nadir. The great circle $H Z S N$ will be the observer's celestial meridian; like all great circles passing through the celestial poles, it is an hour circle or circle of declination. The circle $E C W D$ is the equinoctial (the celestial equator), and the circle $E Z W N$ perpendicular to the meridian is the prime vertical, cutting the horizon at E and W, respectively the east and west points. The north pole of the heavens is P, and is marked by the Pole Star or North Star.

The latitude of any place on the earth is equal to the altitude of the elevated pole at that place. Hence by measuring the altitude of the Pole Star, the north latitude of a place above the equator is directly obtained. This follows from a consideration of Fig. 2, in which $P p$ is the earth's axis, and $E Q$ the equator. The line $H R$ tangent to the earth's surface at L is the horizon, and the point Z the zenith of L. Assume that the earth's axis and the line $L P''$ parallel to the earth's axis to be both indefinitely prolonged. Because of the immensity of the celestial sphere as compared with the earth, these two lines will sensibly meet at a common point on the surface of the celestial sphere, and this common point is the elevated pole. To an observer L this elevated pole will therefore lie in the direction $L P''$, and $P'' L H$ will be its altitude. From Euclidian geometry we know that the angle $H L Z$ is equal to the angle $P O Q$, and the angle $Z L P''$ equal to $Z O P'$. Hence the angle $P'' L H$ (the altitude of the pole) is equal to $L O Q$, the observer's latitude.

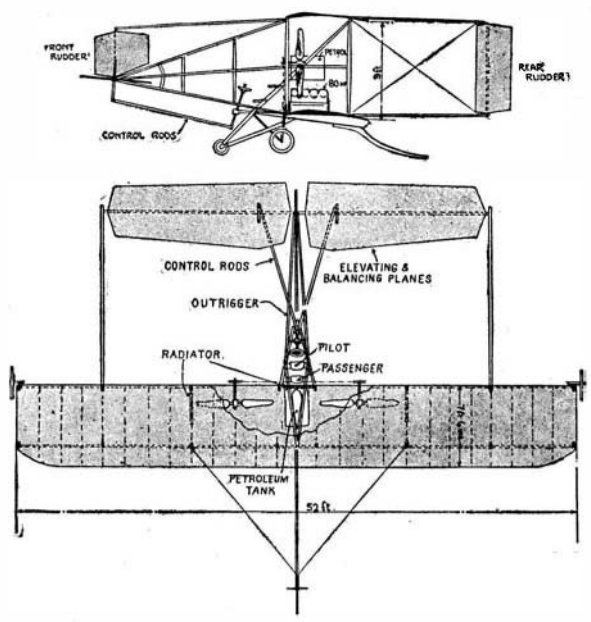
The latitude of a place on the earth is also equal to the declination of the zenith at that place. The declination of a body or point is its angular distance from the plane of the celestial equator, and hence $Z O Q$ in Fig. 2 is the declination of the zenith or latitude of L in Fig. 2.

In order to calculate his latitude, the navigator or explorer employs a sextant, which is an instrument by means of which the angular distance between two visible objects can be measured. Since Pole Star observations cannot always be taken, because the horizon is not always visible at dusk or at night time, the navigator is generally compelled to measure the sun's altitude, and to use that as the basis of latitude calculations. As shown in Fig. 3, the sextant is a sector of a circle, whose arc measures 60 deg. A movable radius, called the index bar, $C D$, revolves about the center of the sector. At its lower extremity the bar carries a vernier D. At the upper extremity of the index bar is a silvered mirror C, the surface of which is perpendicular to the plane of the instrument. Another glass N, called the horizon glass, is rigidly attached to the frame of the instrument, the upper half of which glass is transparent and the lower half silvered. The surface of the horizon glass must also be perpendicular to the plane of the instrument. A telescope T is directed toward the horizon glass, with its optical axis parallel to the plane of the instrument. Two sets of colored glasses F and E are usually provided for the protection of the eye when the sun is observed. The sextant is constructed on the principle that the angle between the first and last direction of a ray which has been reflected twice in the same plane is equal to twice the angle which the two reflecting surfaces make with each other.

Suppose that we wish to measure the angular distance between the sun A and some distant object B on the horizon (Fig. 4). The object B is distinctly visible at D in the telescope through the upper, transparent half of the horizon glass m. The object B is so distant that the rays $B' C$ and $B M$ coming from it may be regarded as sensibly parallel. If $a b$ and $C I$ are the positions of the index glass and index bar when both glasses are parallel, the ray $B' C$ will be reflected by the two glasses in a direction parallel to itself, and the observer, whose eye is at D, will see both the direct and the reflected image of B in coincidence. If the index bar be moved to some new position $C I'$, so that the ray from the sun, A, is finally reflected in the direction $m D$, then the observer will see the direct image of B and the reflected image of A in coincidence. The angular distance between the two bodies is evidently equal to the angle between the first and the last direction of the ray $A C$, which angle is equal to twice the angle made by the two glasses with each other, or twice the angle $I C I'$. If then we know the point I on the gradient arc at which the index bar stands when the glasses are parallel, twice the difference between the reading of that point and that of the point I' will be the angular distance of the two bodies. To avoid this doubling of the angle, every half degree on the arc is marked as a whole degree.

The sun is the body generally used by navigators in determining latitude. The time of noon being approximately known, the observer begins to measure the altitude of the lower limb of the sun a few minutes before noon, and continues to measure it until the sun ceases to rise, or "dips," as it is called. The greatest altitude attained by the sun is taken as the meridian altitude. Corrections are made for index error, dip, atmospheric refraction, parallax, and semi-diameter, and the result is the sun's true meridian altitude. Taking this from 90 deg. we obtain the sun's zenith distance. Looking in the Ephemeris or Nautical Almanac we find the sun's declination given for Greenwich (or Washington) noon of every day, with the hourly change, so that we can easily deduce the exact declination at the moment of observation. Then the observer's latitude is obtained, because the latitude of the observer equals the sun's zenith distance plus the sun's declination. This is apparent from a consideration of Fig. 5, in which the circle $A Q P B$ is the meridian, Q and P the equator and the pole, and Z the zenith. $Q Z$ is the declination of the zenith, or the latitude of the observer. If the sun is observed at s, south of the zenith as it crosses the meridian, then $Z s$ is its zenith distance and $Q s$ its declination, which is known. Then $Q Z$ equals $Q s + s Z$; in other words, the latitude equals the declination of the sun plus its zenith distance.

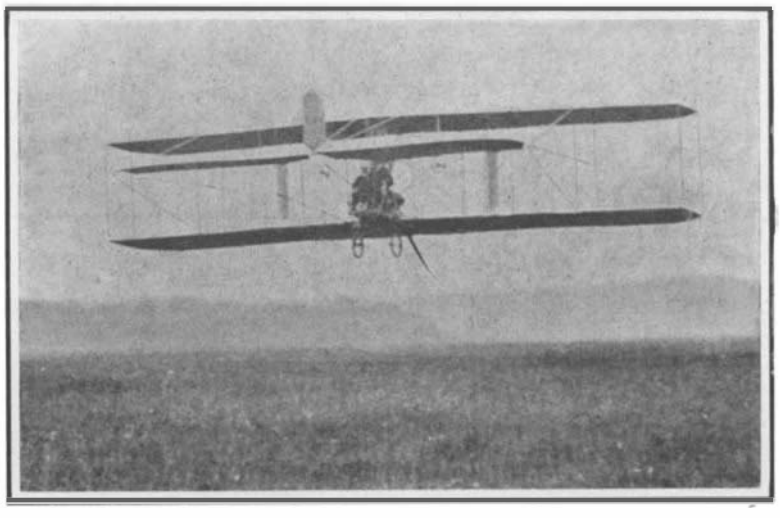
The handling of the sextant is so simple a matter, and the application of corrections to its readings so easy, that we fail to understand how anyone can seriously doubt Dr. Cook's accuracy.



Plan and side elevation of Capt. Cody's biplane.

CAPT. CODY'S BRITISH ARMY AEROPLANE.

Following close upon the great exhibition of flying which was given recently at Rheims, Capt. S. F. Cody, who has been working for a number of years in the interests of the British government, has met with complete success with his aeroplane, and has succeeded in accomplishing a cross-country flight of one hour and three minutes' duration, in the course of which he rose to a height of about 400 feet, circled a church steeple, and traveled altogether about 47 miles. This is the first flight demonstration of any account which has been given in England, and the fact that it has been accomplished by an American after persistent experimenting puts another aviation record to the credit of the United States.



Capt. Cody in flight in his latest biplane.

CAPT. CODY'S BRITISH ARMY AEROPLANE.

Capt. Cody has made a few minor changes in his machine since it was illustrated by us in our issue of January 30th last. Chief among these is the dividing of the single-surface horizontal rudder in front of the machine into two separate planes, or wings, placed side by side, and arranged so they can be worked together or separately and in opposite directions. This division of the horizontal rudder into two parts has been substituted for the separate wing tips, or balancing planes, which were formerly placed at each end of the single surface. By inclining the two wings of the present rudder in opposite directions, the machine can be righted when it tips to one side or the other, and this movement of the wings can also be used in steering the aeroplane to the right or the left. Steering in a horizontal plane is accomplished chiefly by means of two vertical rudders—one in front above the horizontal rudder, and one some distance at the rear of the planes.

The Cody biplane is mounted upon three wheels and one skid. Two of the wheels, which are about 2 feet in diameter, are placed side by side just under the front edge of the lower plane, while the third one is located in advance of the other two, and at the intersection of two pairs of heavy inclined uprights extending downward from the rear longitudinal of the upper plane and from beneath the bed of the motor respectively. The former pair of inclined uprights carries seats for the aviator and his passenger, the latter seat being a foot or more above the aviator's seat and just in front of a radiator consisting of long thin tubes extending upward to the front edge of the top plane. A single skid extends backward from the rear edge of the lower plane on the center fore-and-aft line of the machine. Most of the weight of the aeroplane is carried upon the two large wheels placed beneath its front edge. Coiled-spring shock absorbers surround the upright rods extending from the axle of these wheels to the lower edge of the front plane. If the machine tips downward in front when running along the ground, the weight is taken by the small wheel in front, while if it tips upward the skid at the rear touches the ground. This skid also acts as a brake when alighting. The use of the inclined uprights extending out in front, and also the use of bamboo to support the rudders, makes Capt. Cody's biplane somewhat similar in construction to that of his fellow countryman, Mr. Curtiss.

The main planes of Capt. Cody's machine are 52 feet long by 7½ feet in a fore-and-aft direction. They are spaced 9 feet apart at the center, this distance gradually diminishing to 8 feet at the ends. Both planes are arched slightly in a transverse direction, the upper one being curved downward somewhat more than the lower one, in order to bring it nearer to the latter at the ends. The ends of both planes, moreover, are almost flat, although the other parts of the surfaces have the usual parabolic curve. In arching these surfaces downward, Capt. Cody has followed the idea of the Wright brothers, who claim that a slight downward curvature of the ends of the planes is preferable to an upward curvature of them. In the "June Bug" biplane of the Aerial Experiment Association, it will be remembered that the upper plane had its ends curved downward, while the ends of the lower plane were curved upward. This arching of the surfaces in opposite directions was, we believe, the idea of Lieut. Selfridge, and it was found to work very well.

The wings of the horizontal rudder are also arched slightly in a similar manner to the main planes. These are operated by a horizontal steering wheel mounted upon the end of a universally pivoted lever. Swaying the wheel from left to right or *vice versa* sets the wings of the horizontal rudder so as to right the machine when it tips, while turning the wheel moves the vertical rudders in front and behind and also inclines the wings of the horizontal rudder slightly in opposite directions, in order to tip the machine downward as it makes a turn; pushing forward the steering wheel or pulling it backward causes the two wings of the horizontal rudder to move together, and inclines them downward or upward, in order to direct the machine in either of these two directions. Capt. Cody has also provided for auxiliary balancing planes at the ends of the main planes. These can be attached to the uprights half way between the planes, if they are found necessary, in order to tip the machine in making abrupt turns. The inventor has also provided for warping the main surfaces if he finds this necessary. He has employed a system of warping the wing extensions of box kites for some time past with the man-lifting kites with which he has experimented. If it was found that the kite was not riding properly, by hauling it down and warping the wing extensions of the main box the trouble could be remedied.

The power plant of the Cody machine now consists of an 8-cylinder E. N. V. gasoline motor capable of developing about 80 horse-power. This motor has replaced the 50-horse-power Antoinette which he used early in the year. It has been moved slightly back from the front edge of the lower plane, instead of being placed forward of the front edge as heretofore. In other words, the positions of the motor and the aviator have simply been reversed. The motor drives two

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CAPT. CODY'S BRITISH ARMY AEROPLANE.

(*Concluded from page 198.*)

two-bladed propellers in opposite directions by means of sprockets and chain. These propellers, as noted in our former article, have blades which taper toward the tips, the widest part of the blade being at the hub. Another interesting point about these blades (which are made of aluminium) is that the arms which carry them are fastened to the rear or pressure side of the blades. These arms are inclosed by a false face, in order to avoid sharp angles, but there is a high ridge down the face of the blade, which is so great that the blade has in reality a triple curved face. From the cutting edge to the center the camber increases the pitch; then comes the reversal of the curve, where the false face rounds the arm; and finally a renewal of the sharp camber, where the false face runs off into the trailing edge. The propellers are said to give a thrust of over 20 pounds to the horse-power.

The weight of the Cody biplane complete with the aviator is about 2,000 pounds. Despite the fact that it is such a large machine, it has been designed with a view to ready portability. The main planes each divide into three sections, consisting of a central portion 20 feet in length, and two end portions each of 16 feet in length. The poles which support the rear rudder fold back against the planes, and the front rudder bamboos can be readily dismounted. The chassis also comes apart, and thus the whole machine can be easily and quickly dismounted for transport. Although no test has been made of its speed, this machine because of its powerful motor and efficient propellers, and, especially, because Capt. Cody has attempted to reduce all head resistance to a minimum, is undoubtedly a very fast one. It is probable that it will compete with the Bleriot and Antoinette monoplanes which are to race in England for a $25,000 purse next month.

For the details and drawings of the Cody biplane published in this article, we are indebted to the English weekly Flight.

Aviation Abroad.

The second foreign aviation meeting, which was held last week at Brescia, Italy, was by no means as successful as the first event at Rheims. The field was very rough, which made landing without breakage difficult, and in addition to this the weather was not always propitious. M. Lefebvre, the daring French aviator who piloted a Wright biplane at Rheims, was killed at Juvissy on September 7th when his machine plunged to the ground. This is the second fatal accident which has occurred with a Wright aeroplane. Lieut. Calderara, of the Italian army, who also had a bad fall in his Wright machine a couple of months ago, again came to grief when he took Lefebvre's place at Brescia on September 8th, the first day of the meeting. Just after starting the aeroplane tipped so badly that one runner struck the ground and was demolished. M. Bleriot struck a tree and broke his propeller. Anzani's propeller also broke while he was attempting to make a test flight. Both the latter accidents were attributed to the unevenness of the ground. Curtiss and Bleriot crossed the startling line every day in the 31-mile race for the Grand Prix, according to the regulations, but no extended flights were made up to the time of our going to press. It was much too windy on the 10th instant for any flight to be made. At Berlin Orville Wright continued to make daily flights. On September 7th he flew for 52 minutes, and on the 9th he made two flights for Crown Prince Frederick. He is teaching Capt. Englehardt to operate the machine. At Scarborough Beach, near Toronto, Can., Mr. C. F. Willard last week made two excellent flights out over Lake Ontario with the Curtiss biplane of the Aeronautic Society. Each time he started by running down an incline on the shore of the lake, and made a circle from one to two miles in circumference, landing in the water successfully upon floats fitted to the aeroplane. This is the first time a motor-driven aeroplane has been fitted with floats and made to alight without damage upon water.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SHIRT-COLLAR.—J. DORF, New York, N. Y. The collar is of the turn-down type, arranged to permit the wearer to conveniently slide the necktie in the collar to the desired position, the necktie not coming in contact with the rear collar button but passing over a flap overlying the collar button and forming an integral part of the turn-down portion; permitting the wearer to draw the collar tight in front by the necktie, causing the collar to appear with a lock front and keeping the top edges close together.

Electrical Devices.

BATTERY-COVERING.—G. E. ANDREWS, Providence, R. I. The more particular purpose of the inventor is to provide a two-part covering made of rubber, and provided with means for rendering a battery cell so completely watertight that the cell may be effectively employed where moisture is excessive, or even be totally submerged under the surface of water.

SWITCH-HOOK-CONTROLLING DEVICE.—M. M. KAHN, Louisville, Ky. In operation, the weighted arm normally rests upon the hook of weight. When, however, the telephone is in use, the arm is thrown backwardly into position, and may be secured in this position by means of the set screw. After the telephone has been used, the arm is again turned forwardly into engagement with the hook.

Of Interest to Farmers.

PLANT-PROTECTOR.—E. R. DRAKE, De Land, Fla. In growing some vegetables, and particularly tomatoes, and especially in southern latitudes, great care is necessary in controlling access of the sun's rays to the plants so as to graduate their effect to a certain non-injurious degree. The north side requires no such protection as the others, but being open, it allows free access for setting the plants and for weeding, and otherwise tending them while growing.

BEET-HARVESTER.—M. J. ELY, Oxnard, Cal. An object here is to provide a device in which the plow can be raised or lowered and locked in either position so that when the digger is being used and the plow is locked in its lowered position, it cannot be lifted therefrom without lifting the entire weight of the whole frame of the machine together with the wheels and the weight of the driver.

THRESHING-MACHINE. — T. S. HAYNES, Bay City, Texas. The invention has in view a rigid frame arranged at one side of the harvester and adjustable to different elevations above the ground, the frame carrying the harvesting mechanism and braced intermediate its length by the frame of a downwardly and outwardly-inclined elevator.

Of General Interest.

CARD-INDEX CASE.—E. A. YUNGEL, New York, N. Y. In this index case it will be impossible to place a card out of its correct position, and the invention may be broadly defined as consisting of a card-holding receptacle, with the bottom thereof having card-engaging members located in relatively different positions for each card or set of cards the case is to contain and without interruption between adjacent members.

EYE-SHADE.—G. E. HENRY, Philadelphia, Pa. This improvement has reference to eye shades of the kind mounted upon spectacles, the more particular purpose being to support the shade upon the end portions of the spectacles, and also to produce certain changes in construction of the shade and its support, thereby increasing the general efficiency of the device.

Hardware.

SELF-HEATING SOLDERING-IRON. — A. HUSSON, Oshkosh, Wis. The object of the invention is to produce an iron which will operate effectively to produce a thorough vaporization of the liquid as it is admitted to the burner. The invention relates especially to the types of irons which are heated by liquid fuel.

WIRE-STRETCHER.—F. STANLAKE, Owosso, Mich. This invention pertains to improvements in stretchers, and more particularly to that type in which there are employed a ratchet member and a pivoted lever member having dogs in engagement with the ratchet member and having its pivot movable longitudinally of the ratchet.

Heating and Lighting.

HOT-WATER HEATER.—E. B. SADTLER, Richmond, Va. In the present patent the invention is an improvement in hot water heaters and it has for its object the provision of a simple and effective structure which will be durable in operation, and which will not easily get out of order or leak and will produce a maximum heating effect in operation.

BOILER.—C. E. CHAPMAN, Fort Edward, N. Y. A purpose here is to provide a stationary flash boiler in which the steam dome and water column are removed from and are practically independent of the boiler proper, and wherein the amount of water conducted to the boiler from the water column by excess air pressure in the water column over and above the boiler pressure is under complete control.

GAS-LIGHTER.—W. D. C. WRIGHT, Philadelphia, Pa. A spark coil and battery cells are disposed in a casing, to which is attached a hollow standard, at the top of which there is a stationary electrode and also a spring electrode, the latter being attached to an electrical conductive rod held in bearings in the hollow stem. The casing is of conductive metal and the rod is in electrical communication with the casing. Means provide for completing the circuits.

Household Utilities.

LIQUID-STRAINER. — M. ARRUEBARRENA, Cienfuegos, Cuba. The principal object the patent has in view, is to provide a continuously acting filter for sugar syrup, which may be operated with the minimum of power and readily cleaned. Throughout the whole of the construction, the material used is perforated, and therefore filtration is not arrested at any point.

Machines and Mechanical Devices.

CLUTCH.—J. SCHNEIDER, Ann Arbor, Mich. In the present patent the invention relates to clutches, and it has for one of its objects the provision of one which will permit of the ready engagement of the drive and driven shafts, with automatic means which will more securely connect the two shafts should there be any slip from the wearing of the parts after the clutch has been thrown into operative position.

CARD-EXHIBITING DEVICE. — A. J. THOMAS, Roubaix, S. D. Means are here provided for conspicuously displaying illustrated postal cards, or cards whereon fancy buttons or like merchandise are placed. The invention affords an apparatus of great capacity and extremely well adapted for the exhibition of cards in large number and of different design, that are brought into view by manual operation of the machine.

POT-FEEDER FOR TYPE-CASTING MACHINES.—L. A. SENGELE, Victoria, Texas. In this instance the invention relates to type-setting and type-casting machines, and more particularly to such machines as are employed to cast slugs provided with impression characters, each slug representing the line, or its equivalent, to be printed.

CENTRIFUGAL BOLTING-MACHINE. — G. CUSSON, Chateauroux, Indre, France. The invention has reference to an apparatus suitable for use in a flour mill as a flour extractor for the different grindings of wheat, as an extractor of semolina, oatmeal, or groats, as a meal-sifter, and capable also of being used in various industries.

Prime Movers and Their Accessories.

BOILER-FLUE CLEANER.—J. WIECHMANN, Albany, N. Y. In this case the object of the inventor is to provide a new and improved boiler flue cleaner, arranged to insure a thorough removal of scale and to provide the desired flexibility of the cleaner to readily pass through bent or curved tubes, flues, or pipes.

INDICATOR.—C. W. SNYDER, Hudson, N. Y. The improvements are in indicators adapted for use in connection with engines, for making indicator cards to show the variations in the pressure in the cylinder during the movement of the piston. It is especially adapted for use with internal combustion engines.

Railways and Their Accessories.

GRAIN-CAR DOOR.—P. J. A. SCHNOOR, Holstein, Iowa. This door is intended to meet the several requirements in loading or unloading grain and can be conveniently manipulated to form openings of more or less extent according to the use to which the car is to be put. It may readily be attached to the door of an ordinary car.

DUMPING CAR.—T. LAWSON, New York, N. Y. This invention pertains to dumping cars admitting of general use, and particularly railway cars of the general type described in a former patent granted to G. I. King and T. Lawson. The object of the present invention is to improve the general construction of the car, and especially of the means for tilting the box and opening the doors thereof.

MAIL-BAG CATCHER.—D. W. COUNCIL, Rutherfordton, N. C. The object of this patent is to provide a device which may be applied to the car without any changes in the same, which will take the bags from the crane or support already in use, and hold it until it is removed from the holder, and which will deliver the outgoing bag, at the time it receives the incoming one.

Pertaining to Vehicles.

VEHICLE-SPRING.—J. N. BREWSTER, New York, N. Y. The invention refers to carriages, road wagons, trucks and like vehicles, and its object is to provide a spring, arranged to yieldingly support the vehicle body and to readily compensate for the variation of the load, without danger of breaking the springs and without requiring the heavy multiple leaf springs now generally employed.

HARNESS.—D. F. BALENTINE, Greenville, S. C. An object in this case is to provide simple harness for detachably securing a draft animal to a vehicle, by means of which the horse or other draft animal can be firmly secured to the vehicle, and which permits the horse to be instantly released in case of necessity without the driver leaving his position in the vehicle.

CARBURETER FOR INTERNAL-COMBUSTION ENGINES.—P. J. GROUVELLE and E. H. ARQUEMBOURG, 71 Rue du Moulin Vert, Paris, France. The object of the inventors is to obtain an additional supply of air in a carbureter which is automatically operated by the vacuum which is created in the carbureter by the suction of the motor and to permit of varying the proportions of air and of carbureting fluid according to requirements by using the vacuum itself.

Designs.

DESIGN FOR A BADGE.—J. W. GREEN, Los Angeles, Cal. The badge has the shield form with a beaded border. Inside of this the flat surface is ornamented with a clock face at the top placed between the outspread antlers of a deer on whose collar are the capital letters B. P. O. E. A small flower is on each side of the animal's head at the lower corners.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Legal Notices

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

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