GENERAL DISCUSSION

THE JOINTS OF TIME[1]

THE reason that the year begins on January 1 is a "prétty reason," as Lear's poor fool would say. Julius Cæsar, when he reformed the calendar in the year 46 B.C., evidently had in mind to begin the year with the shortest day. The winter solstice at Rome occurred in that year on the twenty-fourth of December of the Julian calendar; consequently the first day of the year would have fallen on December 25. But he delayed it seven days out of regard for prevailing customs and the superstitions of the people. As they had been accustomed to a lunar calendar, they would be better satisfied if the first year of the new calendar came in with the new moon. Accordingly the mean new moon was carefully computed and the new calendar had its beginning on the first of January, 45 B.C., at sixteen minutes past six in the afternoon.

Among all peoples, in all ages, it has been the custom to start the year, whether civil or ecclesiastical, with either the winter or summer solstice or the vernal or autumnal equinox. These times seem to mark the natural beginnings for reckoning the circuit of the seasons. The result of Cæsar's little stroke of diplomacy is that our year now has no relation to astronomic fact or logical reason. It has relation only to superstitions and political considerations which no longer exist. The history of the calendar is a struggle between human nature and arithmetic, the former not wanting to give in to the conclu-

[1] From article by Charles D. Stewart, Hartford, Wisconsin. *Atlantic Monthly.* 137:10-22. January, 1926.

sions of the latter. This history, philosophically considered, not only serves to give us our bearings with regard to the problem of time measurement, but is a subject of considerable interest in itself.

A year consists of 365 days, 5 hours, 48 minutes, and 45.51 seconds. From the standpoint of one who is trying to equip the universe with some practical system of time measurement, this sort of year is manifestly ridiculous. In a practical system of measurement each larger unit should be exactly divisible by the smaller unit next below it.

A month has a mean length of 29 days, 12 hours, 44 minutes, and 2.7 seconds. This is equally absurd. We cannot very well deal with months and years which begin and end with such utter disregard of the smaller units that we have these fractions of a day on our hands.

What, then, is a day, let us ask. That it is not an acknowledged part of a month or a year is a fact which the above figures make sufficiently plain. Nature did not intend it to be such. A day is a day. It is sufficient unto itself, and it is wholly unconcerned about any other unit of time.

In a foot there are a certain number of inches of equal size; and in a bushel the pecks are of like content. But what is a month? There are said to be twelve months in a year, but this statement means little when you consider that the months do not fit into the year except by being altered to a variety of sizes!

As man did not make days, months, and years he is not, of course, to be held accountable for them. But he did make hours, minutes, and seconds, and so it would seem that as a matter of convenience and common sense he would have chosen such smaller time units as would fit in with and be a common divisor of the units already established. And no doubt he would have done so if he could. But evidently there were difficulties in the way; for when we state the length of a year or of a month in

fractions of a second we are simply saying that these larger units are not divisible into any sort of time that man has been able to discover or invent.

Doing as best he could, man divided the day into parts which were equal but which fitted nothing further; and while his work might seem careless, inconsistent, and entirely incompetent, it is not so bad by comparison. For neither do days fit into months, nor months into years, nor years into any astronomical cycle which the heavens exhibit. It is all as bad as our English system of weights and measures; and the whole world knows how illogical and inconsistent and altogether incompetent that is.

Contrary to what any mortal member of any academy would expect, the heavens are *not* constructed on the metric system! They do not countenance or make possible any such mechanical notions of perfection upon the part of man. Consequently the time is out of joint; and as man is a measuring and record-keeping animal there has been constant challenge to his intellect to set it right.

The whole truth of the matter is that Nature has offered us three different standards of time measurement —the day, the month, and the year. We have got to make a choice and abide by it. We may not accept them all as if they were harmonious facts and parts of a heavenly clockwork. That is just what they are not. Sun and moon revolve and rotate as they please; each is true to its own appointments. But the sun takes no care that years shall be divisible into months; and neither does the sun or moon time its evolutions to fit in with that standard of measurement which we call a day.

And this is a fact which is totally unacceptable to the mind of man. There is something about it which is obnoxious to human nature. If man, instead of God, had made the universe he would surely have made months that were exactly divisible into the year. This is a safe assertion in view of the fact that for ages he stuck to the moon as a standard of measurement while at the same

time he tried to drive the chariot of the sun. We like to think that the universe is all working together, cogged and clocklike, with wheels that are proper multiples of one another—the whole acting as one big time system. If it is not so, then it ought to be so, and it is for us to bring the stars into harmony.

Of course there is but one way. That is to assume that they rotate and revolve thus and so. Consequently we have made the year a convenient length; and we have invented a system of leap years, leap months, and leap centuries to put us periodically into step with the facts. Finding ourselves compelled to deal in fractions of a day, we borrow from time, or extend credit to it, and then set things approximately right on a clearing-house system. We save up our scraps of time till we have enough to make a day, and we add it to a year; but as this is too liberal we pause once in a hundred years to take a day back; and as this is just a little too parsimonious we remember every four-hundredth year not to take the day that was coming to us. And for this temporizing with time we are hardly to be blamed. For the day and the year are each important to us; and when each insists upon being the sole standard of measurement, what else are we going to do about it?

Up to the time when our present form of calendar was adopted, all peoples, with the exception of the Egyptians, went strictly by the moon. A month was a month, an average duration of 29½ days; and it was of no very vital concern to them that twelve of those months amounted to only 354 days instead of a proper year.

To a people adopting a form of calendar the exact length of the year seems to be of no great importance. The year, with its four seasons, is supposed to bring a progressive change of climate; but when we consider that mere spells of weather make irruptions upon the seasonable climate and set the year backward or forward by days and weeks, an astronomer's information as to the

exact number of days in a year would seem to be of mere academic interest.

But an exact foreknowledge of the phases of the moon is of immediate and practical importance. Besides lighting the way for travelers and holy pilgrims, and thus making itself of prime importance in the regulations of religion and commerce, the moon was so obvious a timepiece, and so easily determined in its comings and goings, that it naturally became the first standard of measurement. A discrepancy of a week or two between twelve lunar months and the length of a solar year would appear to make no great difference in practical life.

But such a discrepancy is cumulative. The error keeps growing; it adds to itself year after year; and pretty soon it amounts to months. The inevitable result is that the months rotate through the seasons. And no people, whether herdsmen or planters, can afford to go by dates that are completely out of harmony with the solar year.

It was a puzzling prospect that opened up before the eyes of our forefathers when, after much effort to construct a satisfactory calendar, they discovered the true nature of the difficulty. They made use of months that lasted from moon to moon; but no particular number of moons fitted into a year! When they tried twelve there was a considerable remainder of time which that twelve-month did not fill out; consequently, their first month of the year, starting eleven days before the actual solar year was ended, would cause a falling behind of the season with regard to the supposed date. Each year would fall farther behind, the result being that the months revolved rapidly through the year. The practical effect of this was that a winter holiday, such as our Christmas, would get around to midsummer; and all the while they were carefully observing its month and date! And a summer festival would work its way, perforce, to the middle of winter! This was very embarrassing. It not only made

an undesirable state of affairs with regard to religious and other holidays, but it was confusing to the planter, a certain day of the month meaning nothing in his line of endeavor.

This harassing state of affairs prevailed among the early Greeks and Romans and troubled the mind of the world generally. It continued to work confusion at Rome up to the time the present form of calendar was adopted. When Julius Cæsar took over the solar year from the Egyptians, computed time at Rome had gained eighty days on actual time. And yet the priests had been accustomed to throwing an extra month into the year whenever it seemed to need it, after the manner of a crew dressing the ballast in a ship.

One might easily suggest that, if a lunar twelvemonth is eleven days short of the actual year, it would only be necessary to add these eleven days to the end of the year or distribute them among the months. This suggestion is really foolish. It would put the month out of step with the moon; and what use would a lunar calendar be in that case? It must be borne in mind that a calendar must go absolutely by the moon or absolutely by the sun, else it will run completely astray and be no calendar at all. The ancients managed very cleverly so far as the moon was concerned. A complete lunation is approximately 29½ days. Their months therefore had twenty-nine and thirty days alternately. By following this rule strictly they struck an average that kept in close step with the moon and only needed a day thrown in at long intervals to correct the slight error. This was the practice of the Greeks. The problem was to find a way to correct this calendar to correspond with the annual journey of the sun and yet not get out of step with the moon. They could have lunar months which rambled through the seasons in a most confusing way, or they could have a year which was fairly true to the sun, but with months that had no relation to the moon. And it is not in human nature to be satisfied with either.

It was a great day in the history of humanity when the astronomer Meton, of Athens, made his observation that once in nineteen years the sun and moon come round to the same relative position in the heavens. This means that the new moon, or any other phase of the moon, falls upon the same time or season that it did nineteen years before.

Here was an astronomic fact that was due to be taken advantage of. In this total time of nineteen years he counted just 235 lunations. This was a happy coincidence for the purpose of a lunar calendar. At last it was found that the sun does do something, complete, in exactly the same time that it takes the moon to do it. As a matter of fact, the 235 lunations take nineteen years and two hours; but the coincidence was sufficient for the purpose.

The problem had always been to get the moon into step with the sun without breaking a month to do it, and thus getting out of step with the moon. And when it is noted that any certain number of lunations equals any certain number of solar years, the problem is on its way to solution.

The period consisted of 6940 days. All that remained was to divide this period into years of twelve and thirteen lunar months. As twelve lunar months are less than a solar year, and thirteen are in excess of a solar year, either one is approximately correct. And the problem was to mix these years in such proportion that their total would come out even with the luni-solar period. It was found that by having seven of these thirteen-month years, or leap years, distributed among the nineteen the proper total was made up. Through all these years, whether of twelve or thirteen months, the moon was strictly followed by the alternation of twenty-nine-day and thirty-day months, except at intervals when an extra thirty-day month was used by way of correction.

To the modern mind such years would be far from satisfactory; for twelve of them in each nineteen-year

period had 354 days, while the seven leap years had 384 days, due to the extra thirty-day month. But they were not trying to have solar years. This is a mathematical impossibility so long as you are observing lunar months. Their problem was simply to have a system of correction. on a true astronomical basis, which would hold them in an approximate relation to the sun and would keep their months from rotating through the seasons.

Heretofore a month had been but an uncertain craft for a man to trust himself to upon the sea of time. It had a way of floating clean off its bearing so that man and month were lost together. And when the date belied the season there was no certain and set formula to bring them into some recognized relation again. But this nineteen-year coincidence—a recurring basis of correction—was like having a row of stakes driven for you all across the blue of eternity. It was only necessary to figure out a formula for getting from one to the other; and this was done by having the thirteen-month years to hold the months and the seasons in approximate relation till the nineteen-year goal was reached. After that the formula could be repeated, and the problem was solved forever!

This calendar, a memorable invention, was made public at the Olympic games on July 16 of the year 432 B.C and acclaimed by the people. Thereafter the number of each year, from one to nineteen, was engraved "on pillars of marble in letters of gold", and in church calendars after the beginning of the Christian era the Metonic number of each year was printed in golden ink. It is the same Golden Number which we find in the modern prayer-book in connection with the rule for finding the date of Easter. The calendar-maker could hardly get along without it.

The Jewish calendar is essentially the same as this old Greek calendar, being based upon the Metonic cycle and the alternating months of twenty-nine and thirty

days. It differs a little in the management of the leap years and common years, there being three lengths of each; but the end attained and the principle are the same. The Mohammedans cling to it religiously.

The Romans, if they had strictly observed the rules of the Metonic calendar, instead of altering figures upon the basis of superstition, would no doubt have found it fairly satisfactory. But they made a complete mess of it; and Julius Cæsar solved the problem by adopting the Egyptian method, which makes the sun the standard. When this was done the moon was cast utterly aside—necessarily. A solar calendar cannot serve two masters.

In establishing the solar calendar Cæsar took advice from the astronomers at Alexandria and made the length of the year 365¼ days, which is slightly in excess of the true period. In 1582 the error of about eleven minutes per year had accumulated until it amounted to ten days. This shifting of the date away from the season became undesirable because it brought Easter and all the other movable festivals at a wrong time. Pope Gregory XIII corrected it, making the fifth of October the fifteenth, 1582. And in order that the error might not grow to such size again he ordained that every year of even hundreds should not be counted a leap year, excepting every four-hundredth, beginning with the year 2000. In Catholic countries the change was promptly adopted; but in the Protestant world the people refused to take advice from the Pope even though he was dealing with a mere matter of arithmetic. It was not till 1751, after nearly two centuries of inconvenience, that Great Britain and her dependencies gave in. By that time the error was eleven days; and September 3, 1752, was called September 14.

Viewing our present proposals for calendar reform in the light of history, we cannot but be struck by the fact that there is no call for astronomical correction. Our scheme of time measurement, substantially the same as it was in the year 45 B.C., and only slightly corrected in 1582, is astronomically perfect.

When Julius Cæsar made months of thirty-one days purely upon a basis of superstition, it really was no great matter from a scientific standpoint. The month was no longer an astronomical unit; the moon had utterly passed out as a standard of measurement. Of our present proposed plans, that known as the Astronomer's has great standing in Europe; and that has a thirty-one-day month in every quarter. Its advantage over the present calendar is that a difference of from one to two days in the lengths of the quarter-years is done away with; and that is all. It is a difference which would probably be taken account of by statisticians or in certain business transactions. While many of the features of calendar reform win our assent at once, we scarcely know what attitude to take when we find the continuity of the week broken into and our relations with the past again put out of joint. The length of the month is of no importance astronomically; it is purely a matter of taste or business convenience. Astronomically the calendar is perfect; and it was made so by astronomers who had no observatories in the modern sense, and who made all their discoveries with the naked eye.

Of the great naked-eye astronomers I hardly know whether to give my admiration to Meton, who made the moon practical for human use, or to Hipparchus or to Copernicus. Meton was very useful to the world, but beyond his connection with the lunar calendar we know little about him. Hipparchus, who lived in the second century before Christ, was the first of whom we have reliable record; and he is accounted the founder of scientific astronomy. He explained the precession of the equinoxes, and was the first to discover from direct observation of the sun that the length of the year is somewhat less than 365¼ days. Copernicus was of the modern speculative type, which strikes out and concerns itself with God's own business. Purely in his mind's eye, and with no proof beyond appearances that were open to all,

he saw a world-machine which, as was proved by later discovery, was very much like one which God Himself had invented.

The astronomers who helped Gregory XIII to correct the system of leap years in 1582, when Shakespeare and Cervantes were living and Luther had not long been dead, had no notion of such a thing as a telescope. Their only lenses were the ones God gave them; and so it was with all the great astronomers who lived and died before them. Consider well, then, the calendar on the wall. It came down to us, just as it is, from the days of paganism! It owes little to modern astronomy and nothing whatever to the telescope. And, except for the fact that Cæsar did not start it on the day of the winter solstice, it is astronomically perfect!

BRIEF CHRONOLOGY OF CALENDAR PERIODS AND REFORM MOVEMENTS[2]

7000 B.C.—Civilization in Egypt traced to this date. Use of calendar presumed.

4713 B.C.—January 1 of this year was set by Joseph Scaliger as the beginning of the Julian Period.

4235 to 2450 B.C.—The Great Pyramid at Gizeh near Cairo was built. Its structure is said to indicate it was built to throw shadows for the testing of chronology by tracing the sun's movements.

4004 B.C.—The date of the Creation, as assumed by the chronology of Bishop Usher of England.

3761 B.C.—The date of the Creation as assumed by the Jewish calendar.

3102 B.C.—The supposed beginning of the account of time in India. This date is fixed as the beginning of what is known as the Kaliyug Era.

[2] From Article Brief Chronology of Calendar Periods. *Congressional Digest.* 8:97-8. April, 1929, with additions from the National Committee on Calendar Simplification and other sources.

2397 B.C.—The supposed beginning of the account of time in China.

776 B.C.—The supposed beginning of the Era of the Olympiads.

754 B.C.—The Romans were operating under a year of 304 days.

753 B.C.—The Era of Rome began. The letters A.U.C. were used to indicate this period, meaning *anno urbis conditae* or the year of the founding of the City of Rome.

509 B.C.—The Roman year had grown to 12 months totaling 354 days, with a biennial addition of 21 days, making 1460 days in 4 years or an average of 365 days per year. This 21 day adjustment, Mr. M. B. Cotsworth states, is identical with the old Druidical "quarter moon" adjustment.

432 B. C.—Meton, a Greek, discovered that 19 solar years contained 235 lunations. The Greek year at that period was a lunar twelve-month of 354 days.

238 B. C.—Reforms in the Egyptian calendar were made in Rome.

45 B. C.—Julius Caesar put the Julian calendar into effect in Rome. The name of the month Quintilis was changed to July in honor of Julius Caesar.

8 B. C.—Augustus Caesar persuaded the Roman Senate to change the name of the month Sextilis to August, in his own honor.

312 A. D.—The Emperor Constantine of Rome abolished the Olympiads and established in their stead the Indictions, or Cycles of 15 years, intended to be employed in connection with public accounts and the collection of imperial taxes. On January 1, the Roman Indiction went into effect.

325 A. D.—The General Council of Nicia (Nice, Italy) was held.

358 A. D.—Rabbi Hillel II made an adjustment in the Jewish calendar.

532 A. D.—The Christian Era was invented by a monk, Dionysius Exiguus. It is held to have begun on January 1, in the middle of the 4th year of the 194th Olympiad; the 753rd year of the building of Rome and in 4714 of the Julian Period. The Christian Era was introduced in Italy some time in the 6th Century.

816 A. D.—The Christian Era was ordered to be used by Bishops of the Council of Chelsea but was not generally used until several centuries later.

879 A. D.—King Charles III of Germany was the first to add "In the year of Our Lord" to the date of his reign.

1454 A. D.—The Council of Trent was held.

1577 A. D.—Pope Gregory XIII appointed a commission to study a plan of calendar reform designed by a Neapolitan physician, Aloysius Lilius.

1582 A. D.—The new calendar known as the Gregorian calendar, was first put into effect in four countries —Italy, Spain, Portugal and France.

1583 A. D.—Switzerland and the Catholic Netherlands adopted the Gregorian calendar.

1609 A. D.—The Protestant States of Germany adopted the Gregorian calendar.

1751 A. D.—The Calendar New Style Act was passed by the British Parliament. It was introduced by Lord Chesterfield.

1752 A. D.—The Calendar New Style Act came into effect, resulting in the adoption of the Gregorian calendar by Great Britain and all her colonies including the American Colonies. Prior to this the 25th of March had been the beginning of New Year in Great Britain.

1793 A. D.—On November 24, the Revolutionary calendar of the French Convention was instituted. This calendar made September 22 the beginning of the year in commemoration of the founding of the French Republic, September 22, 1792. This year had 12 months of 30 days each, with five supernumerary days at the end of

each year. Weeks were abolished and the months divided into three decades of 10 days each.

1804—On December 31, the French Revolutionary calendar was abandoned.

1835 A. D.—An Italian priest, l'abbe Marc Mastrofini, published in Rome a proposal to reform the calendar by having every year begin on Sunday, with the last day of the year having no week day name.

1849—August Compte, a Frenchman, proposed a calendar of 13 months of 28 days each, with blank days. This day was to be observed as an 8th day feast. Leap day was to be called the intercalary day. It was the first known proposal to use "blank" days to establish a perpetual calendar. The book bore three ecclesiastical sanctions of the Roman Catholic Church.

1873—Gregorian calendar adopted by Japan.

1900—Calendar improvement brought before the Evangelical Conference at Eisenach .

1908—A bill was introduced in the British Parliament to reform the Gregorian calendar.

1910—In June a Congress of European Chambers of Commerce, meeting in London, recommended the calling of an international convention. These same recommendations were adopted at similar meetings in Boston in 1912 and at Petrograd in 1913.

1912—Gregorian calendar adopted by the Chinese Republic.

1914—A second bill for calendar reformation was introduced in the British Parliament. Commercial associations meeting in Paris and Liege recommended a 13 month calendar.

1917—American business men began organizing for calendar reform, advocating the Liberty calendar.

1917—Gregorian calendar adopted by the Turkish Parliament.

1918—Bolshevist government of Russia adopted the Gregorian calendar.

1918—On April 16, Representative J. M. C. Smith introduced a bill (H. R. 11486, 65th Cong. 2nd Sess.) which provided that beginning with the year 1920 each year should have 13 months of four weeks each or 28 days, the added month to be called Sol (from Solstice) and to follow June. This bill was referred to the Committee on Interstate and Foreign Commerce but no action was taken.

1919—The International Astronomical Union appointed a committee to study calendar reform.

1921—On May 12 Representative Drane introduced in the House a bill (H.R. 6166) to change the calendar from the Gregorian to a perpetual calendar establishing 13 months instead of 12. It was referred to the Committee on the Judiciary.

1922—The Chamber of Commerce of the United States and the American section of the International Chamber of Commerce began consideration of the question of simplifying the calendar with the result that the International Chamber requested the League of Nations to take up the question.

1922—The Congress of the International Astronomical Union met at Rome.

1922—On February 9 there was a hearing on a bill (H.R. 3178, 67th Cong., 2nd Sess.) before the Committee of the Judiciary relating to the modification of the calendar.

1922—On March 6, Representative A. Piatt Andrew introduced in the House by request a bill (H.R. 10741, 67th Cong., 2nd Sess.) to eliminate from our Julian calendar all numbers in it prompted by the pride of Augustus and to incorporate in their places the original uniform numbers written by Caius Julius and enacted by the Roman Senate. This bill was referred to the Committee on the Judiciary but no action was taken.

1922—On June 29, Representative Schall introduced a bill (H.R. 12221, 67th Cong. 2nd Sess.) authorizing the

President to call an international conference to improve the Gregorian calendar and to recommend, for universal adoption, a common calendar to be used in the reckoning of calendar dates and in regulation of time throughout the world.

1923—Greece and the Greek Church adopt the Gregorian calendar.

1923—The League of Nations appointed a Committee of Inquiry on Calendar Simplification. This Committee analyzed 185 proposals from 38 nations and filed a comprehensive report to the League.

1924—The Assembly of the Geodesic and Geophysical Union at Madrid.

1924—On January 7, Representative Schall introduced a bill (H. R. 4847, 68th Cong., 1st Sess.) to provide for the adoption of the Liberty calendar. This bill was referred to the Committee on the Judiciary but no action was taken.

1926—On September 26, the Assembly of the League of Nations accepted the findings of the Committee of Inquiry.

1927—On September 27 the Secretary General of the League of Nations transmitted to the nations, including the United States, a request for the establishment of national committees to study and report on calendar reform. The Secretary of State thereupon requested an expression of opinion from the various government departments and found their sentiment was favorable toward calendar change and the formation of a national committee.

1928—On January 27 a bill (S. 2862, 70th Congress, 1st Sess.) providing for the modification of the calendar to the Liberty calendar was introduced into the Senate by Mr. Schall and referred to the Committee on the Judiciary.

1928—On February 18 the Pan American Conference at Havana adopted a resolution recommending that

each of the Latin-American states appoint a national committee to study the question of calendar simplification, and that they make the necessary preparation to participate in an international conference to determine which is the best method of reform.

1928—On February 23 the National Academy of Sciences, Washington, D.C. adopted a resolution in favor of a change to the thirteen month calendar.

1928—On July 9 the National Committee on Calendar Simplification was organized at Washington, D.C. Although not an official organization it had representatives from the Federal departments of the Treasury, Navy, Interior, Agriculture, Commerce, Labor, Interstate Commerce Commission, as well as from industrial, business and civil interests.

1928. On December 3 and 5 two joint resolutions (H.J. Res. 330 and H.J Res. 334, 70th Cong., 2nd Sess.) were introduced by Representative Stephen G. Porter, and one (S.J. Res. 173) was introduced by Senator Thomas D. Schall, intended to give effect to the Pan American resolution. Hearings were held in December and January before the House Committee on Foreign Affairs, but no action was taken.

1929—On April 15 and 29 two resolutions (H.J. Res. 16 and H.J. Res. 60) were introduced into the House by Representative Stephen G. Porter requesting the President to propose the calling of an international conference to consider the simplification of the calendar or to accept in behalf of the United States an invitation to participate in such a conference.

LEAGUE OF NATIONS' REPORT[3]

Before submitting its conclusions, the Committee feels that it should point out the main, and undisputed, defects of the present Gregorian calendar, *i.e.*:

[3] From League of Nations. Special Committee of Enquiry into the Reform of the Calendar. Geneva. 1926.

1. Inequality in the Length of the Divisions of the Year.

The divisions of the year, the months, quarters, and half-years, are of unequal length. The months contain from 28 to 31 days. As a result, the number of days in the quarters are respectively 90 (91 in a leap year), 91, 92, and 92. The first half-year, therefore, contains two or three days less than the second. Another result is the unequal number of weeks included in the quarters and half-years.

The unequal length of months, quarters, and half-years is a cause of confusion and uncertainty in economic relations, in the arrangement of all statistics, accounts, commercial and transport figures, &c.

The fact that the months contain 28, 29, 30, or 31 days is responsible for the fact that all calculations of salaries, interest, insurance, pensions, leases and rent which are fixed on a monthly, quarterly, or half-yearly basis are inaccurate and do not correspond with one-twelfth, one-quarter or half of the year. In order to make daily calculations in current accounts with comparative certainty and speed, banks are obliged to make constant use of special tables. Moreover, in most of the countries of Europe, the unequal length of the months has led financial concerns to calculate deposit and current accounts on the basis of a year of twelve months of thirty days, or a year of 360 days, whereas in the discounting of bills the year is still reckoned at its exact number of days. Finally, the quarters and half-years do not contain an exact number of weeks.

2. Want of Fixity in the Calendar.

The calendar is not fixed: it changes each year; the year, in fact, consists of 52 weeks, plus one or two days. Thus, if the first day of the year is a Sunday, in the following year it is a Monday (or even a Tuesday in the

case of a leap year). Were it not for the extra day of leap year the calendar would only have seven different alternatives corresponding to the seven days of the week on which the year can begin; owing, however, to the extra day of the leap year, the exact *reproduction* of the calendar of any year only takes place once every 28 years. Thus, the day of the month falls each year on a different day of the week from the one on which it fell the previous year. In consequence:—

(*a*) The dates of periodical events can never be fixed with precision. Such a date can, in fact, only be determined in two ways: either by the day of the month (August 15th for example) or by the day of the week in the month (the third Tuesday in October). With the present Gregorian calendar, this double method is not precise, for, if the day of the month is fixed for periodical events, this day may sometimes fall on a Sunday or general holiday.

Each year, therefore, the authorities have to make a special decision, as for instance, for the meeting of a tribunal, the convocation of Parliament, the dates of holidays, fairs, markets, administrative assemblies, the fixing of summer-time, &c.

On the other hand, if a special day (the first Monday in the month, for example) is fixed for these events, other difficulties arise, as the date corresponding to this day varies continually from month to month and from year to year.

If the calendar were fixed, the dates of these events could be fixed once for all. They would fall on the same dates as well as on the same days of the week.

(*b*) The position of the weeks in the quarters varies each year, that is to say, the weeks overlap the divisions of a year in a different way each time, and complications accordingly arise in the reckoning of accounts, statistics, &c.

(*c*) The 1st, 15th, and 30th of a month are sometimes Sundays. When the 1st of a month falls on a Sunday, it is not possible to revise and verify immediately all the work of the previous months and quarters and to establish without delay the various comparisons which are essential from a business point of view. This is a serious disadvantage in respect of accounts and statistics. The 15th and 30th of the month are very important dates as regards the falling due and the payment of rents. When these dates are Sundays, the payments must be postponed or advanced.

(*d*) Finally—and this is, perhaps, the greatest drawback from a statistical and commercial point—since the various days of the week are not of the same value as regards the volume of trade, and the years and the months do not from year to year include the same number of individual week-days, there can be no genuine statistical comparison between one year and another, while the various subdivisions of the year itself—the half-years, quarters, and months—are likewise incapable of comparison.

3. Special Disadvantages of the Non-Fixity of Easter.

The date of Easter varies at present between March 22nd and April 25th, *i.e.*, over a period of 35 days, and involves a corresponding displacement of the movable festivals. Numerous disadvantages result, both from a civil and a religious point of view. In the civil sphere, school, university, and judicial work, and commercial interests, including those relating to transport, are particularly affected. The beginning of the scholastic year and some of its holidays are fixed, whereas others are movable. The same disadvantages apply to judicial or administrative holidays. Many commercial transactions and the transport services connected with them are severely prejudiced by the changing date of Easter: in particular, business dealing with textiles, articles of

fashion, and the hotel-keeping industry, since Easter marks the beginning of the spring fashions and is an important date from the tourist point of view. If Easter is early, the weather of the Northern Hemisphere being unfavourable in the temperate zones at this time of the year, travelling and changes in dress are postponed. If, on the other hand, Easter is late, there is more tourist business, but the textile trade in spring wear is severely injured, because summer articles are purchased at once. In a general way the organisation of traffic and transport is disturbed by the changing date of Easter. From the religious point of view, there are disadvantages due to the fact that the number of Sundays in the year being practically fixed, the services of the Roman Catholic liturgy which cannot take place before Easter when this festival is early have to be postponed until after Whitsuntide.

As stated above, the Committee found itself obliged to separate the question of the fixing of Easter from that of the general reform of the calendar, and it will adhere to this policy in its report, submitting its conclusions on these two points separately.

General Reform of the Calendar

The Committee has received a considerable number of schemes for the reform of the calendar from various sources in numerous countries. The number of these schemes shows the keen interest which the question of calendar reform is arousing throughout the world. It does not seem necessary to give, in the report itself, a detailed classification of these schemes. They are, however, analysed, the analysis being preceded by a general classification. It may be of interest to note that the schemes submitted were received from the following countries:

Algeria 1, Argentine 2, Austria 7, Belgium 10, Brazil 2, Canada 4, Chile 1, China 1, Danzig 1, Denmark 1,

Egypt 1, Esthonia 1, France 33, Germany 24, Great Britain 5, Greece 3, Hungary 3, India 3, Ireland 1, Italy 5, Java 1, Netherlands 5, Norway 1, Poland 3, Roumania 10, Kingdom of the Serbs, Croats, and Slovenes 3, Spain 3, Switzerland 14, Syria 1, Tunis 1, Turkey 1, United States of America 27, Uruguay 11.

There was also one international proposal.

In the course of the enquiry, consideration was also given to a number of schemes already known to the Committee.

The total number of schemes received was 185. The Committee noted, after examining the last hundred received, that, although each had been conceived by its author on an original basis, none offered any new combination that could reasonably be put into practice. The Committee consequently concluded that the material was complete, and that all combinations which can be carried out with any hope of success are known to the Committee.

Of course, if every one of these draft schemes had to be discussed, there would be little likelihood of securing a result. After collecting the necessary information and obtaining preliminary opinions from the various governments and international associations interested, the Committee concluded that one of its duties was to restrict the problem by eliminating all main groups of reform schemes which seemed useless and impracticable, when judged on their intrinsic merits and the possibility of their acceptance by the public.

The Committee came to the conclusion that it could not recommend the following groups of changes and schemes of reform:—

I. Modifications of the Year proposed by Certain Authors of Calendar Reform Schemes.

(*a*) *Beginning of the year.* The Committee was of opinion that it could not recommend any reform designed

to make the year open on December 22nd in place of January 1st, since the undeniable advantage of the civil year practically coinciding with the astronomical year as reckoned from the winter solstice certainly would not compensate in most peoples' opinion for the very serious disadvantages inseparable from the change, *i.e.*, the confusion inevitably created by dropping ten days. This confusion would be specially felt in those countries which had very recently adopted the Gregorian calendar. In addition, the year in which these ten days were dropped would be of no value whatever for the comparison of statistics of any kind, and particularly statistics relating to economic and social life.

(*b*) *Length of the year.* The Committee was of the opinion that it could not recommend any alteration in the length of the year as fixed by the Gregorian calendar, which in its present form, with the arrangement made for leap years, was sufficiently accurate for all practical purposes. The Committee accordingly was unable to consider the suggestions made in certain reform plans to modify the Gregorian method of fixing leap year, nor could it accept various proposals to establish a "normal" year consisting of a complete number of weeks, a change which would involve the addition from time to time of a "leap" week or month. The recurrence of years differing considerably in length from the "normal" year would give rise to very serious difficulties, particularly as regards fixing religious festivals, the possibility of comparing annual statistics and various observances connected with family life (birthdays and anniversaries).

2. Division of the Year into Months of considerably Different Length.

The Committee felt that it could not recommend the solution proposed in certain reform schemes, namely, the division of the year into eight months of 28 days and four months of 35 days, because the very perceptible inequal-

ity of the months would be extremely inconvenient from every point of view, and particularly as regards monthly salaries and monthly payments. Moreover, a comparison of monthly statistics would become extremely complicated.

3. Alteration in the Name of the Months.

The Committee considered that such a change, though in some respects strictly logical, would arouse considerable opposition, and would not be of sufficient practical utility.

Now that the above proposals have been eliminated, the Committee feels that the attention of the public, on whose approval any reform of the calendar must depend, should be directed exclusively (in order that it may understand their respective advantages and disadvantages) to the fundamental principles of three main groups of reform, leaving aside the details of any particular scheme in any one group.

The first of these groups consists of those schemes the object of which is to simplify the reform as far as possible and cause the least possible disturbance to existing habits and customs by equalizing the quarters. In this group of proposals, each quarter consists of two months of 30 days and one month of 31 days, while one quarter contains an additional day. There is no blank day (outside the week). Such levelling-up of the quarters would be of real advantage from the point of view of quarterly statistics, such as summaries of stock exchange transactions, banking accounts, &c., and as regards the comparability of meteorological statistics and averages. It would also simplify calculations for ascertaining the day of the week on which any given date falls. If, for instance, it were decided that each quarter should consist of two months of 30 days and one month of 31 days, there would be a fairly simple relation between the day of the week and the date of the month. It would merely be necessary to remember on what day

of the week January 1st fell; if it were a Sunday, the first of February would be a Tuesday, the first of March a Thursday, and so on. In the following quarter the rule would be the same; if April 1st were a Sunday, May 1st would be a Tuesday and June 1st a Thursday. This simplification would be due to the fact that 30, 30, and 31 days make exactly 13 weeks. Another reform on these lines has been proposed which is less perfect, but even more simple. The suggestion is to abolish the 31st day of August and add one day at the end of February of the following year.

This group of schemes interferes with tradition less than any of the others. It evokes no objections on religious grounds, and its disadvantages are merely those which are inherent in every variety of reform. The only problem raised—and it is one which has been referred to in various replies received during the enquiry is whether its advantages, which are considerably less than those of other reform schemes, are sufficient to justify the change.

The "Blank-day" Principle.

The other two main groups are characterised by the presence of a blank day in ordinary years, and two blank days in leap years. One of these groups involves twelve months (some months with 30 days and others with 31), while the other contemplates 13 months of 28 days. Unlike the first of the main groups under consideration, the two latter establish a perpetual calendar and completely rectify the variability of the existing calendar. They also possess all the advantages of the first main group in the way of equalising the divisions of the year. Against their common advantages must be set certain disadvantages which they also possess in common, and from which the first group is practically, if not entirely, immune; we refer to certain religious difficulties, arising mainly in Protestant and Jewish circles, in connection with the introduction of the blank day, which breaks the

perpetuity of the cycle of weeks (*cf.* one of the documents communicated during the enquiry). Finally, greater disturbance is caused in existing habits and customs.

In addition to these common advantages and disadvantages, the two groups of twelve and thirteen months also possess the following individual advantages and disadvantages:—

TWELVE MONTHS (8 MONTHS OF 30 DAYS, 4 MONTHS OF 31 DAYS).

Advantages	Disadvantages
1. Half-years and quarters have a full number of months and weeks	1. The months are not of the same length.
2. Every month can contain the same number of working days. (See (*d*) on page 66.	2. The months do not contain a complete number of weeks.
	3. The dates do not fall on the same day of the week in each month.
	4. The comparison of future dates with past dates and the comparison of future statistics with past statistics is less complicated than in the 13-month group, but more complicated than in the group which merely regularises the quarters.

THIRTEEN MONTHS OF 28 DAYS.

Advantages

1. The months all have the same number of days.
2. The periods for which salaries are calculated exactly correspond to the periods of expenditure.
3. The fact that the months are all of the same length has great advantages from the point of view of monthly statistics.
4. Each month contains the same whole number of weeks.

Disadvantages.

1. The figure 13 is not divisible by 2, 3, 4, or 6.
2. The quarters of the year (of equal length) do not contain a whole number of months.
3. The introduction of a year of 13 months implies a considerable change in customs which have been established for many thousands of years.
4. In general, a greater number of corrections would be required in drawing up statistics than with the 12 months system.

Generally speaking, and considering only the intrinsic value of the last two main groups, the thirteen-month system would seem to be of greater utility from the point of view of statistics and commerce, if the month, rather than the quarter, is to be taken as the unit of economic life. The twelve-month system would be preferable in the other contingency. As regards the possibility of their practical application, the preliminary enquiry shows that

the various governments are more favourable to the 12-month system, which would cause less disturbance to established customs. Most commercial organisations seem to take the same view.

An increasing number, however, seem to favour the thirteen-month system, particularly those which are already using it as an auxiliary calendar—a point to which we shall refer later—and have been able to gauge its results.

The Committee does not at present see its way to pronounce in favour of any of the other groups. The question of the reform of the calendar cannot be raised in the abstract and having regard exclusively to the theoretical advantages of one or other reform, but must be considered in relation to its practicability, and with the intention of adhering strictly to the views of the public and taking into consideration the extent to which public opinion has been educated on this subject. No reform can be effected without the consent of all, or almost all, the important bodies interested, and these cover a wide range—religious, administrative, economic and scientific, for example. It rests with public opinion, as here defined, to judge of the merits and the practicability of each of these groups of systems. The Committee does not, however, believe that it has as yet been possible to obtain sufficiently definite statements of the final views of those interested.

The Committee, after examining the results of its various enquiries, gained the clear impression that, although a great number of people in many countries had shown great interest in the question, and although powerful propaganda movements were on foot, it was nevertheless a fact that public opinion was not yet prepared, even if it welcomed reform, to press for immediate action in a particular direction. An international conference for the conclusion of a convention for effecting reform, after agreement with the high religious authorities

in cases in which reform would require such agreement, would have no chance of success unless that degree of preparation of public opinion had been reached. Up to now the preparation of opinion has been carried out in the bodies interested—without sufficient concentration on the principles involved—and rather in connection with definite systems and under the influences of organisations engaged in propaganda in favour of such systems to the exclusion of others—and further without any co-ordination within each country of the views of the different bodies concerned.

The replies received from the various governments clearly show that most governments have only consulted certain scientific bodies. They most probably felt that they had not sufficient data to allow of their submitting the views of all the classes of the population who would be affected by the reform.

The Committee now submits to public opinion the elements of a definite plan of work, together with adequate information thereon. The necessary eliminations have been made. The plan to be laid before the public necessarily follows the general explanations which have been given of the respective advantages and difficulties of the three groups of systems. Enlightened and organised opinion in each country should concentrate upon a clear understanding of the principles involved, which alone will enable us, when the time comes, to choose among the different groups of systems. There should, in particular, be a fresh examination by the opposing religious bodies of the principle of a blank day, by discussion on this subject in each country between religious bodies and others interested in the matter, an examination by statisticians and economists of the relative importance of the three-monthly period and of the week as units of economic life in opposition to the month, with a view to determining the choice between a twelve-month and a thirteen-month calendar and a definition of the advantages of a limited measure of reform.

It is also essential that the investigations in this direction by those interested should be co-ordinated and organised in each country on official or semi-official lines. An organisation of this kind would make it possible to form in the leading countries that body of public opinion which is at present lacking, and without which it would be premature to try to establish any international agreement. It would also, in most countries, help forward the work of education which the large propaganda associations will have to do, and their disinterested assistance is absolutely necessary for the success of so difficult an undertaking as that of calendar reform. The task will be made lighter if these associations encourage a free discussion of principles, and avoid taking sides too early in the day and advocating the adoption of any one scheme of reform in all its details.

It is not for the Committee to suggest any definite method of organisation. The competent authorities of the League might perhaps make such a suggestion, and consider how the League can keep itself regularly informed of the progress made. If, after a reasonable period has elapsed, it seems clear that it would be quite impossible, in view of the state of public opinion, to attempt to establish a perpetual calendar on the lines of the two latter main groups, the League of Nations might perhaps propose the lesser reform represented by the systems in the first main group. For the present, the essential work would seem to be to prepare public opinion patiently, in conjunction with the League of Nations, so that when the right time comes—that is to say, when it is seen that the preliminary conditions for agreement exist in every country—the League may consider what steps should be taken to secure an international agreement.

The Committee feels that it cannot terminate this statement of its conclusions regarding the general reform of the calendar without referring to the question of the auxiliary calendar. This is, of course, a calendar used

by private organisations for their own requirements in connection with accountancy, the payment of staff, &c., instead of the official one generally employed. From the information received it appears that a large number of important organisations (British railways and many American organisations) have already adopted various systems of auxiliary perpetual calendars, in particular auxiliary calendars based on the 13 months of 28 days system.

These facts are of interest because they prove that the disadvantages of the present calendar have been felt in actual practice—so much so, indeed, that in certain economic spheres, another form of calendar is being used in place of the present one. The Committee does not wish to lay undue stress on this point, which may lie outside its main duties; but it feels that the experiment deserves mention, and should, indeed, be followed with sympathetic interest, because it is helping to educate public opinion on the possibility of calendar reform, and is also making it possible to gauge, in practice and without further delay. the value of certain factors in the general reform.

Stabilisation of Easter

In the replies which the Committee has received to its enquiries, the expressions "fixing" and "stabilisation" of Easter have been used as interchangeable terms. Naturally, if the question of Easter is separated from that of the general reform of the calendar, or to be more accurate, that of establishing a perpetual calendar, the expression "stabilisation" is the only correct term, because, if the calendar is not perpetual, and if, as almost all authorities agree in thinking, Easter must fall on a Sunday, its date will unavoidably oscillate within a seven-day period. The problem is, therefore, one of reducing the extreme variations in the date of Easter—to which we have re-

ferred at the beginning of this report—not by fixing Easter on a given date, but on a given Sunday. With regard to the stabilisation of Easter, the Committee feels that its enquiries warrant the drawing of certain very definite conclusions.

In a former letter to the Advisory and Technical Committee (dated February 16th, 1925) the Committee of Enquiry pointed out that the stabilisation of Easter is a reform on which, when the time comes for its application, the Christian religious committees will in the first place have to give their opinion and now, at the end of its work, the Committee wishes to reiterate this statement. Similarly, the Committee desires at this preliminary stage of the quesion, to indicate broadly the attitude of the various supreme religious authorities, as defined by themselves. The details of these replies will be found in the different Annexes.

In a letter dated March 7th, 1924, from the Apostolic Nuncio at Berne, the Holy See stated that any changes which might be made in regard to the fixing of Easter, though they would meet with no objections from the point of view of dogma, would nevertheless involve the abandonment of deeply rooted traditions from which it would be neither legitimate nor desirable to depart, except for weighty reasons of universal interest; the Holy See added that it did not see any sufficient reason for changing what had been the perpetual usage of the Church, handed down by immemorial tradition and sanctioned by the Councils from early times. Even if, therefore, it were shown that some change in these traditions were desirable for the good of mankind, the Holy See would not be prepared to consider the question except on the advice of the forthcoming Œcumenical Council.

In a letter dated February 18th, 1924, from His Holiness the Œcumenical Patriarch Gregory of Constantinople, the Committee was informed that the Pan-Orthodox Congress had decided, at its meetings of May 23rd and

June 5th, 1923, that the Orthodox Church was prepared, if all Christian Churches were in agreement, to pronounce in favour of the stabilisation of Easter.

By decision of the Convocation of the Anglican Church, dated April 28th, 1925, this Church has expressed its opinion:—

"(1) That there is no dogmatic reason why the Church should oppose a fixed date for Easter, but the Church of England could not consent to the proposed change unless it was accepted by the other Christian Communions.

(2) That if a fixed Easter were adopted, April should be assigned for the Festival, which should fall on a Sunday, approximately midway between the present limits of variation.

(3) That it is important to take into account the whole sequence of the Church's Year in considering any proposals for fixing Easter, and particularly for any general reconstruction of the Calendar.

As regards the denominations not represented in the Committee, the Federal Council of the Churches of Christ in America, in a resolution of its Committee expressed its sincere interest in the efforts of the League of Nations to secure a universal agreement upon a fixed day for Easter Day. In a letter dated February 27th, 1924, the Committee of the Evangelical Churches of Germany stated that these churches would raise no objection in principle to the stabilisation of Easter, and would readily agree to such a measure provided it were the result of general agreement.

In a letter dated February 16th, 1924, the Council of the Federation of Swiss Protestant Churches stated that it regards the fixing of the date of Easter as the most urgent and most important reform of all.

Finally, on February 16, 1925, Dr. Keller appeared before the Committee as delegate of 82 Protestant Churches and Federations of Churches in America, Austria, Belgium, Czecho-Slovakia, Denmark, France, Germany, Great Britain, Netherlands, Hungary, Italy, Lithuania, Norway, Poland, Roumania, Spain, Sweden, and Switzerland (including some of those whose opinion

has been given above) and stated that, as there was not yet any central organisation, it had not been possible to ascertain the opinion of all the numerous single Churches, but he did not think that the communities which he represented saw any difficulty or disadvantages in stabilising Easter. He pointed out that the Council of the Swedish Evangelical Bishop and some British Churches were not sympathetic to any reform, but, nevertheless, no Protestant Church would oppose a reform which would serve the good of humanity.

The non-Christian religious communities do not seem to be directly concerned in the question, and they have only been consulted incidentally.

The Jewish communities who were represented at the meeting of the Committee on February 16th, 1925, stated that they had no objection to the stabilisation of Easter.

As the Committee has already pointed out in a letter to the Advisory and Technical Committee, most of the Christian Churches have declared themselves disposed to accept the stabilisation of Easter, on condition that the measures are adopted by the various Churches simultaneously. The Holy See has indeed stated that it does not think it possible, except for the most weighty reasons, to interfere with the religious tradition of centuries; but it has declared that, if it can be shown that the fixing of the festival of Easter would be of universal benefit, it would submit the question to the next Œcumenical Council.

The Committee, therefore, being aware from the outset that no fundamental objections would be raised by any supreme religious authority, and having noted, from the letters received, that probably all the religious authorities, in spite of the difficulties mentioned by some of them, would be ready to consider the stabilisation of Easter, if the benefit to mankind of such a reform could be clearly defined and proved, has endeavoured, by

means of a special enquiry, to ascertain the opinion of the non-religious circles concerned.

The disadvantages of the variability of Easter, which have been pointed out, are felt by the general public mainly in connection with trade and travel, and in the interference with the absolute regularity of the scholastic year.

The Committee consulted commercial interests through the International Chamber of Commerce. The reply of the International Chamber of Commerce is published *in extenso* (*see* Annex II, B. 1).

In March, 1923, the International Chamber of Commerce, at its Rome Congress, adopted the following resolution:—

> Whereas the desirability of fixing the date of Easter in the interests of all sections of the community has been repeatedly affirmed by Chambers of Commerce individually and collectively at various Congresses and Conferences for many years past.
>
> This Congress, adopting the resolution of the London Chamber of Commerce, recommends that:—
>
> The International Chamber of Commerce take all possible steps towards the accomplishment of this long-delayed reform.

In June, 1925, the Brussels Congress of the International Chamber of Commerce adopted the following resolution:—

> This Congress of the International Chamber of Commerce, having regard to the world-wide expression of opinion in favour of fixing the date of Easter, reaffirms the resolution adopted at the Second Congress in Rome, 1923, calling upon the International Chamber of Commerce to take all possible steps towards the accomplishment of this long-delayed reform.
>
> This Congress takes cognisance of the useful work already performed by the Chamber in pressing the question at the League of Nations and decides that the Chamber will renew its efforts in this and other directions, so that the resolution may be carried into effect at the earliest possible date.

At the request of the Committee, the International Chamber of Commerce asked its National Committees to supply further information and to this request the Committees of twelve countries replied. The replies received

from most of these countries, particularly the northern countries, show that the variability of Easter exercises an unfavourable influence on a number of industries, in particular the men and women's clothing, boot and shoe, leather, and tourist industries.

With regard to the effect of the variability of Easter on travel, the Committee has received information from two of the largest tourist agencies (*see* Annex II, B.3). This information shows that, although the advantages of any given fixed date for Easter would, from a general tourist point of view, differ to a certain extent according to countries, it may be said that a fixed date for Easter would nevertheless present certain advantages.

In its previous general enquiry, the Committee had also obtained information on this subject from all the railway administrations which are members of the International Railway Union (*see* Annex I.C.2). The railways of Germany, Esthonia, Spain, (Madrid, Saragossa, Alicante), France, Great Britain, Greece, Luxemburg, Hungary, Poland, Czecho-Slovakia, and Switzerland, and the Oriental Railways stated that they were in favour of the stabilisation of Easter.

Finally, the Committee took special pains to ascertain the opinion of the scholastic authorities in as many countries as possible. A circular on this subject was addressed to all the State Members of the League and to Germany. Twenty-three governments replied, no reply being unfavourable to the stabilisation of Easter. Certain governments replied that in their opinion the matter was not of practical interest; others stated that they had no objections to offer; but the vast majority of governments and competent educational authorities pronounced definitely in favour of the principle of stabilisation. Secondary educational authorities, in particular, were of opinion that the stabilisation of Easter would be of great advantage, because the school curricula could then be the same each year, and the various courses of lessons could

be more satisfactorily distributed throughout the year. Certain governments stated that they held the religious authorities to be alone competent to reach a decision on the principle of the date of Easter, and that, consequently, the opinion expressed by the educational authorities of their country was subject to the attitude which the religious authorities might eventually adopt.

The German government referred to a previous reply favourable to stabilisation, stating that, before giving its opinion, it consulted the various circles concerned, including the educational authorities. The proposal had been approved by the governments of all the German States, and consequently by all the German scholastic administrations.

The governments of Victoria and Queensland (Australia) were of opinion that it would be desirable to stabilise Easter, both from the point of view of school management and to make it possible to arrange school terms more satisfactorily than at present.

The Danish government stated that, although the question might not be of great importance to higher educational establishments, secondary school inspectors strongly recommended the fixing of Easter as being highly important from the point of view of school curricula and holidays.

The Esthonian Department of Public Instruction considered that, generally speaking, it would be highly desirable to solve the problem of the fixation of Easter. The Finnish Ministry of Public Instruction was of opinion that such stabilisation would considerably improve the regularity of the work in the various branches of education.

The French Ministry of Public Instruction stated that, in its opinion, the stabilisation of Easter would be entirely advantageous as the duration of the school terms would thus be equalised, with beneficial results to study. The French Ministry of War expressed the same opinion with regard to the curriculum of military schools.

In Great Britain, the Universities Bureau of the British Empire, the Secretary of the National Union of Teachers, the Chairman of the Joint Committee of the four Secondary Associations, the Executive Committee of the Association of Education Committees (England and Wales), the County Councils' Association, the Association of Directors and Secretaries for Education, the Association of Municipal Corporations and the Standing Committee of Vice-Chancellors and Principals of the Universities of Great Britain and Ireland, have all emphatically stated that they consider the fixing of Easter to be important from the point of view of a more satisfactory division of the school year.

The governments of Canada, Czecho-Slovakia, Greece, India, Liberia, Netherlands, New Zealand, Roumania, Sweden and Switzerland, have expressed the same views.

The Netherlands government stated that the fixing of Easter would, from a scholastic standpoint, present great advantages. The Director-General of Primary and Secondary Education in Sweden holds that it would be distinctly desirable to fix the date of Easter, and, consequently, that of Whitsuntide. In Switzerland, the Council of the Federal Polytechnical School has definitely pronounced in favour of the fixing of Easter.

The Committee does not feel called upon itself to draw any conclusions from these enquiries, which it has endeavoured to carry out on as definite lines as possible. It considers that it will be sufficient to offer a few observations with regard to the date on which Easter might be stabilised, though naturally this is a point which the supreme religious authorities must be left to consider after they have come to an agreement among themselves on the principle of stabilisation.

The Committee notes, however, that most of the replies received seem to favour the stabilisation of Easter on the second Sunday in April. The Committee would be prepared to accept this date. It would, however,

venture to suggest the possibility of a slight emendation: if Easter were fixed on the second Sunday in April it might fall on April 8th, in which case, the festival of the Annunciation (Lady-Day) and Passion Sunday would fall on the same day. In order to avoid this, the Committee might consider, in case the principle of stabilisation should be accepted, the following formula, which possesses the same practical advantages and obviates the difficulty referred to: Easter to be fixed on the Sunday following the second Saturday of April.

WEEK OR MONTH AS INTERMEDIATE TIME UNIT[4]

The suggestion of the week and the month as a subject for discussion before the Royal Statistical Society arises from two circumstances. The first is that, in the course of last year, the Chief of the United States Weather Bureau announced that the Bureau was in possession of observations of weather in the United States carried on systematically by automatic records, or eye-observations twice daily at least, for a period now nearing fifty years. The Bureau naturally wished to make up its mind as to the best method of grouping the observations for statistical purposes before embarking upon the vast task of presenting the results as a representation of the climates of the United States. The solution suggested by Dr. Marvin, the Chief of the Bureau, is to employ the week of seven days, extended to eight days for one week (or for two weeks in leap year) and to group the weeks into fortnights or "months" of four weeks.

The second circumstance is that the Ministry of Agriculture has recently taken up the systematic correlation of weather conditions with agricultural and horticultural results, and has appointed a committee to

[4] From paper by Sir Napier Shaw, Sc.D., F.R.S., before the Royal Statistical Society, May 19, 1925. *Royal Statistical Society. Journal.* 88:489-97. July, 1925.

organize the procedure. For that purpose the month has emerged automatically as the period of distribution of information to members of the committee; the information from the stations is collected month by month, but the meteorological data for districts are week by week.

On both sides of the Atlantic we are confronted therefore with the rival claims of the week and the month as the intermediate unit of time between the day and the year for statistical purposes and the subject is sufficiently important for statisticians to give some attention to it.

There is a further reason for taking up the subject at the present time; the constantly recurring agitation for the reform of the calendar has reached a stage when action may become possible through the influence of the League of Nations which has appointed a committee to consider the calendar. I do not, however, propose myself to ask the Statistical Society to take any part in an agitation for the reform of the calendar, but only to ask them to make up their minds as to the proper ordering of statistics, so that any League or committee that arranges a calendar may be fully aware of the requirements of statistical science. It would be something of a catastrophe for the League of Nations in its cosmopolitan wisdom to arrange a reform of the calendar and to learn afterwards that the requirements of statistical science pointed to something quite different; and such a catastrophe is really not unlikely, and for a curious reason, and that is the incompatibility or irreconcilability of the month and the week. I call the reason curious because, I suppose, no one can doubt that the seven-day week is intended to represent, as nearly as days can, one-quarter of the 29½-day lunar month. I understand that the Romans, with the nones of their calendar, intended to work upon the principle of religious observances at eight-day intervals, that is to say of an octave or eight-day week. They might in consequence see nothing incongruous in a 31-day month, but clearly a week of seven days is just a

little bit nearer to the quarter of 29½ days, which is 7:375 days, than a week of eight days. Both, however, are so far out of the true reckoning that a week is no longer reconcilable with the true lunar month. Four weeks of seven days are 1½ days short of a true lunar month and four weeks of eight days are 2½ days over the true month.

The whole subject is full of incongruities. The day can only be reconciled with the year by the device of leap year, which makes the number of days in the year generally 365 but sometimes 366. In like manner the week cannot be reconciled with the year unless we are willing to count one week of eight days in ordinary years and two weeks of eight days in leap years; or, perhaps to keep the data for the additional one day or two days separate from the 52 groups of seven days.

We are thus led to understand that all statistical presentations of observed facts which are concerned with a succession of periods of time must embody at least two principles, a principle of measurement and a principle of adjustment for the purpose of reconciliation; the statistical problem that I wish to suggest is to get the best principle in either case.

It is no exaggeration to say that the statistical method is in its essence a method of comparison of data at different times for different places, or for different classes of facts; consequently it is of the highest importance that statisticians should agree not only upon the principle of measurement but also upon the principle of adjustment. There is, so far as I know, no difference of opinion as to regarding the day as a primary unit in the principle of measurement, and there is complete accord in regarding the hour, the minute and the second as accepted sub-divisions of the primary unit. I refer to the unanimity with some sadness, because for modern methods of computation they are really barbarous divisions of the day.

Next to the day, the year is the most generally ac-

cepted unit, but the unanimity is to some extent affected by divergence of opinion as to the principle of adjustment. Generally speaking, we are agreed that a year consists of 365 days with an adjustment for leap year, but for some statistics the principle of adjustment makes the year generally 364 days (52 weeks) with an occasional year of 371 days (53 weeks). (*Cf. Nature,* vol. 15, p. 586, May 9, 1925.)

The week and the month are, as I have said, fundamentally irreconcilable, but they take on a specious appearance of reconciliation in the quarters which may be 13 weeks, including 91 days, or 3 months of 90, 91 or 92 days.

The main problem of the calendar which engaged the attention of astronomers and ecclesiastics long before the proper organization of statistics became a vital question, is the reconciliation of the lunar month, which has an average duration of 29:530588715 days with the solar year or cycle of the seasons which is 365:2422166 days. I do not propose to go into the history of the various efforts. They resulted in the compromise of our present calendar year of 365 or 366 days and our calendar months of 28,30 or 31 days. I only remark, that in so far as the desire was to keep in touch with successive new moons, our conventional months are an egregious failure. It is rather remarkable that it should ever have been accepted, and we may wonder what degree of compulsion was exercised in order to enforce the acceptance of the beginning of the calendar month as a substitute for the visible sign of the new moon for the payment of periodic instalments of rent or interest. All that really remains of advantage now is a duodecimal division of the year, though it is a division into twelve unequal parts. The principle of reconciliation of the month with the year as expounded by our calendar is frankly no reconciliation at all. And yet it is the basis of innumerable bodies of statistics. It involves a further attempt at reconciling the month with groups of days for shorter periods than

a calendar month, by dividing the month into three equal or unequal parts of 10 days, 11 days, 9 days or 8 days respectively.

Other and bolder statisticians have from time to time set up a principle of division of the year into periods of 5 days, of which 73 groups make up an ordinary year and only require adjustment in leap years.

My first endeavour will be, therefore, to set before you a summary, however imperfect it may be, of the principles of division for the purpose of measurement, and the principles of adjustment for the purpose of reconciliation of which examples are to be found in the presentation of actual statistics.

I shall first enumerate categorically the various principles of division and the accompanying principles of adjustment.

TABLE I—PRINCIPLES OF STATISTICAL PRACTICE

Category	Principle of division	Principle of adjustment
A	5-day periods	One 6-day period in leap year.
B	7-day periods (weeks)	One 8-day week in an ordinary year; two 8-day weeks in leap year.
C	7-day periods (weeks)	52-week year with occasional 53-week year.
D	10-day periods (decades)	11 days or 8 days in final period of the month, 9 days in final period in leap year.
E	28-31-day months	29-day month in leap year.
F	Quarters of 13 weeks each	52 or 53-week year, as C.
G	Quarters of the civil year of 3 months each.	As in E.
H	Quarters of the farmer's year (3 months beginning with September).	As in E.
I	Quarters of the "May year," centred at equinox and solstice.	As in B.
Z	Whole period year of 365 days	366 days in leap year.

NOTE.—Lustra of 5 years and decades of 10 years are sometimes used for periods greater than a year.

The Categories of Published Statistics

I next set out an enumeration of some of the bodies of statistics which are published, with the category to which they belong in respect of division and adjustment. In doing so I use the following abbreviations for the various classes of statistics:—

A = Agricultural.
F = Financial.
M = Meteorological.
R = Railway.
S = Social: Poor Law, etc.
T = Trades and shipping.
V = Vital statistics.

Table II.—The Categories Selected For Various Classes of Statistics in Different Countries

Country.	Class of statistics.	Category.	Country.	Class of statistics.	Category.
Algeria	M	E	Great Britain	A	C, Z
Argentine	M	E	„	F	Z (Mar. 31)
Australia	F	Z (June 30)	„	M	A, C (Sat.), E, F, Z
„	M	E			
„	T	Z (June 30)	„	R	E, G, Z
„	V	Z	England and Wales	S	E, G, Z
Austria	M	A, E	„	T	E, Z
Belgium	M	E	„	V	C (Sat.), F, G, Z
Bolivia	M	E			
Brazil	M	E			
„	V	E	Scotland	V	C (Sat.), E, G, Z
Bulgaria	M	D, E			
„	V	E	„	A	C
Canada	F	Z (Mar. 31)	N. Ireland	V	C (Sat.), F, G, Z
„	M	E			
„	T	Z (Mar. 31)	S. Ireland	V	C (Sat.), F, G, Z
„	V	Z			
Ceylon	M	—	Greece	M	A, D, E
Chile	M	E	Holland	M	D, E
China	M	E	Hungary	M	A, E
Cuba	M	E	„	V	E
„	V	E	Iceland	M	E
Czecho-Slovakia	—	—	India	M	E
Denmark	M	E	Italy	M	D, E
„	V	C (Sat.)	„	V	E
Dutch East Indies	M	E	Jamaica	M	E
			Japan	M	E
			Mauritius	M	E

TABLE II—THE CATEGORIES SELECTED FOR VARIOUS CLASSES OF STATISTICS IN DIFFERENT COUNTRIES

Country.	Class of statistics.	Category.	Country.	Class of statistics.	Category.
Egypt	M	Σ	Mexico	M	E
„	V	C (Wed.)	New Zealand	F	Z (Mar. 31)
Finland	M	E	„ „	M	E
France—			„ „	T	E, Z
Paris	M	E	„ „	V	Z
Strasbourg	M	A, E	Norway	M	E
„	T	E, Z	Philippine Is.	M	E
Germany	M	A, D, E	Poland	M	E
	T	E, Z			
	V	C (Sat.)			
Portugal	M	D, E	Switzerland	V	C (Sat.)
Açores	M	D, E	United States	A	C (Tues., Fri., Sat.), E
Lourenço Marques	M	D, E			
Russia	M	E	„ „	F	Z (June 30)
Spain	M	E	„ „	M	C (from Jan. 1), E
„	V	C (Wed.)			
Sweden	M	E, H	„ „	T	E, Z
Switzerland	M	E	„ „	V	C (Sat.), Z

NOTE.—The day in brackets following the letter C denotes the day on which the week ends; the date following the letter Z denotes the date on which the year ends.

"Trade returns are for calendar months in all cases."

Authorities—

Meteorological and agricultural publications in M.O. Library.

MS.—R.S.S. staff.

H.M.S.O.—Monthly list of recent publications of interest to the statistician.

Guide to current official statistics.

In cases where E (monthly category) is entered against M (Meteorological class of statistics) an annual summary is always given, and the category Z might therefore always be included. Z has, however, only been entered in the table in addition to E when there was some special note about annual values in the reference.

M for U.S.A. includes solar radiation at five stations.

With regard to meteorological statistics, the publication for international purposes is mainly regulated by

the decisions of the International Congresses of Vienna in 1873 and Rome in 1879, in which the calendar month and year were adopted as the normal unit with collateral approval of five-day means (pentads), with which in practice have been associated also ten-day means (dekades). The regulation, as given in the *Codex of Resolutions adopted at International Meteorological Meetings* is as follows:—

As units of time should be chosen—
1. The mean solar day, reckoned from midnight to midnight, of the place of observation.
2. The civil year.
3. The months.
4. Dove's five-day periods (73 per annum).
The calculation and publication of five-day means of temperature is recommended for a considerable number of stations in each net-work, the choice of which is left to the Central Institute of the country.
It was decided to abide by the civil month everywhere, and to calculate the monthly means as pure arithmetical means. Moreover, the mean of the 12 monthly means is to count as the mean of the year.

The deviations from this practice are for the most part to be regarded as additions to the international data adopted for the more local applications of meteorology to agriculture and hygiene.

The statistical embarrassment of months of unequal length is such a common experience that I have made no special search for examples. I remember noticing, probably during last December, that one newspaper demurred to another's adverse comments on the trade returns for November as being tacitly based on a comparison of a 30-day month with a preceding one of 31 days.

The convenience of taking the months as one finds them justified their selection fifty years ago for meteorology when no other basis common to all countries was possible. But now that the experience of fifty years has shown the value of international cooperation, and has provided material for the conclusions that can be drawn *prima facie* from the compilation of meteorologi-

cal statistics, we are in a position to attempt a higher degree of accuracy. The desirability and even the necessity of such an advance are emphasized when we consider that statistical methods of computation have been very much developed during the past fifty years, and that we have now to deal with the inter-correlation of subjects as well as of countries and of seasons.

It is evident from Table II that the common meteorological practice agrees with that of trade, but is not altogether in accord with that adopted for the other classes of statistics, particularly of vital statistics.

It is also noted that at the inauguration of an international system the main purpose was to coordinate the existing practice rather than to devise the most effective engine for investigations by statistical methods.

In view of the divergences of practice, the time has arrived when those who are interested in the formation of effective tables of statistics should formulate some opinions upon the questions at issue.

I submit the following suggestions:—

1. That the reconciliation between the sub-period and the year should be accomplished within each year in turn, and not delayed for completion for a four- or five-year period.
2. That no reconciliation between the week and the month is possible.
3. That the consensus of opinion respecting "climate and crops," as well as vital statistics, is that a shorter period than a calendar month is necessary.
4. That, in view of the fact that the adjustment of months to the year fails to keep the months in touch with the actual phases of the moon, and is at best imperfect, the division of the year into twelve more or less equal parts cannot be regarded as a fundamental principle of statistical science.

On the other hand, when the week has been chosen for statistical purposes it has always been the week ending with Saturday, or with some other day, the same in successive years.

The only reason that occurs to me for rigorous adherence to the same day of the week for beginning and ending weekly periods, which seems to be of no importance in the case of months or years, is the habit in respect of weekly as compared with monthly or quarterly periodicals.

The second suggestion is sufficiently evident with very few words of explanation. If a body of statistics is made up in weekly periods they cannot be arranged in months without dissection into days, and *vice versa.* One cannot use an ordinary monthly form for weekly summaries; weekly and monthly summaries must be regarded as separate and independent enterprises.

For the third suggestion we may note that when in 1878 the Meteorological Council, a very powerful scientific delegacy of the Royal Society, set out to design a weather report for the purposes of agriculture and hygiene, they chose the week as the time-unit, not the month, and the decision is confirmed by the weekly *Weather and Crop Bulletin* of the United States Department of Agriculture; *Crops and Markets* are also the subject of a weekly periodical. It is quite possible that the original decision of the Meteorological Council was guided by the practice of the Registrars-General in respect of returns of births, deaths and marriages. In any case, it is matter of common experience that irreparable damage to crops can be caused by weather within periods much less than months. Indeed, for the study of weather in relation to crops or to public health, the daily values and the daily charts cannot always be dispensed with, and summaries for shorter periods than months are never indispensable.

DEVICES FOR MAKING STATEMENTS AND STATISTICS TRULY COMPARATIVE[5]

Five different methods are being used by concerns to overcome the defects which have been indicated. Each one of these methods will be discussed showing the advantages and disadvantages.

1. Use of Daily Averages: Some concerns use the daily average of the monthly data. This method is used more by statisticians in making accurate comparisons and calculations. The monthly variations can be entirely eliminated by this method. It has the disadvantage of an extra calculation and the result, as for instance the daily average sales, does not mean so much to the executive who is used to getting his report in the form of monthly sales. This is a good method to use in plotting monthly sales.

2. Use of Weekly Reports: Some concerns use weekly reports entirely for operating statements and have practically discontinued the monthly reports on account of the variations in the month. The following is quoted from a letter from the president of the White Sewing Machine Company:

> In the operation of our retail business all of our business is measured in multiples of weeks and we frequently more or less ignore the month to the extent that a week might overlap inasmuch as we would compare five weeks with five weeks, etc.

Concerns are making more and more use of the weekly report instead of monthly because it not only overcomes the variations in the month, but also gives a closer control over the business. For many reports this plan is advantageous. This plan would not be feasible, however, for the higher executives who would not care to keep in touch with all the operations of the business on

[5] From Folsom, M. B. Devices for Making Statements and Statistics Truly Comparative. p. 5-8. *American Management Association.* New York. 1927.

a weekly basis. Neither is it feasible for reports requiring a closing of the books.

3. Calendar of Four-Week and Five-Week Months: While both of the above schemes have advantages and can be used for certain purposes, it will still be necessary for most concerns to have a period corresponding to the month. A large number of companies are now using a calendar composed of four-week and five-week months for their accounting and statistical records. As an illustration, the General Electric Company adopts a fiscal calendar for use in their works. Each quarter consists of three periods, with thirteen weeks in the quarter. The 1927 calendar is as follows:

	Weeks	
January	4	Jan. 2—29
February	4	Jan. 30—Feb. 26
March	5	Feb. 27—Apr. 2
April	4	Apr. 3—30
May	4	May 1—28
June	5	May 29—July 2
July	4	July 3—30
August	4	July 31—Aug. 27
September	5	Aug. 28—Oct. 1
October	4	Oct. 2—29
November	4	Oct. 30—Nov. 26
December	5	Nov 27—Dec. 31

The make-up of the calendar is similar for each year, i.e., January always has four weeks, February four weeks, and March five weeks, although the first day and the last day of each month vary accordingly to the year. The corresponding months of consecutive years can therefore be compared with no adjustments. Other advantages of this type of calendar are that the month always consists of an exact number of weeks with no days beyond the weeks, and the quarters have the same number of days.

The chief disadvantage of this type of calendar is that the months do not all have the same number of weeks so that one month cannot be compared with another month of the same year without making adjustments for the varying number of weeks. The adjustments can be made, however, with less trouble than with the ordinary calendar, because the month-ends coincide with the week-ends. It is only necessary to divide one month by four and another month by five to put them on a comparable basis.

The following is quoted from a letter from the General Electric Company in regard to their calendar:

> A calendar of this description has been in use for about three years and while there are advantages and disadvantages, depending upon whether the works or the general office is involved, it has been found sufficiently valuable to continue its use, especially in the production and works accounting departments.
>
> Our works accounts are closed on the basis of fiscal month of four or five week period, in order that payrolls and statistical data may be compiled upon a weekly basis. If we close according to the calendar month, many of the closings would come in the middle of the week, which would mean accruing wages and would result in statistics regarding production, etc., for parts of weeks.
>
> On the other hand, our general office closings are made upon the basis of calendar months. The principal reasons for this procedure are that customers' statements must be rendered for complete months, and our balance sheets, in order to be clearly understood, must be for calendar months.
>
> Our fiscal calendar has its disadvantages when making up monthly comparisons, i.e., the difficulty of arriving at accurate comparisons month by month when you have a condition of both four week months and five week months. It is obviously incorrect to compare, for example, the production of a five week month as against a four week month.

The Famous Players-Lasky Corporation uses a calendar for their accounts similar in principle to that used by the General Electric Company, but somewhat different in detail. Their calendar does not correspond as closely with the regular calendar as the General Electric Company's due to the fact that February is given five weeks instead of four weeks.

This type of calendar is used by a large number of meat-packing companies. Armour and Company, for instance, use it, the year being divided into twelve periods, four five-week and eight four-week periods, the month ending on the Saturday nearest the end of the calendar month.

4. Four Weeks to the Month With the End of the Fourth Period Coinciding With the End of the Month: One large concern uses this method in compiling sales reports, both weekly and monthly. The first three periods correspond with the first three calendar weeks, and the fourth period includes the remainder of the month. These reports are issued currently and cumulative for each week, so that the cumulative report for the fourth period would always be the monthly report.

This scheme has the advantage of keeping the weekly reports within the calendar month. Comparisons bebetween the four periods of the month, however, are upset and adjustments are necessary if current weekly comparisons are made. This same concern uses charts upon daily averages, the charts being brought up each week. The curves show the daily average sales for the preceding four periods.

5. Thirteen-Period Year: A number of concerns are now using a calendar consisting of thirteen periods of four weeks each. The number of these concerns is steadily increasing.

THREE PLANS[6]

The most desirable change which can be made with the least dislocation of our present calendar, and which is incorporated in most of the proposed methods of reform, would be to have the same day of the year always fall on the same day of the week. As there are 52

[6] From article Reform of the Calendar, by Carl Reinhardt, Cobalt, Ontario, Canada. *Royal Astronomical Society of Canada. Journal.* 16:105-11. March, 1922.

weeks plus one day in a year of 365 days, and plus two days in a leap year, by adding this extra day or days, and not considering or designating them a day of the week or month, every day of the year will always fall on the same day of the week.

New Year's day, which is observed as a commercial holiday in nearly every part of the civilized world, seems to be by general consent the one best adapted to be made the non-week day in every year. There is not the same agreement in the proposals, however, as to the position in the calendar which Leap Year day, the extra non-week-day in leap year, is to occupy. It seems extremely desirable that it should be the *last* day of the year. Only in this way can the proposed "fixed calendar" deserve the name. To place it following New Year's day, or between the end of June and the first of July, as has been frequently suggested, would alter the position in the calendar of every day following it in that year, and one of the greatest advantages of a fixed calendar in astronomical and nautical calculations, banking and other reckonings, would be lost.

To have a second extra day during the holiday season at New Year's should be acceptable to all nationalities, while a holiday of no religious or commemorative significance in the middle of the year, would be both inconvenient in the commercial world, and interrupt a busy season in the industrial world. Placed in the holiday season as the last of the year, and therefore next to the other non-week-day, New Year's day, it will also make each half of a leap year the same length, 183 days. "Leap Year day" should undoubtedly be the last day of the year, no matter what other reform is adopted.

Having disposed in the above way of the extra day or days in the year over the even 52 weeks, the same day of the year will in future always fall on the same day of the week, and it only remains to consider how best to subdivide these 364 days into months. Of the methods

which have been proposed, three only are likely to receive consideration.

The first which we will consider, because it necessitates but little change from our present calendar is that proposed by Prof. L. A. Grosclaude, of Geneva, Switzerland.

The year would have twelve months as at present, each quarter of 91 days divided into three months of 30, 30, and 31 days.

This calendar has received very general approval throughout Europe, particularly by Chambers of Commerce, since it achieves its main object, a perpetual calendar, with the least possible change from our present one, no date in the latter having its position from the beginning of the year altered by more than two days in the proposed one. Each month has 26 working days, and each quarter is the same length, making it possible to compare production costs of one period with another in any industry. Each quarter begins on a Monday and ends on a Sunday, a convenience in closing accounts. Its disadvantage lies in the fact that the months do not begin on the same day of the week throughout the year, and it would therefore still be necessary for all except those with a good memory to consult a calendar to learn the day of the week of any day of the month.

The second method of reform to be considered here was discussed in the British Parliament in the year 1911, when Sir Henry Dalziel presented his "Fixed Calendar Bill."

In this also our present subdivision of the year into twelve months is retained, but it has the very desirable feature added of having the same day of every month as well as of the year always the same day of the week. This is accomplished by making all the months begin on Sunday and end on Saturday, and since it is impossible

in a year of twelve months to avoid a difference in length of the months, it is as well to increase this difference to a full week.

Each quarter of the year is the same length, 91 days or 13 weeks, and is subdivided into two short months of 28 days or 4 weeks, and one long one, the third, having 35 days or 5 weeks. January, February, April, May, July, August, October and November, would thus have 28 days, and March, June, September and December, each 35 days.

All the desirable features of this calendar are attained with no serious alteration from our present style, and also with but little change in the date of any occurrance or anniversary from that which it at present occupies. The average change for the year is only two days, and the greatest change which any date would undergo only amounts to four days.

It has the advantage to industries of making a comparison in production costs possible for each quarter year, simplifies a comparison of monthly costs over our present calendar, and greatly enhances the value of the week as a measure of time.

The advantage in computing bank interest, rents, etc., where the quarters are of the same length is obvious, and this advantage would be still further increased if the legal difficulties could be arranged so as to make the two non-week-days also non-interest or rent bearing days, so that 364 days could be known as a "Bankers' Year," when the quarter and the week would both be exact subdivisions of the year.

The third and last "Reformed Calendar" to be here considered is the "Thirteen Months Calendar" proposed by the French philosopher Auguste Comte nearly a century ago, and frequently discussed since by scientific societies and commercial bodies in various modified forms, but essentially the same in its main features. It has

also been several times presented in the form of bills to the British and other legislative assemblies of both Europe and America.

It has always been difficult to secure legislation for reforms of this character. Take for example the long fight which has been unsuccessfully waged to secure the adoption of the metric system in North America and Great Britain, or a decimal currency in the latter country. It is going to be doubly so to secure the simultaneous and identical legislation necessary in the present case.

In the final analysis it is the individual national parliaments, dominated largely by commercial interests, which will accept or reject whatever plan the coming conference in Rome adopts or recommends, and until public opinion has been educated to the point where the demand is unmistakable and insistent, and some degree of unanimity reached regarding the specific reform wanted, it will be impossible to secure from the politician the passage of such a law.

The goal of the astronomer is to obtain a fixed international calendar. Any of the three plans outlined above secures him this, and though a particular one of these may appear the most desirable, in reality it is not of vital importance to him which is chosen.

Quite a few scientific societies, as well as commercial and other bodies have unqualifiedly endorsed the 13 months calendar, often, it would appear, without a full knowledge of the other plans, and a bill is now before the House of Representatives of the United States in favour of it. On the other hand, European opinion appears to favour Grosclaude's proposal. Dalziel's method has many adherents in England, as securing the best features of the other two plans and offering an excellent compromise between the requirements of the banker and the manufacturer.

OTHER PROPOSALS FOR REFORM[7]

The international fixed calendar plan. Proposed by Moses B. Cotsworth, F. G. S., F. S. A., F. C. A., of Vancouver, British Columbia.

Liberty Calendar plan. This plan provides for the setting apart of New Year day in each year and making it an independent legal holiday, which is not included in any week or month. Also, the setting apart of the extra day in leap years as leap day and likewise making it an independent legal holiday. It further provides that each seventh day shall become leap year Sunday.

It further provides for the omission of such other leap year days as shall be necessary to harmonize the calendar year with the true solar year. It divides the remaining 364 days of each year into 13 months of four complete weeks of seven days each, beginning each week with Monday.

Swiss plan. This plan sets aside each New Year's day and each leap year day as independent legal holidays, and provides for the omission of leap year day in all centennial years the number of which is not a multiple of 400. This plan divides the remaining 364 days into four quarters of 91 days each, each quarter containing one month of 31 days and two months of 30 days.

This plan was proposed and advocated in the convention by Dr. A. F. Beal, of the Bureau of Standards, Washington, D.C.

John Robertson plan (first Scottish plan). This plan also sets aside New Year's day and leap year day as independent legal holidays. It then provides that the first two months of each quarter shall contain four weeks each, while the third month of each quarter shall

[7] From Eleven plans submitted to the first national convention in the United States to discuss the reform of the calendar, held at Washington, D. C., February 7 and 8, 1922. *United States. House. Committee on the Judiciary.* Modification of the calendar: hearing on H. R. 3178. p. 23-5. 67th Congress, 2d Session. February 9, 1922.

contain five weeks. Under this plan there will be eight months in the year of 28 days each and four months in the year of 35 days each, making with New Year's day a total of 365 days in the calendar year.

Alexander Philip plan (*second Scottish plan*). This plan proposes to make no break in the continuity of weeks; it would make no change in the present Gregorian calendar, except to take one day from August and add it to the month of February, simply undoing what was done in 28 B. C., when Augustus Cæsar took one day from February and added it to August, which was the month named after him.

Ghilain plan. This plan sets aside New Year's day and leap year day and divides the remaining 364 days into 10 months of 30 days each, and 2 months of 32 days each, thus retaining a 12-month year.

Metric calendar plan. This plan is of revolutionary character. It provides for 73 weeks of 5 days each, and for 10 months in the year—5 months of 36 days and 5 alternate months of 37 days each. This probably means the decimal plan, as there is no metric basis in it.

This plan would rename all the months of the year, and would also rename all the days of the week. It would go further and change the lengths and number of the hours in a day, and the number of minutes in an hour, with the idea of reducing all the shorter measurements of time to a decimal system.

The metric 5-day week fails to fit any one of its months.

Plan proposed by Dr. D. C. Savage of Nashville, Tenn. It is intricate. The author takes the position that the Julian calendar adopted by Julius Caesar in 46 B. C. should not have been superseded by the Gregorian calendar, and he advocates the restoration of the Julian plan with inclusion of certain features of the Jewish calendar.

INTERCALATED WEEK[8]

The present projected reform of the calendar is essentially different from the Gregorian one of 1582. Then there was question of cementing the calendar year closely to the solar year. For this purpose it was necessary merely to correct the Julian period of leap years. This was done in such a happy way that the error, which can never be avoided in any system, amounts to scarcely one whole day in three thousand years. The present desideratum is not a correction of this error, but a greater uniformity within the calendar year itself. The same days of the month are to fall on the same days of the week. As to whether this is an elegant or inelegant procedure, this is not the place to decide. There is question merely of testing the ways and means of effecting it.

In the library of the Vatican Observatory there is a special case devoted to the numberless schemes for the reform of the calendar, that have been sent to this supposed central station since the World War. These schemes are not less divergent than were the answers of four centuries ago of emperors, kings, dukes, learned men, academies and universities, that were sent to the Commission of the Gregorian Calendar.

With one exception to be detailed later, all the new calendars agree upon one point only, and that is upon the insertion of blind or blank or zero days, or days that are not to belong to any week. As the solar year is about one and a quarter days longer than a full number of weeks, the new calendar, if it is to be a year of weeks, will have each year one day over and in leap years two. What is to be done with these supernumerary days? The simplest remedy, one that by-the-way called for the least

[8] From article Reform of the Present Calendar, by William F. Rigge. Based on an article in the *Stimmen der Zeit*, vol. 106, nos. 3 and 4, 1923-24, by J. G. Hagen, of the Vatican Observatory. *Popular Astronomy*. 32:129-33. March, 1924.

reflection, was not to count these as week days at all. The simplicity of this solution appealed at once to all reformers, although they knew that the seven days of the week have followed each other in unbroken succession since the days of Adam, have been conscientiously preserved by patriarchs and prophets, and have been sanctified by the new-founded Christian Church in its Sunday observance. This time-honored and unbroken tradition would be shattered. Of course, the Christian Church is not bound by the law of Moses, it could make an exception to the religious observance of the seventh day, and at times permit the substitution of the eighth day, but it would be only fair to consult the wishes of the Jews on this point. And why should not historians also be asked whether they would relinquish a method of correcting a doubtful date by its day of the week?

These difficulties, however, seemed to make no impression upon the calendar reformers, and the scheme of the days of no week worked like a charm. But it also connoted a penury of ideas, because it never occurred to them that, besides days, other time intervals, such as months, could also be inserted in the civil year, as everybody that writes about the calendar ought to know from the methods employed by the ancients, especially the Jews and the Greeks. If months can be intercalated, why not weeks as well?

Now it has been shown more than twelve years ago, that the insertion of whole weeks would not interrupt the succession of the week days and would at the same time satisfy the pet idea of fixing the days of the year upon the same days of the week. But unfortunately, these reformers did not bother themselves about the literature of the subject.

In the *Publications of the Astronomical Society of the Pacific,* XXIV 161, (1912), there is an article by George M. Searle, in which the intercalation of weeks is explained in detail. Searle was for some years an

assistant of Gould at the Albany Observatory. After that he became a Catholic and joined the Congregation of Paulists. He was then intrusted with the small observatory of the Catholic University of America at Washington, and even proposed as director of the Vatican Observatory. His election, however, as Superior General of the Paulists brought his astronomical career to an end. It was exactly at this time that he wrote the article referred to, the general plan of which he had published many years before in the *Catholic World*.

Searle starts out correctly with the conviction that every rule for intercalation must be cyclic, as had indeed ever been the custom in all calendars. Who does not know of the Egyptian, Chaldean and Greek cycles, the predecessors of the Julian and the Gregorian? Leap years, or years in which an intercalation is to be made, must be known to the public without the necessity of a printed calendar.

Now Searle made the discovery that insertions of whole weeks could be elegantly fitted into the Gregorian cycle of 400 years. This cycle consists of an integral number of 20871 weeks. For, as each year at present has one day more than a full number of weeks, this would make, first, 400 days over. Then there are, secondly, 100—3=97 leap years during this period, giving so many days more. There are thus in all 497 days more than full weeks, and these 497 days may obviously be distributed in 71 full weeks. These 71 weeks Searle proposed to add singly to ordinary years which should each have 52 weeks exactly with no day over, that is to say, his ordinary year should have 52 weeks or 364 days and his leap year 53 weeks or 371 days.

As to the manner of distributing these 71 leap years in the cycle of four centuries, Searle proposed this very simple way. First, every fifth year is to be a leap year. But as this would give 80, 9 more than the 71 needed, he said: Secondly, the years whose number is divisible by

50, however, are to be common years. This would make 8. The ninth exception must then be placed somewhere else in the cycle, either in the beginning, the middle or the end. Again, therefore, and more briefly, *Every year whose number ends in a* 5 *or a* 0 *is a leap year, except when it ends in a* 50 *or a* 00, *and when it begins a new cycle.* This rule is simpler even than the Julian and the Gregorian with their division by 4.

It is to be especially emphasized that when Searle proposed his scheme, he had no idea of changing the months, except in so far that one of them was to lose a day, and in leap years one was to be a week longer than usual. But his method had the express purpose of making every day of the year fall on its same day of the week, without interrupting the regular sequence of weeks. Whatever shortcoming an intercalary week may have in respect to an intercalary day, is fully balanced by the retention of unbroken weeks. It has, however, the decided advantage, that the error of the Gregorian reckoning here loses its entire significance. For if this amounts to less than a day in three thousand years, it will not grow to a full week in twenty thousand years.

This is certain, therefore, that the permanency of the days of the year in respect to the days of the week does not depend upon the months. Of course, matters may not rest here, and an attempt will be made to unify the months. The two questions should, however, be kept apart.

It is not the purpose of this article to enter upon the many methods that have been proposed in the rearrangement of the months. It was merely to direct attention to this one point that the pet idea of uniformity may be realized without disturbing the time-honored sequence of the seven days of the week. That all the reformers of the calendar with one exception have proposed the

scheme of blank days, or days of no week, appears to be due to the fact that they know of no other way. Now that this way has been found, these blank days, it is to be hoped, will be buried forever.

OBJECTIONS TO INTERCALATED WEEK[9]

In the collection and discussion of meteorological and many other statistics, "monthly means" play an important part. Although the irregular calendar month is not, for scientific purposes, an ideal subdivision of the year, its faults are not sufficient to outweigh the advantages of a unit so familiar to the general public. These monthly means, would, however, lose all their significance, if the calendar month did not, year after year, remain in nearly the same position relative to the tropical year. With the present calendar the range of this position for any one month is a day only, over a short period of years, except at the end of a century, when it may be nearly two days, and even over a long period of years it is less than two days. A range of this size is unavoidable, and is not large enough to affect very materially the value of monthly statistics.

Under the scheme of intercalated weeks, however, the range over even a small number of years would be a week, while at the middle or end of a century it would be eleven days (or even seventeen, but as regards this point see below), and the range over a large number of years would be eleven days. There would, moreover, be an odd week of statistics every fifth year, which could not be as easily disposed of as is the odd day in leap year at present. The present convenient system of collecting and presenting data by calendar months would have to

[9] From article Reform of the Present Calendar, by H. Jameson, Colombo Observatory, Ceylon. *Popular Astronomy*. 32:416-17. August, 1924.

be given up, at any rate in the case of climatological and other scientific statistics, and suitable units chosen, with reference not to the calendar, but to the tropical year. This would not only entail much additional work in the preparation of these figures, but would greatly diminish their value to the general public.

Searle's scheme could not fail to cause much inconvenience, too, in ordinary business life. For example, is the same yearly rent to be paid for a house or for business premises, over a year of 53 weeks as over one of 52? Will a man on a yearly salary receive the same for 52 weeks as for 53? His expenses will be appreciably higher in leap year. I can foresee difficulties, too, with the income-tax collector, regarding the assessment of the yearly profits of a business. An extra day in leap year might be passed over without adjustment, but hardly an extra week.

Where accounts are kept, and salaries paid, monthly, the extra week would also tend to complicate matters, and to create confusion.

It might be objected, that the present calendar months vary in length among themselves, and that, nevertheless, no difficulty is experienced in keeping monthly accounts, or in paying monthly salaries. Why then should there be any difficulty in variable years? But over a very few months, the variation in the length of a month practically averages out, while it would take five years to average out the variation in the year.

I cannot see that these objections to an intercalated week are in any way balanced by the merely sentimental advantage of unbroken weeks, plus perhaps a slight advantage to historians of the future in checking their dates. No reform of the calendar can be considered satisfactory, which varies the length of the calendar year, or its position relative to the tropical year, more than the minimum absolutely necessary.

IMPORTANCE OF UNIVERSAL APPEAL[10]

The importance of a uniform and simple calendar is not a question which affords any ground for dispute. Whether regarded from the point of view of the chronologist, striving to evolve order out of regnal years and intercalary months, or from that of a business man in Cairo, transacting affairs with clients who adhere severally to the Moslem, the Coptic, the Hebrew, the Julian, and the Gregorian calendars, the diversity of system from time to time, from place to place, and between creed and creed, is an exasperating and unmixed misfortune. The New Year festival is celebrated by the motley races which go to make up the population of Singapore on dates which extend over several months. In Constantinople, until quite recently, even the division of the day was a source of grave inconvenience, since the day ended at local sunset. The persistence of such anomalies shows how hard is the way of the reformer. Tradition and religious scruple, and even the mere inertia of custom, are leagued against him. From the point of view of the whole world, a far greater advance would be made by any large step towards the adoption of one universal calendar than by making small theoretical improvements in a particular system, however important that system may be. Whatever happens, it is certain that the Gregorian calendar in its main features will survive. For this reason alone its reform is not to be lightly undertaken. A universal appeal can only be based on fixity of tenure as a necessary condition. The French Republican calendar should at least be useful as an awful example. Changes in our calendar can only be admitted after their necessity has been absolutely proved, and then only with the utmost deliberation. It is not a matter in which a false step can be easily retraced.

[10] From article Reform of the Calendar, by H. C. P. *Nature.* 86:281-2. April 27, 1911.