Thus, for instance, in Egypt the sun being used, the unit of time was a year; but in Chaldæa the unit of time was a month, for the reason that the standard of time was the moon. So that when people began speaking about periods of time it was quite easy for one nation to conceive that a period of time was a year when really it was a month, and *vice versâ*. It has been suggested that the years of Methuselah and other persons who are stated to have lived a considerable number of years were not solar years but lunar years—that is, properly, lunar months. This is reasonable, since if we divide the numbers by 12 we find that they come out very much the same length as lives are in the present day.

The Egyptians, taking the sun as their measurer of time, began very early with a year of 360 days. For some reason or other they divided these 360 days into months, probably with some lunar connection, so that they had 12 months of 30 days. Now, we know that that is not the true length of the year, and it is clear that any nation which uses such a year as that will find its festivals going through the year. Further, such a year as that is absolutely useless for the agriculturist or the gardener, because after a time the same month, to say nothing of the same day of the month, will not mean reaping-time, will not mean sowing-time, or anything else. So that this 360-day year did not last very long; so long as it lasted, however, they knew that they got the seasons back to months of the same name in a period of 70 years.

This method led to complications, which possibly may have had something to do with the building of these temples. Egypt being exclusively the gift of the Nile, you can quite understand that their earliest calendar would be connected with the Nile, and so one finds it. We and other peoples occupying the zone in the north divide the year into four seasons; the Egyptians divided it, and still divide it, into three: they have four months of the flood of the Nile, then they have four months after the Nile has retired, in which they do their sowing, and then they have other four months which they call their summer, in which they gather their harvest.

We began, then, with a year of 360 days, and, having 360 days instead of $365\frac{1}{4}$, we had a cycle of 70 years, and during that cycle each day of the year meant something different with regard to the advance of the seasons, and with regard to the work of the agriculturist and the gardener to what it had meant in the preceding year. But this state of things did not last long. The 1st of the first month fell at the summer solstice on June 20, and the reason that it fell then was, that the inundation of the Nile reached Memphis on that day. Whether with the help of the temples or not, they soon got very much nearer, and changed the year of 360 for one of 365 days, which is, roughly, within a quarter of a day of the truth. They had still their 12 months of 30 days, and then they added an extra month of 5 days. With their perfectly orientated temples they must have soon found that their festival at the summer solstice—which festival is known all over the world to-day—did not fall precisely on the same day of the new year, because, if 365 days had exactly measured the year, that flash of bright sunlight would have fallen into the sanctuary just as it did 365 days before. But what they must have found was, that after an interval of four years it did not fall on the first day of the month, but on the day following it. They at once faced this, and found out that 365 days did not exactly make a year, but that they had to do with a quarter day in addition. What the Chinese did was this: every fourth year, instead of adding 5 days to their 360, they added 6 days, and in that way they practically brought the calendar right.

Theory indicated that retaining the 365-day year, the 1st of the first month would come back to its exact relationship to the inundation of the Nile after a period of 1460 years, the 1460 years of course depending upon the quarter being added ($365 \times 4 = 1460$).

This was known in Egypt to the priests alone. They would not allow the year of 365 days, called the *vague* year, to be altered, and so strongly did they feel on this point that every king had to swear when he was crowned that he would not alter the year. We can surmise why this was. It gave great power to the priests; they alone could tell on what particular day of what particular month the Nile would rise in each year, because they alone knew in what part of the cycle of 1460 years they were, and in order to get that knowledge they had simply to continue going every year into their Holy of Holies one day in the year as the priests did in Jerusalem, and watch the little patch of bright sunlight coming into the sanctuary. That would tell them exactly the relation of the true solar solstice to their year, which was supposed to begin at the solstice, and the exact date of the inundation of the Nile could be found by those who could determine observationally the solstice, but by no others.

In reading books on Egypt we come across another cycle which is supposed to be a very mysterious one; in fact it is one which, I think, has not yet been sufficiently investigated, and it is very well worth the trouble of anybody who will give the time. They begin with a year of twelve months, each of which has thirty days, thus giving 360 days; this was found not to work. They then tried 365 days, but that also would not work, because then the first day of Thoth (their first month) would only indicate the inundation of the Nile one year out of 1460; and then the priests interpolated the other day and got the cycle right, but it was not yet quite right. In the time of Hipparchus 365·25 did not really represent the true length of the solar year; instead of 365·25 we must write 365·242392—that is to say, the real length of the year was a little less than $365\frac{1}{4}$ days.

Now the length of the year being a little less, of course we should only get the absolute coincidence of the 1st of Thoth with the inundation of the Nile in a longer period than the 1460 years cycle; and, as a matter of fact, the 1460 years had to be expanded into 1506 to fit the months into the years with this slightly shortened length of the year; so we have a period which is called *sothic*, of 1460 years; and a period which is called *phœnix*, of 1506 years.

There is a great wealth of interest connected with the uses of the temples from the point of view of worship, but that does not concern us here, except that it is intimately connected with the next part of the subject, for I have next to point out that it necessitated in Egypt, Chaldæa, and elsewhere contemporaneous observations of the stars. I therefore now pass from the sun to the stars.

J. NORMAN LOCKYER.

(*To be continued.*)

FORESTRY IN NORTH AMERICA.

IN continuation of the notes under the above heading which appeared in NATURE last January, I wish to refer to a splendid paper[1] recently read by Sir Dietrich Brandis, F.R.S., to the Natural History Society of Bonn. It consists chiefly of a compilation from Dr. Mayr's book, "Die Waldungen von Nord America" (Munich, 1890), and from works by Prof. Sargent Bernhard Fernow, the present Chief of Forestry at Washington, and some other authors, as well as from the Agricultural Reports of the United States.

Dr. Mayr is the son of a Bavarian State forest officer, and, after studying forestry and botany at Munich, he was sent, at the expense of the Bavarian Government, to observe in their native forests, at different ages, certain important

[1] "Der Wald in den Vereinigten Staaten von Nord America," von Dr. D. Brandis in Bonn, 1891. (Sonder Abdruck aus den *Verhandlungen des Naturhistorischen Vereins*, 47 Jahrg.)

North American forest trees, experimental plantings of which have from time to time been made in Germany. After spending seven months on these researches, and extending his tour through Japan, Java, Ceylon, and Northern Hindustan, Dr. Mayr returned to Germany in 1888, and was shortly afterwards appointed Professor of Forestry and Forest Botany at the College of Agriculture and Forestry at Tokio in Japan. The present writer had the great pleasure of accompanying him in January 1888 for about three weeks through some of the coniferous and oak forests of the North-Western Himalayas and the subtropical forests of the lower hills near Dehra.

After leaving Germany a second time for Japan, Dr. Mayr had a further opportunity of visiting North America, and thus has twice traversed the length and breadth of the country between the Dominion of Canada and Mexico.

Mayr treats of the demands of the most important North American trees as regards climate and soil, with a summary account of their anatomical structure and of the physical and technical qualities of the most important woods, and his book contains numerous illustrations. He also gives lists of destructive fungi and insects observed by him on the different species.

Brandis has some criticisms to mete out for a few somewhat rash generalizations made by Mayr. These are that evergreen broad-leaved (not coniferous) forest requires a higher winter temperature than deciduous forest, and that deciduous forest vegetation is always absent in tropical countries on account of the uniformity of the climate throughout the year. Brandis shows clearly, from a comparison with the deciduous forests of teak and other species in India, Burma, and Java, that this statement will not hold wherever there is a prolonged dry season, which renders the trees leafless for a certain period of the year.

Another statement of Mayr's controverted by Brandis is that conifers never grow in tropical countries except where the altitude renders the climate non-tropical, and that in North America they have longer needles, supply heavier timber, and contain the more resin, the nearer they grow to the tropics. The latter statements may be true for *Pinus australis*, the pitch pine of the Southern States of North America, but do not hold good in India, where the *Pinus longifolia* of the Himalayas has the longest needles and probably yields as much resin as the tropical pine (*P. Merkensii*), which, however, has the heaviest wood of all the Indian pines, and grows in latitude 17° N., in Tenasserim, at about 600 feet above sea-level, in an absolutely tropical climate.

Mayr's statement that oranges will only grow to perfection in a hot dry climate is also not true for India, as oranges of splendid flavour are grown in enormous quantities in the damp lower hills below Cherapunji, in Assam, where the rainy season lasts for eight months, as well as in the dry regions near Delhi, and the comparatively dry country near Nagpur, in the Central Provinces of India.

Apart from these criticisms and an interesting discussion on the origin of prairies, we find in Brandis's paper a most complete account of the distribution of North American forest trees.

Forest vegetation is much richer in North America than in Europe, containing about 412 species, distributed as follows:—

Atlantic region	176
Pacific region	106
Common to both	10
Central region on and surrounding Rocky Mountains	46
Tropical species near the coasts of Florida ...	74
	412

as against 158 species in Europe.

At least six North American species of forest trees, according to Brandis, are also indigenous in Europe, being—

Cercis canadensis	=	*Siliquastrum*
Diospyros virginiana	=	*Lotus*
Celtis occidentalis	=	*australis*
Platanus occidentalis	=	*orientalis*
Ostrya virginica	=	*carpinifolia*
Castanea americana	=	*vulgaris*.

All these species now grow naturally in Europe south of the Alps, and since many American forest genera existed in Europe in Tertiary times, whilst only five European forest genera (Ceratonia, Laburnum, Olea, Syringa, Laurus) are not found in America, it is possible that other species formerly common to both countries were destroyed in Europe north of the Alps by the Glacial epoch.

It would take too long to describe each region in detail, and I must here merely glance at them in the briefest manner.

A small outlier of the West Indian tropical flora extends into the south of Florida, and is followed by a broad zone of evergreen broad-leaved forest, of which *Magnolia grandiflora* is the chief representative. We then get the pitch pine forests on the sandy formations of Florida, Georgia, North and South Carolina, extending westwards to Alabama and Mississippi. The wood of the pitch pine (*P. australis*) is the best coniferous wood in the world, but the forests are being utterly ruined. They are tapped in the most wasteful manner for turpentine, 8,000,000 dollars being the estimated local value of the annual return. More wood is burned than is utilized, and, according to Mayr, already wide belts of white sterile shifting sands border both sides of the railways of the Gulf States, showing what the poorer tracts of the country will come to, if the farmers do not give up their pernicious habit of burning thousands of square miles of forest every year.

Another tree of the Southern Atlantic zone is the swamp cypress (*Taxodium distichum*), growing on annually inundated land, and presumably safe from fire, if not from ill-regulated and wasteful felling.

The valuable pencil cedar (*Juniperus virginiana*) also flourishes at its best in the Southern Atlantic region, but grows almost everywhere in the United States and British America, from latitude 54° southwards. To the north and in the prairies it has, however, only a stunted growth. Hardly any sound wood of this species is now procurable, as I learned last year from Messrs. Faber and Co. at Nuremberg. Next to this zone comes the description of the broad-leaved deciduous forest of the temperate region, containing many oaks, walnuts, hickories, and the tulip tree (*Liriodendron tulipifera*). The heavy seeded trees are found chiefly in the south, and lighter seeded ones, as maples, birches, and elms, more to the north.

There is a long account by Brandis of the prairie region, and the region of thinly-stocked forest bordering on it; and it appears that here, as cultivation extends, and the fires do not sweep over such vast extents of land as they did formerly, woods of Mesquit bean (*Prosopis juliflora*), and other trees are spreading by seed or coppice shoots, in Western Texas, and also in Wisconsin, Illinois, Iowa, and other States. Much has been done in the prairie region by plantations, and these succeed admirably wherever the climate is sufficiently moist; but in the central and western parts of Kansas all planting has hitherto failed, owing to the extremely dry climate.

In the northern pine zone of the Atlantic forest region, *Pinus Strobus*, the Weymouth or white pine is the most important species, and formerly covered enormous tracts from the Gulf of St. Lawrence to North Georgia, and beyond the sources of the Mississippi. At present, the only considerable supply of white pine is in Canada, and in the lake districts of the States of Michigan, Wisconsin, and Minnesota. The timber operations in the white pine forests have only one object, which is to bring as much timber as possible out of the forest in the shortest possible time, and to make money. Only the best trees are felled, and the rest burned. A forest after a timber gang has left it presents a remarkable appearance: between the standing blackened and partially charred stems of the broad-leaved and other trees which have not been felled are the stumps of the felled pines, whilst the ground is covered with wood, which would not have paid for its removal, and rots, or is burned by the annual fires.

In 1880, there were in the three lake districts 7000 million cubic feet of standing white pine timber, whilst in the last ten years 6205 millions of cubic feet have been felled and exported, 750 millions in 1889 alone. There is, therefore, little more left than can be exported in a single year. Many of the large saw-mills have already been obliged to stop work, or get timber from Canada. Chicago, which owes its rapid rise to the timber trade, imports yearly 166,000,000 cubic feet of white pine timber. This is about three-fourths of the whole forest yield of Prussia, the produce of 6,750,000 acres or 10,547 square miles of forest. Besides the Weymouth pine, *Pinus Banksiana*, the grey pine, and *Pinus resinosa*, and various broad-leaved trees are found. The sub-Arctic region of Alaska and British North America is poor in species; *Picea alba* and *nigra*, the white and black spruce, being characteristic trees.

Merely glancing at the North Mexican forest region, with forests of *Prosopis juliflora*, and grassy tracts containing gigantic cacti, and *Yucca baccata*, a palm lily, attaining 40 feet in height, we come to the Pacific forest region, where the Douglas fir, *Pseudotsuga Douglasii*, is the most important tree, and yields, in suitable localities, perhaps the greatest quantity of timber per acre of any known species.

We finally come to the red wood forests of the Pacific coast, where *Sequoia sempervirens* prevails, its congener *Sequoia gigantea* only occurring over a limited area. Unregulated fellings also prevail in the Douglas and red wood forests, and their supply cannot last much longer.

Besides the wholesale destruction of forests which goes on in America, and has already driven the United States to remove all duty from Canadian wood, the most appalling destruction is now being annually caused by the floods which pour down the slopes of the mountains, bringing down boulders, stones, and gravel on the cultivated lands below. Mayr has seen standing trees covered with mud up to a height of 15 feet in some of the Southern and Central States, whilst hundreds of magnificent trees lay uprooted in the full vigour of their growth. This can clearly be traced to the destruction of the hill forests.

How long will rulers of the United States shut their eyes to the appalling waste of the resources of their country which is still rampant! Brandis hopes that private capitalists may invest their money in forests, tempted by the rapid rise in the price of wood, and may manage them properly; but all European experience points to the necessity of State forests, and a trained State Forest Service to manage them, as the only efficacious remedy against the impoverishment of the soil and natural resources of America.

W. R. FISHER.

DAILY INTERNATIONAL WEATHER CHARTS.

AT the meeting of the Meteorological Congress at Vienna in September 1873, General Myer, the Chief Signal Officer of the United States Army, submitted the following proposal:—

"That it is desirable that, with a view to their exchange, at least *one* uniform observation of such a character as to be suitable for the preparation of synoptic charts be taken and recorded daily and simultaneously at as many stations as practicable throughout the world."

Although various suggestions had been made before, and synoptic charts had been previously constructed for large areas, this proposal was a bold step in advance, as the charts hitherto published—those of the English Meteorological Office excepted—were mostly synoptic only, but not strictly synchronous, whereas the plan now proposed was to treat the whole observational area of the globe as a unit, and to represent the actual conditions existing at the same instant of physical time.

The proposal was well received, and on January 1, 1875, General Myer was able to publish his daily International Bulletin, and to supplement this, on July 1, 1878, by the daily International Weather Map. These publications were continued until the end of March 1884, after which time the daily Bulletin was discontinued, but the chart was issued on an enlarged scale, containing data referring to pressure and wind direction and force at all reporting stations in the northern hemisphere and over the northern portions of the Atlantic and Pacific Oceans, and this has been published up to the end of December 1887. We have before referred to the ability with which this great undertaking has been carried out by the Signal Service. The necessity of obtaining strictly simultaneous observations was generally acknowledged after the discovery of Buys Ballot's law of the relation between wind force and barometric pressure, about the year 1857, and it is almost entirely due to the construction of synoptic charts over large areas that so much progress has been made in weather prediction in the last quarter of a century. This progress would hardly have been possible while each country dealt exclusively with its own area, notwithstanding the great advance made over the old system of dealing with means of observations by the publication of telegraphic weather reports and weather charts. But notwithstanding the progress already made, we are still unable to foresee what may occur for more than a day or so in advance. Much more research is required, and the thousands of observations now taken on land and sea over the globe should be plotted at least once a day. We should therefore much regret the discontinuance of such work as that now before us, which deals with nearly half the globe.

To take one or two of the facts shown by the charts themselves: the very severe gale which visited these islands on December 8 and 9, 1886, in which about the lowest barometer reading on record was observed, will be remembered in connection with the capsizing of the Southport and St. Anne's lifeboats near Formby, resulting in the loss of twenty-seven lives out of twenty-nine which constituted the two crews. In a paper upon this storm, read before the Royal Meteorological Society on April 20, 1887, by Mr. C. Harding, it is stated, after a careful examination of the materials then available, that "the Atlantic was in such a disturbed condition at this time that it is not possible to track the passage of the storm across the Atlantic with any certainty." The daily International Charts, however, show the position of the storm day by day, and also that it did actually cross the Atlantic from shore to shore, and was central over the Gulf of St. Lawrence on December 3.

Another instance of remarkable weather, it will be remembered, occurred in June 1887—the Jubilee year; the weather was remarkably dry and fine in this country, there being an extraordinary drought of about thirty days. The charts for that period show that similar anticyclonic conditions also embraced a very large part of the eastern portion of the Atlantic, and extended abnormally over a portion of Europe; while the travelling disturbances are plainly shown to be confined to the American side of the ocean.

It is only Government organizations that can undertake the laborious work of producing such charts; but when they are published, the matter should not be left there: the meteorologist should make use of the materials pro-