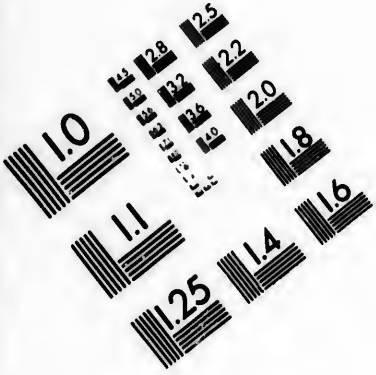

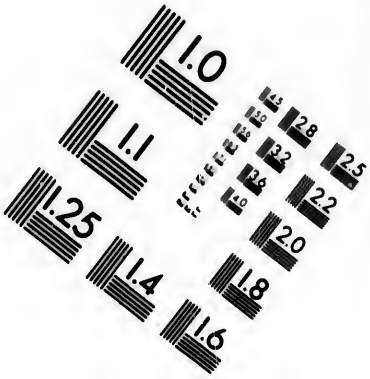

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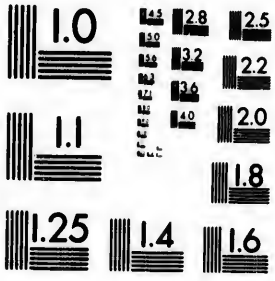

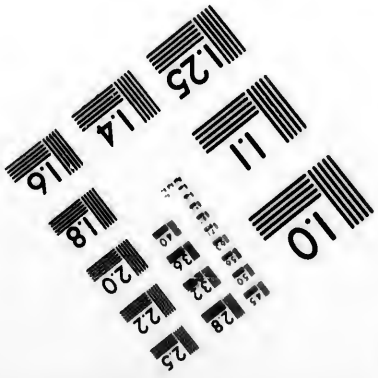

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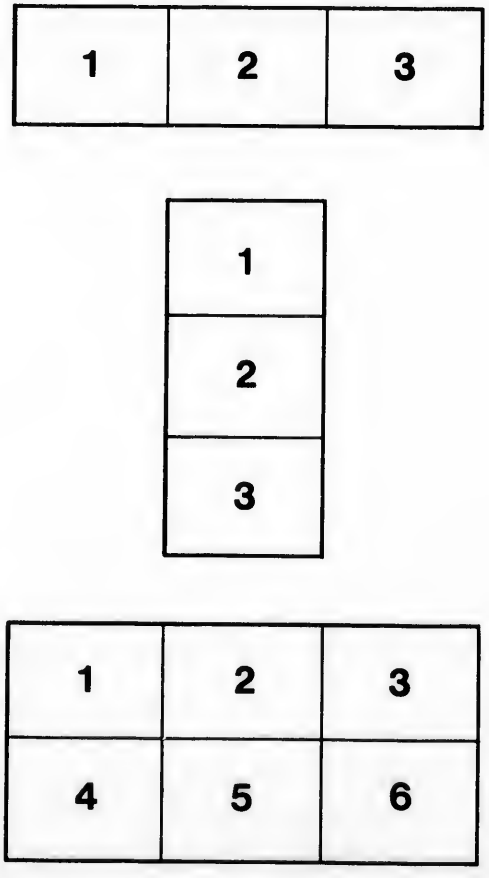

Fleming, Sandford.

THE INTERNATIONAL

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PRIME MERIDIAN CONFERENCE

WASHINGTON.

OCTOBER, 1884.

RECOMMENDATIONS SUGGESTED

BY

SANDFORD FLEMING.

RESPECTFULLY SUBMITTED.

THE INTERNATIONAL

Prime Meridian Conference

WASHINGTON,

OCTOBER, 1884.

Recommendations suggested by Mr. Sandford Fleming, with explanatory remarks.

The Act of Congress, by the authority of which delegates from the Governments of all nations have been summoned by the President of the United States, defines the main purpose of the Conference, as follows:—

"To fix on, and recommend for universal adoption, a common "Prime Meridian, to be used in the reckoning of longitude and in "the regulation of time throughout the world."

In order to facilitate the examination of the several subjects included in the general question, I beg leave to suggest that they be considered under the following heads, viz:—

1. The regulation of time.

2. The reckoning of longitude.

3. The adoption of a Prime Meridian.

Under these separate heads I venture to submit a series of recommendations, to which the attention of the Conference is respectfully asked.

1.—THE REGULATION OF TIME.

SUGGESTED RECOMMENDATIONS.

1. *That a system of universal time be established, with the view of facilitating synchronous scientific observations, for chronological reckonings, for the purposes of trade and commerce by sea and land and for all such uses to which it is applicable.*

2. *That the system be established for the common observance of all peoples, and of such a character that it may be adopted by each separate community, as may be found expedient.*

3. *That the system be based on the principle that for all terrestrial time reckonings there be one recognized unit of measurement only, and that all measured intervals of time be synchronous or directly related to the one unit measure.*

4. *That the unit measure be the period occupied by the diurnal revolution of the earth defined by the mean solar passage at the meridian to be established as a time zero.*

5 *That the zero meridian for time reckoning be identical with the zero of terrestrial longitudes to be established and known as the Prime Meridian.*

6. *That the unit measure defined as above be held to be a day absolute and designated a Cosmic Day.*

7. *That such Cosmic Day be held as a chronological date, changing with the mean solar passage at the Prime Meridian.*

8. *That all divisions and multiples of the Cosmic Day be known as Cosmic Time.*

9. *That the Cosmic Day be divided into hours, numbered in a single series, one to twenty-four* (1 to 24). *Note.—As an alternative means of distinguishing the cosmic hours from the hours in local reckonings, they may be denoted by the letters of the alphabet, which, omitting I and V, are twenty-four in number.*

10. *That the hours of the Cosmic Day be sub-divided, as ordinary hours, into minutes and seconds.*

11. *That, until Cosmic Time be admitted as the recognized means of reckoning in the ordinary affairs of life, it is advisable to assimilate the system to present usages and to provide for the easy translation of local reckonings into Cosmic Time, and vice versa.*

12. *That all local reckonings be based on a known interval in advance or behind Cosmic Time.*

13. *That the surface of the globe be divided by twenty-four equidistant hour meridians, corresponding with the hours of the Cosmic Day.*

14. *That, as far as practicable, the several hour meridians be taken according to the longitude of the locality, to regulate local reckonings.*

15. *That, in all cases where an hour meridian is adopted as the standard for regulating local reckonings, the civil day shall be held to commence twelve hours before and end twelve hours after the mean solar passage of such hour meridian.*

16. *That the civil day, based on the twelve hour meridian* (180° *from the Prime Meridian*), *shall coincide and be one with the Cosmic Day.*

17. *That the system of Cosmic Time being accepted, it is advisable that it be acted upon by all civilized nations with as little delay as possible.*

REMARKS.

The determination of a Prime Meridian, common to all nations, will admit of the establishment of a system of computing time satisfactory equally to our reason and our necessities.

At present we are without such a system. The mode of notation followed by common usage for time immemorial, whatever its applicability to limited areas, when extended to a vast continent, with a network of lines of railway and telegraph, has led to confusion and created many difficulties. Further, it is insufficient for the purposes of scientific investigation, so marked a feature of modern inquiry.

Taking the globe as a whole, it is not now possible precisely to define when a year or a month or a week begins. There is no such interval of time as the universally defined ... everywhere invariable. By our accepted definiti... a day is local; it is limited to a single meridian. At some point ... the earth's surface one day

is always at its commencement and another always ending. Thus while the earth makes one diurnal revolution, we have continually many days in different stages of progress on our planet.

Necessarily the hours and minutes partake of this normal irregularity. Clocks, the most perfect in mechanism, disagree if they differ in longitude. Indeed, if clocks are set to true time, as it is now designated, they must, as a theory, vary not only in the same state and county, but to some extent in the same city.

As we contemplate the general advance in knowledge, we cannot but feel surprised that these ambiguities and anomalies should be found, especially as they have been so long known and felt. In the early conditions of the human race, when existence was free from the complications which civilization has led to; in the days when tribes followed pastoral pursuits and each community was isolated from the other; when commerce was confined to few cities, and intercommunication between distant countries rare and difficult; in those days there was no requirement for a common system of uniform time. No inconvenience was felt in each locality having its own separate and distinct reckoning. But the conditions under which we live are no longer the same. The application of science to the means of locomotion and to the instantaneous transmission of thought and speech have gradually contracted space and annihilated distance. The whole world is drawn into immediate neighbourhood and near relationship, and we have now become sensible to inconveniences and to many disturbing influences in our reckoning of time utterly unknown and even unthought of a few generations back. It is also quite manifest that as civilization advances such evils must greatly increase rather than be lessened, and that the true remedy lies in changing our traditional usages in respect to the notation of days and hours, whatever shock it may give to old customs and the prejudices engendered by them.

In countries of limited extent, the difficulty is easily grappled with. By general understanding, an arrangement affecting the particular community may be observed and the false principles which have led to the differences and disagreements can be set aside. In Great Britain the time of the Observatory at Greenwich

is adopted for general use. But this involves a departure from the principles by which time is locally determined, and hence, if the principle be not wrong, every clock in the United Kingdon, except those on a line due north and south from Greenwich, must of necessity be in error.

On the continent of North America, efforts have recently been made to adjust the difficulty. The steps taken have been, in a high degree successful in providing a remedy for the disturbing influences referred to and, at the same time, they are in harmony with principles the soundness of which is indisputable.

When we examine into time in the abstract, the conviction is forced upon us that it bears no resemblance to any one matter or essence which comes before our senses; it is immaterial, without form, without substance, without spiritual essence. It is neither solid, liquid nor gaseous. Yet it is capable of measurement with the closest precision. eless, it may be doubted if anything measurable could be computed on principles more erroneous than those which now prevail with regard to it.

What course do we follow in reckoning time? Our system implies that there are innumerable conceptions designated "time." We speak of solar, astronomical, nautical and civil time, of apparent and mean time. Moreover, we assign to every individual point around the surface of the earth, separate and distinct time in this variety. The usages inherited by us imply that there is an infinite number of times. Is not all this inconsistent with reason and at variance with the cardinal truth, that there is one time only?

Time may be compared to a great stream forever flowing onward. To us, nature in its widest amplitude is a unity. We have but one earth, but one universe, whatever its myriad component parts. That there is also but one flow of time is consistent with the plain dictates of our understanding. That there can be more than one passage of time is inconceivable.

From every consideration, it is evident that the day has arrived when our method of time reckoning should be reformed. The conditions of modern civilization demand that a comprehensive system should be established, embodying the principle that time is one

abstract conception, and that all definite portions of it should be based on, or be related to, one unit measure.

On these grounds I feel justified in respectfully asking the consideration of the Conference to the series of recommendations which I venture to submit.

The matter is undoubtedly one in which every civilized nation is interested. Indeed it may be said that more or less every human being is concerned in it. The problem is of universal importance, and its solution can alone be found in the general adoption of a system grounded on principles recognized as incontrovertible.

Such principles are embodied in the suggested recommendations. They involve, as an essential requirement, the determination of a unit of measurement, and it is obvious that such a unit must have its origin in the motion of the heavenly bodies. No motion is more uniform than the motion of the earth on its axis. This diurnal revolution admits of the most delicate measurement, and in all respects is the most available for a unit measure. It furnishes a division of time, definite and precise, and one which, without difficulty, can be made plain and manifest.

A revolution of the earth, denoted by the mean solar passage at the Prime Meridian, will be recognizable by the whole world as a period of time common to all. general agreement this period may be regarded as the common unit by which time may be everywhere measured for every purpose in science, in commerce and in every-day life.

The aim of the scheme set forth in the recommendations is to establish a sound, rational system of notation, which eventually may become universal, and by which, everywhere, at the same time, the same instant, may be observed. But, in the inauguration of a scheme affecting so many individuals, it is desirable not to interfere with prevailing customs more than necessary. Such influences as arise from habit are powerful and cannot be ignored. The fact must be recognized, that it will be difficult, immediately, to change the usages to which the mass of men have been accustomed. In daily life we are in the habit of eating, sleeping and following the routine of our existence at certain periods of the day. We are familiar with

the numbers of the hours by which these periods are known, and, doubtless, there will be many who will see little reason in any attempt to alter their nomenclature; especially those who take little note of cause and effect, and who, with difficulty, understand the necessity of a remedy to some marked irregularity which, however generally objectionable, does not bear heavily upon them individually.

For the present, therefore, we must adapt, as best we are able, the new system to the habits of men and women, as we find them. Provision for such adaptation is made in the series of recommendations (see 11, 12, 13, 14, 15 and 16) by which, while local reckoning would be based on the principles laid down, the hours and their numbers need not appreciably vary from those with which we are familiar. Thus, time-reckoning in all ordinary affairs in every locality may be made to harmonize with the general system.

Standard time throughout the United States and Canada has been established in accord with this principle. Its adoption has proved the advantages which may be attained generally by the same means. On all sides these advantages have been widely appreciated, and no change so intimately bearing upon common life was ever so unanimously accepted. Certainly, it is an important step towards the establishment of one system of Universal Time, or, as it is designated in the recommendations, Cosmic Time.

The alacrity and unanimity with which the change has been accepted in North America, encourages the belief that the introduction of Cosmic Time in every day life is not unattainable. The intelligence of the people will not fail to discover, before long, that the adoption of correct principles of time-reckoning will in no way change or seriously affect the habits they have been accustomed to. It will certainly sweep away nothing valuable to them. The sun will rise and set to regulate our social affairs. All classes will soon learn to understand the hour of noon, whatever the number on the dial, whether six, as in scriptural times, or twelve, or eighteen or any other number People will get up and retire to bed, begin and end work, take breakfast and dinner in the same periods of the day as at present, and our social habits and customs will re-

main without a change, depending, as now, on the daily returning phenomena of light and darkness.

The one alteration will be in the notation of the hours, so as to secure uniformity in every longitude. It is to be expected that this change will at first create some bewilderment, and that it will be somewhat difficult to be understood by the masses. The causes for such a change to many will appear insufficient or fanciful. In a few years, however, this feeling must pass away and the advantages to be gained will become so manifest that I do not doubt Cosmic or Universal Time will eventually commend itself to general favour and be adopted in all the affairs of life.

2.—THE RECKONING OF LONGITUDE.

SUGGESTED RECOMMENDATIONS.

1. *That the surface of the globe being divided by twenty four equidistant meridians (fifteen degrees apart) corresponding with the hours of the Cosmic Day, it is advisable that longitude be reckoned according to these hour meridians.*

2. *That divisions of longitude less than an hour (fifteen degrees) be reckoned in minutes and seconds.*

3. *That longitude be reckoned continuously from east to west, beginning with the Prime Meridian as zero.*

4. *That longitude, generally, be denoted by the same terms as those applied to Cosmic Time.*

REMARKS.

Longitude and time thus determined become so intimately related that they may be expressed by a common notation. Longitude is simply the angle formed by two planes passing through the earth's axis, while time is the period occupied by the earth in revolving through that angle. If we adopt the system of measuring time by the revolution of the earth from a recognized zero, viz., the Prime Meridian, one of these planes, that through the Prime Meridian, becomes fixed; the other, that through the meridian of the place

being movable, the longitudinal angle is variable. Obviously the variable angle ought to be measured from the fixed plane as [illegible] and as the motion of the earth by which the equivalent time [illegible] the angle is measured is continuous, the longitude ought to be reckoned continuously in the one direction. The direction is determined by the notation of the hour meridians, viz., from east to west.

If longitude be so reckoned and denoted by the terms used in the notation of Cosmic Time, the time of day everywhere throughout the globe would invariably denote the precise longitude of the place directly under the (mean) sun. Conversely, at the epoch of mean solar passage at any place, the longitude being known, Cosmic Time would be one and the same with the longitude of the place.

The advantages of such a system of reckoning and nomenclature, as suggested in the recommendations, are self-evident.

3.—THE ADOPTION OF A PRIME MERIDIAN.

SUGGESTED RECOMMENDATION.

1. *That the meridian, twelve hours* (180°), *from the Observatory at Greenwich, be adopted as the Prime Meridian to be universally used by all peoples as the common zero in reckoning time and longitude.*

REMARKS.

So far as the principles on which Cosmic Time is proposed to be established, it is unimportant at what point or in what hemisphere the Prime Meridian may be projected.

But the establishment of a Prime Meridian, to be recognized as a common zero of longitude and time, affects all civilized people, and interests of great importance have to be consulted in its determination.

Among the papers laid on the table will be found one on this subject, to which I beg leave to refer.* This paper was read before the Canadian Institute in 1879, and it expresses the views I now hold.

* Longitude and Time-Reckoning.—A few words on the selection of a Prime Meridian, to be common to all nations, in connection with time-reckoning.

There are weighty reasons that Greenwich should be the zero of longitude, but the Prime Meridian would be the separating line on the surface of the globe, between two consecutive diurnal revolutions, and consequently between two Cosmic dates. It is obvious, therefore, that the selection of Greenwich as Prime Meridian would throw the commencement of one date and the close of another in the middle of man's ordinary working hours. This would be objectionable, not in England only, but likewise throughout Europe.

The zero meridian should undoubtedly be removed from the masses of population and, looking to the future, away from any considerable extent of habitable land. We should keep in view the desirability of all mankind reckoning by concurrent dates.

The International Geodetic Congress at Rome proposed that all Governments should adopt Greenwich as the initial meridian, and that longitude should be reckoned from this meridian, as a zero, running in one direction from east to west. If longitude be considered apart, the wisdom of the recommendation must on all sides be acknowledged.

But if the reckoning of time is to be considered, we cannot ignore the reasons advanced in favour of a Prime Meridian being established in another part of the globe. The meridian exactly 180° from Greenwich has been suggested. This proposal has the support of M. Otto Struve, Director of the Imperial Observatory at Pulkova, and others. From the first I have held this view, and I can find no argument which has such weight as to lead me to set it aside. In my humble judgment I consider that the Cosmic Day should commence when the sun passes the anti-meridian of Greenwich. The Astronomer Royal of England, Mr. Christie (10th December, 1883), expresses his preference for this commencement of the day, and he remarks that in proposing it to the Committee he received the support of M. Faye, on the part of France.

For these reasons the view which I respectfully beg leave to offer is that the Prime Meridian should be established twelve hours (180°) from the Greenwich meridian.

If this recommendation be sustained, Greenwich civil time will become identical with Cosmic Time.