away the ordinary usages based on that theory as being unsound and untenable, and the way is made clear for a comprehensive system of time-reckoning to embrace the whole globe.

About fourteen years ago the effort was first made to introduce a reform which would satisfy the requirements of the age. Whatever system might be adopted, it was felt that it should be based on the fundamental principle that there is only one time. It was, moreover, held to be expedient that there should be only one reckoning of time common to all nations; and, to secure a common reckoning, one established zero and one common unit of measurement became necessary.

With the attainment of these objects in view, preliminary discussions took place at the meetings of several scientific associations in Europe and America, and it was held that in a matter of such widespread importance the unit of time should be a measure which could be readily referred to as a perpetual standard for the use of the entire human family. It was likewise felt desirable, if not indispensable, that all nations should acquiesce in its recognition.

It was accordingly proposed at an international geographical congress at Venice in 1881, and confirmed at a geodetic congress at Rome held two years later, that the government of the United States should be invited formally to call a conference of representatives, to be specially appointed by the governments of all civilized nations, to consider the subject, and determine the zero and standard of reckoning to be used in common throughout the globe.

Six years ago this conference assembled, under the auspices of the United States, in the city of Washington, the governments of twenty-six nations sending fully accredited delegates. Their deliberations extended over the month of October, 1884. With substantial unanimity they passed a series of resolutions, in which the unit of measurement was constituted, and they recommended that time be computed according to the solar passage on a recognized zero meridian of the earth's surface.

The resolutions of the Washington conference thus authoritatively established the fundamental principles which underlie the scheme for a general unity of time-reckoning; each nation being left in its discretion to accept the details of the reform whenever deemed expedient in each individual case. To facilitate the acceptance of the new system, the circumference of the globe has been divided into twenty-four sections, the reckoning in each section being based on a standard subsidiary to, but directly related to, the unit measure. In the twenty-four subsidiary standards thus constituted the hours are simultaneous, although differently numbered in accordance with the longitude of the several sections. With the single exception respecting the numbers by which the hours are locally to be known, there is complete identity in every subdivision of time throughout the twenty-four sections. The many local days which follow in succession during each diurnal period are by this arrangement reduced to twenty-four normal days, each differing an hour in its commencement from the day which it succeeds. Twelve of these normal days precede, and twelve follow, the primary standard or unit measure of time, which is the mean of the whole series of normal days. By this expedient, which has received the name of "the standard time system," the means have been provided by which all nations, without any apparent great departure from old usages, may observe substantially the one common reckoning.

¹ Address at the opening of Section III. of the Royal Society of Canada, by the president, Dr. Sandford Fleming, May 27, 1890.

The adoption of the system of standard time has already made considerable progress. In North America, standard time was first introduced in railway economy: it has since been generally accepted by the mass of the community. In Asia the same system has been legally established throughout the Japanese Empire. In Europe a general interest has been awakened on the subject; and at the present moment it attracts special attention in Austria-Hungary, Germany, and Belgium. Late advices give expression to the belief that standard time will be adopted by the railway service of these countries before many months. It is already observed in Sweden and Great Britain.

Thus, at the present day, standard time has been fully accepted in Asia by not less than forty millions of people, in Europe by almost an equal number, in America by more than sixty millions; and there is scarcely a doubt that in no long period it will be in use throughout the greater part of central Europe, making a total number of probably two hundred and thirty millions of the most progressive peoples in the three continents who will have accepted the principles of reckoning based on a common unit. Without taking into account central Europe, where the reform is on the eve of adoption, the unification of time-reckoning has so far advanced, that in Japan, Belgium, Sweden, England, Scotland, Canada, and the United States, all well regulated clocks strike the hours at the same moment (although locally the hours are distinguished by different numbers), and the minutes and seconds in all these countries are absolutely synchronous.

The unit of measurement authoritatively established by the resolutions of the international conference of 1884 is the basis of the system by which these results have been obtained; and we must regard this new system as the one which shall hereafter be observed by the great mass of the civilized inhabitants of the world in their daily reckonings and in their chronology. It is of first importance, therefore, that no doubt or ambiguity should exist in connection with it. By the resolutions of the conference of 1884, the unit measure may be defined as the interval of duration extending from one mean solar passage on the anti-meridian of Greenwich to the next succeeding passage. This standard unit has been variously designated as follows; viz., 1. A Universal Day, 2. A Terrestrial Day, 3. A Non-Local Day, 4. A Cosmopolitan Day, 5. A World Day, 6. A Cosmic Day.

It requires no argument to show that no one of these six terms is appropriate. The unit of time is not a day in the ordinary sense: it is, indeed, much more than an ordinary day. According to our habit of thought, a day is invariably associated with alternations of light and darkness; and each day, moreover, has a definite relationship to some locality on the surface of the earth. The day, as we commonly understand it, is essentially local; and during each rotation of the globe on its axis, occupying a period of twenty-four hours, there are as many days as there are spots on sea and on land differing in longitude. These numberless days are separate and distinct, each having its noon and midnight, its sunrise and sunset. The time-unit is an entirely different conception: it is equal in length to a day, and must, from its nature, be synchronous with some one of the infinite number of local days. By the resolutions of the Washington conference, it is identified with the civil day of Greenwich. But while the latter is simply a local division of time, limited to the Greenwich meridian, the unit measure is, on the other hand, not so limited: it is equally related to all points on the earth's surface in every latitude and longitude. Under this aspect, the wider functions and general character of the unit measure remove it from the category of ordinary days, as we understand the familiar expression; and, to obviate all doubt and uncertainty regarding it, it is in the highest degree desirable that the universal time-unit should be distinguished by some appellation by which, apart from its local relationship, it may always be indisputably known.

It was Lord Chief Justice Coke who said that "error is the parent of confusion." As the primary object of time-reform is to obviate confusion, we should take every precaution to preclude error. Is it not, therefore, expedient that we should adopt means to secure a proper and appropriate designation for the unit measure, and abandon as misnomers each one of the terms which have hitherto been applied to it? In a paper on the subject of time-

reckoning, published in the "Transactions" of this society in 1886, the unit measure is defined, its uses described, and it is likewise pointed out that its distinctive appellation remains undetermined. I consider it to be my duty to draw attention to the want; and, while it would be an act of presumption on my part to propose a name, I will venture the remark that in the general interests of science an effort should be made to supply it. It has been found expedient to derive technical terms from a classical etymology, and I beg leave to suggest that the same rule might be followed in this case with obvious advantage. Whatever name be chosen, if derived from a Greek or Latin root, the word would in all countries have the same definite meaning, and could readily be incorporated into all languages. If such a word be adopted as will clearly express "a unit measure of time," it will gradually come into general use, as in the parallel cases of "telegram," "telegraph," "photograph," "lithograph," etc.; and by this means all nationalities will be enabled to give expression to one and the same meaning when they refer to time-reckoning in its broad significance.

I humbly submit that the Royal Society of Canada will confer a general benefit, and act becomingly, by taking the initiative in obtaining an appropriate designation for the unit measure of time.

If that view be concurred in by this section of the society, I respectfully suggest that a special committee be appointed to consider the subject, with instructions to report during the present session.¹

NOTES AND NEWS.

A LABORATORY for plant-biology has been recently opened at Fontainebleau, says *Nature* of Sept. 11. It is under the direction of M. Bonnier, professor of botany at the Sorbonne in Paris, to whom application should be made by any contemplating research there.

—In the London *Times* for Sept. 9 we read the following note on how to keep salt dry: "The Dutch Indian Government offers a prize of 10,000 fl. for the best practical answer to the question 'In what manner should the salt which is sold in Dutch India in small packets be packed up so as to keep dry?'"

—The fifty-ninth annual exhibition of the American Institute of this city will open on Oct. 1, and continue until the end of November. The institute's exhibition building covers the large block of ground between Second and Third Avenues and 63d and 64th Streets, affording ample space for a display which is looked forward to with increasing interest from year to year.

—A wonderful example of erosion may be seen in the illustration to Professor Michie Smith's article on the eruption of Bandaisan in the *Proceedings of the Royal Society of Edinburgh*, vol. xvii. p. 70. The valley there depicted was produced by the erosive power of a small stream within the short space of ten months. Its depth, when Professor Smith visited the neighborhood, was 80 feet, and in some places little short of 150 feet.

—It is a fact known to few, that Russia has taken a place among the quicksilver-producing countries. We note in *The Scottish Geographical Magazine* that this metal is at present extracted at two places,—near the village of Kurush in Dagestan: and near the village of Saizef, in the district of Bachmut in Ekaterinoslav. At the former place the ore is said to contain the enormous proportion of 74.7 per cent of quicksilver. At Saizef, where the ore contains only 0.32 to 4.5 per cent, the pure metal extracted in 1889 weighed 164½ tons. Diamond-boring has lately been adopted, and a fairly rich lode of cinnabar has been struck at a depth of 260 feet.

—The special committee of Section III. of the Royal Society of Canada, to whom the expediency of suggesting an appropriate name for the unit measure of time was referred, reported as follows at the general meeting of the society held May 29, 1890: "The committee recognizes the advisability of obtaining a suitable nomenclature, and concurs in the views expressed in the address of the president of the section as to the expediency of

¹ This report is given elsewhere as a note.