William

Description of
the solar compass.
1844

DESCRIPTION

OF THE

SOLAR COMPASS,

TOGETHER WITH

DIRECTIONS FOR ITS ADJUSTMENT AND USE.

BY

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No apology is thought necessary in presenting to the s
veyor the following brief remarks, on the best method
adjusting and using the Solar compass, in as much as this
the first published work on this subject.

No reference will be made to the theory or practice
surveying, any further than it is necessary to explain t
use of this instrument. Imperfect as this attempt may
it is hoped that it will be found useful to the surveyor
acquainted with the Solar Compass.

SOLAR COMPASS, &c.

Introduction.

The object of the following pages, is to throw some light the principles of the Solar Compass, and of the best known ethod, of adjusting and using the same. The writer be-ving it impracticable to accomplish this object, by a refe-nce to a drawing of this instrument, he will therefore refer the improved Solar Compass, manufactured by William J. oung, of Philadelphia; and suppose the reader to have one these, or a similar imstrument before him. He will also ce it for granted, that the reader possesses a general know-lge of angular instruments, and of the theory of surveying.

Parts of the Solar Compass mentioned.

The Solar Compass, being an astronomical instrument, he o would study or use it to the best advantage, should have clear knowledge of Astronomy, as far as it is applicable; so, clear views of the principles on which the Solar Com-ss operates, in order to work understandingly in making various adjustments, and skillfully using the same.

The following parts of the improved Solar Compass, will understood, by inspection. This instrument has two main ates, the upper and the lower. The lower plate is that on ich the sights are placed, and it revolves underneath the per plate on a centre, while the latter remains stationary, d it may be clamped in any position, to the upper plate; ere is also a graduated ring on the under plate, which covered by the upper, except two openings at opposite

points, with verniers to read angles. Upon the upper pla is placed a needle box, having divisions for the north end the needle only of about 36 degrees, with a vernier to re the needle's variation; also, upon this plate, is placed t solar apparatus, consisting of a latitude arc, declination a and an hour circle or arc, with two spirit levels, placed right angles with each other, together with other necessa fixtures.

The latitude arc is that which is attached by screws to th plate, and stands nearly vertical to it; the hour arc li partly horizontal over the levels, and the declination arc placed upon a revolving limb, above the plate, and oth fixtures of the solar apparatus; upon this revolving limb, placed another movable limb, which turns on a joint at on end, and the other end, with a vernier, moves over the de clination arc, with a clamp screw, to clamp it to the sun's de clination for the time being; at each end of this last descri bed limb, there is attached to it a small brass plate stand ing out at right angles with the limb, and into the upper sid of one and the lower side of the other, is set a small conve lens; opposite to each lens on the brass plates there is at tached a small silver plate, by means of three small screws and on each of these, lines are drawn at a suitable distanc apart to embrace the sun's image, which falls upon each fro the lenses. It will be seen, by inspecting this part of the in strument, that it must be used one end towards the sun, whe he has north declination, and the other end for south decli nation.

The other parts of the Solar Compass, undescribed here will be understood by any person acquainted with surveying instruments.

Apparent motion of the Sun, &c.

With a view to gain a more clear understanding of the se of the parts of the solar apparatus, above described, I would call the attention of the reader to the apparent motion f the sun or stars, around the earth, regarding the earth as he centre of their daily revolutions. A distinct view of the pparent conical motion of the sun, &c., when they have orth or south declination, is necessary, in order to under-tand how the movable parts of the solar apparatus may be o adjusted, as to trace the sun, in his apparent course, while he sights of the Compass remain stationary.

Perhaps this subject cannot be better illustrated, than for he reader to imagine himself standing upon the earth's equa-or, and the sun having no declination, the sun would rise to im due east, and set due west; at noon it would be in the zenith, and in the nadir at midnight. In other words, when he sun has no declination, his apparent revolutions is in a perfect plane with the earth's equator; and again: if a straight line be drawn from the rising to the setting sun, and from the sun at noon and at midnight, both of these lines would pass through the earth's centre, and the equator would intersect these lines. But not so when the sun has north or south declination; for his apparent motion will have an angle to the above described plane or lines, with the earth's centre, equal to the amount of the sun's declination north or south—thus it will be seen, that when the sun has north or south declination, and the earth is regarded as the centre of his revolutions, the plane before mentioned, becomes conical. This apparent conical motion of the sun may be further brought to view, by the dishing wheels of a carriage, the rim representing the sun's apparent path, the hub, the

earth, and the spokes, lines drawn from the sun's path. F what has been said, it may be seen that a line drawn fro the sun to the earth's centre, would pass north or south the equator, equal in degree to his declination north south.

The reader is referred to some work on Astronomy, learn how the apparent path of the sun in the heavens brought about, by the diurnal revolutions of the earth, an the inclination of its poles to the plane of its orbit; an I would add, that these remarks apply to the apparent rev lutions of the planets and fixed stars, also.

Position of the Solar Compass on the Equator, &c.

I will now suppose the Solar Compass to be placed on th equator, and its latitude and declination arc set at 0 or zero and standing in a position for an observation, the axis of th revolving limb will be parallel to the poles of the earth, an the revolving limb will play vertical to the equator, and i the sun's apparent path, when he has no declination, an should be kept in this position in all latitudes. It may now be seen, that the demand for north and south declination, i precisely met, by setting off the sun's declination on the de clination arc, and that part of the revolving limb holding th lenses, will have the same conical motion as the sun in the heavens; and it will be further seen, that there is only one position in which the Solar Compass can be placed, that thi revolving limb will follow the sun's apparent path. It is from this principle of the instrument, that the true meridian is obtained, and the variation of the needle from it, found The reader will do well to consider, while examining these principles of the Solar Compass, the position the instrument would occupy on the equator, when in use, and also, what

ıange of position it would undergo, in respect to the hori-
›n, as he recedes from the equator, toward the poles of the
.rth.

I would here remark, that the accuracy of the surveys
ade with the Solar Compass, will depend on the correct ad-
ıtment of its various parts, and a proper method of using

How to adjust the Solar Compass.

Place the instrument on the tripod, and level it or nearly
, by the hand, then by means of the leveling screws, at the
ver end of the ball and socket, bring the bubble in each
vel, accurately to the middle of its opening, if these bub-
es remain at the middle of the openings, while the com-
ss is turned horizontally around, this adjustment is right,
t if they do not, the levels must be so adjusted, by means
the screws at the end of each, for that purpose.

I would here mention, that in all observations with the
lar Compass, for the purpose of making its adjustments, or
ſind the variation of the needle, &c., the sun's declina-
n should be taken from a nautical almanac, and reduced
the hour of observation for the longitude of the place, that
the sun's declination for noon at Greenwich, would be his
clination for 6 o'clock, A. M. ninety degrees west of that
ıce, or at Dubuque, Iowa Territory. The latitude called
· by the instrument, should be set off on the latitude arc,
d the compass correctly leveled; these pre-requisites are
cessary, to a good observation. The observer will also be
ıch assisted by a good reading glass, to examine the ver-
ers, sun's image, &c.

How to adjust the silver plate to correct the index error the declination arc.

In the next place, set off the sun's declination on the clination arc, for noon of the day of observation; also, off on the latitude arc, the latitude of the place, as near known, and clamp the sights of the compass, for a north a south course; then place the sights in that direction, as ne as you can by the needle, and accurately level the inst ment; then, at fifteen or twenty minutes before noon, if t sun has north declination, bring the end of the revolvi limb that has the declination arc upon it, towards the su but if the sun has south declination, the other end; in su a manner, that the sun's image from the lens towards t sun will fall on the silver plate at the opposite end of t limb, and observe if his image is embraced precisely betwe the horizontal lines on this plate, without regard to the v tical lines, which are only used for time. If it be not alter the latitude on the latitude arc, until it will be so e braced, and continue to keep it so by means of altering t latitude, if necessary, until the sun culminates, and make note of the latitude given by the instrument. The sun's clination must now be set off for 4 or 5 o'clock, P. M., if declination be north, or about 3 o'clock if it be south, a when the hour arrives for which the declination has be set off, the compass must be leveled, and the sights direct N. & S. then bring the revolving limb to bear upon the su as before, and turn the instrument a little, if necessary, the ball and socket, to bring the sun's image precisely b tween the lines on the silver plate. You will then cause stake to be set, at 4 or 5 chains distant from the compass, the direction of the sights, and let the tripod remain with

›ving it, for the next day's observation; on the next day, ıen the sun is at the same number of hours, or nearly so, ›m the meridian in the forenoon, as it was in the afternoon the last observation, adjust the instrument, and make an servation as before, and if the stake should not fall in the rection of the sights, as in the previous afternoon's obser- tion, you will place another stake at the same distance ›m the compass as the first, in the direction of the sights. will now be necessary to set a stake half way between the ·o, and turn the sights to bear upon it; this is the direction e sights of the compass will have when all the adjustments e made.

It will now be observed, that the sun's image on the silver ate, is a little too high or too low for the horizontal lines, e amount of which may be very nearly estimated, by e lines made to embrace the sun's image, which are thirty- ·o minutes apart, and the tripple lines below these are five inutes apart. Or the declination may be so changed on e declination arc, as to bring the sun's image precisely be- ·een these lines, and the amount of this change will show ›w many minutes the silver plates must be moved up or ›wn, which is also the amount of the index error, in the de- ination arc, and this index error can be allowed in all sub- quent observations, instead of moving the silver plates to ke it out, as hereafter directed.

Having thus determined the amount of the index error, see ıat the sun's declination is correctly set off, on the declina- on arc, then loosen the three small screws to the silver late, and carefully move it up or down, as the case may re- uire, until the sun's image is embraced between the lines, nd screw it fast. The number of minutes the silver plate

has been moved must be increased or diminished, on the la tude arc, in the right way to have the sun's image fall b tween the lines when he culminates.

You will now make another observation, if it be not past 1 o'clock; and if the sights continue to bear upon the middl stake, this adjustment is probably right, but if they do no the sights must again be directed to it, and the silver plat moved as before, and a corresponding alteration must be mad on the latitude arc; you will observe again at noon, to see the sun's image falls precisely between the lines on the si ver plate, if it do not, move the latitude arc until it does.

To proceed again: At about two o'clock, P. M. make a observation, and see if the middle stake falls in the directio of the sights, if it does, continue to observe at intervals, unti about four o'clock; should the sights still bear upon the mid dle stake, this part of the adjustment is right; but if they d not, the sights must again be directed to it, and the silve plate moved as before directed, also, a corresponding chang must be made on the latitude arc, in that way, that woul bring the sun's image between the lines when he culminates These kind of observations should be repeated in the fore noon and afternoon, until the compass sights will take onl one direction through the day. If the first observation be no completely successful, it will be found that at each subsequen one, the error will be less and less. Some Solar Compasses when taken from the shop, may have no index error in th declination arc; all of them, however, should be submitted t this test, and an experienced observer will generally be suc cessful in making this adjustment, by the second or third ob servation.

I would here remark, that a Solar Compass having an in

x error in its declination arc, will sight too far to the east west, in the forenoon, and the reverse of it in the afternoon, and the mean between these two observations, is the rection the compass sights will take when the index error this arc is corrected ; hence the *great importance* of carelly attending to this adjustment, and repeating it as often there is suspicion that the instrument has undergone any ange from use or otherwise.

If the sun be obscured by clouds while any of the above entioned observations should have been made, the same ıy be deferred to the next clear day, with equal prospects successful results.

How to adjust the second Silver Plate.

Thus far only one of the silver plates for the sun's image, s been adjusted, the other is easily brought into adjustment follows :

Set off the declination at 0 or zero, place the instrument the tripod, with the sights north and south, or nearly so, d clamp it on the ball and socket, then turn the lens before ed, to the sun, the sun's image will now fall as much above below the lines on the adjusted plate, as his declination ıy be north or south. Keep the compass level, in an east d west direction, but tilt or tip the instrument in a north south direction, as the sun may have north or south declition, until his image is embraced between the lines on the ver plate ; then by reversing the ends of the revolving ıb, bring the other lens towards the sun, and the unadjusted ver plate to receive its image, taking care in making this rersal, that the compass remains perfectly stationary ; if sun's image falls between the lines on this plate, it is ht, but if not, the plate must be moved up or down, as the se may require, and as directed for the adjustment of the

first plate. This reversal should be repeated several tin to see if the sun's image falls precisely between the lines, both silver plates. This being done, their parallelism is perfect as necessary. This adjustment may be made at a hour of the day, and if the first plate has been left unadjust or with an index error as before observed, the last plate w also have the same error, when they will reverse correct and must be allowed for, as on the other plate, in all sub quent observations.

How to adjust the Latitude Arc.

The latitude arc may have an index error, and may n read the true latitude of the place of observation; but this of no consequence, as the latitude given by the instrume will be the latitude to be used in all observations, for findi the variation of the needle, or running lines by the So Compass.

One way to find this index error is, to take the instrume to some place where the latitude is known, and by an obse vation find what latitude is given by it, the difference, if an is the index error on the latitude arc, and may be used to fi the correct latitude in any other place.

How to adjust the Hour Arc.

The hour arc may also have an index error. To find th the solar apparatus must be set for the true meridian, a when the sun comes to the meridian, so place the revolvi limb, that the sun's image will fall precisely within the li square on the silver plate formed by the horizontal and v tical lines drawn upon it, and observe how much one s of the revolving limb, over the hour arc, is one side, if a of the zero point; and as much as it is one side of that po so much must be allowed on the same side, for all subsequ bbservations for other hours of the day, which will of cou

solar time, and may be reduced to mean time by adding or btracting the sun's equation for the time being.

How to adjust the Compass sights to the Meridian.

The compass sights may need some adjustment. It has en stated that when certain adjustments have been correct- made, the sights of the compass will take one direction ly, when the solar apparatus is used. It should be men- oned, that this direction may not coincide precisely with ie true meridian. The difficulty of planting the various arts of the solar apparatus by the instrument maker, is pro- ably the cause of this error, and to correct which, a true eridian line is necessary. To make this line, the method ecommended by the Surveyor General of Ohio, Indiana and Iichigan, also by the Surveyor General of Wisconsin and owa, in their general instructions to deputy surveyors, will e found convenient, which is nearly the same as that given y Flint, and some other authors, in their work on surveying, find the variation of the needle.

Having established a meridian line, place the compass up- n it, and by a careful observation with the solar apparatus, ee if the direction of the sights coincides with it; if they do ot, one of the sights on the compass plate should be moved ntil it will range with the other on the line of the true me- idian; this may be done by enlarging the holes of the screw nd steady pins of the sight, with a suitable file, the way the ights require to be moved, just enough to bring them to ange on the line of the meridian, and screw the sights fast n this position; the vacancy on the side of the steady pins, nay be filled up with copper or brass, not magnetic.

Second method.

A second method of correcting this error, is to unclamp

the compass plates, and keep the upper plate stationary, whi
the lower, with the sights, are turned into the true meridia
then clamp the plates fast again. It will now be seen by t
verniers on the upper, and the graduated ring on the low
plate, the number of minutes the compass sights were out
the true meridian, and this amount of index error must be
lowed on all courses run by the instrument, if it is not co
rected in the sights as first mentioned.

Third method.

I will here give another method of bringing the compa
sights to coincide with the true meridian, although I cann
recommend its use only to a very limited extent; but it wi
bring to view what ought to be known to every person usin
a Solar Compass—it is this; If one end of the level lyin
under the hour arc, is raised or lowered by the screws at th
end of it for that purpose, the direction of the sights will b
permanently changed, when the solar apparatus is used, i
proportion to the change of the level; by this means th
sights may be brought into the true meridian.

But this method throws the compass plates a little out o
level when in use, and consequently the sights out of a pe
pendicular. This should put the surveyor on his guar
against any alteration in this level, after the instrument ha
been well adjusted.

How to adjust for an observation on a Star.

It now remains to be shown how the variation of th
needle may be found, by an observation on any of the visi
ble planets or fixed stars, when their declination does no
exceed 23½ degrees N. or S.; also, by the sun when visible
but so far obscured by clouds or fog, as not to give an imag
through the lens. And here I shall suppose the observer t

se a Solar Compass, adjusted as before directed, and one ther additional adjustment will now be necessary.

Place the instrument on the tripod and set the movable mb that holds the lenses at 0 or zero, on the declination rc, then so tilt the compass that this limb will revolve near- horizontally; then set a stake three or four chains from ie compass, with a strip of white paper about one inch wide istened around it, and nearly on a level with the instru- ient; the brass plates that hold the lens should now be irned to range on the stake, by means of the revolving imb; then range by the upper edges of these plates, and lter the position of the compass, if necessary, to bring their ange precisely upon the paper; then reverse the brass lates, by turning the revolving limb half around, taking are that the compass remains stationary; then range by heir upper edges as before. If they range above or below he paper on the stake, the highest plate must be filed down n the top, by a fine file, until by reversals as before, they vill range both ways on the paper. This adjustment is ne- essary to get rid of any index error in the declination arc, vhen an observation is made without using the lens. The Solar Compass will seldom be found incorrect in this respect, ut it would be well to bring them to a test of their accura- y.

To find the variation of the needle by a Star.

Thus prepared, the observer will select from a nautical almanac, a planet or fixed star, that has not more than 23½ degrees declination, and that will not be nearer than two hours of the meridian, at the time of the contemplated obser- vation, which may be known by their right ascension, &c. Set off the star's declination thus selected, on the declination arc, and adjust the latitude arc to the latitude of the place.

The time having arrived for an observation, place the com pass on the tripod, as directed for an observation on the sun the observer will then turn the brass plates, to range in the d rection of the star, by the revolving limb. If the star is n certainly known by the eye, bring one end of the revolvin limb over the hour and minute, the star is from the meridia on the hour arc, (before or after, as the case may be,) the by a range on the upper and out edges of the brass plate will direct the eye to the star intended, or nearly so. Whil making these observations, an assistant should hold a lighte candle a little behind and above the head of the observer, i such a manner that the upper edges of the plates can b clearly seen, and yet not so bright as to obscure the star.

If the upper edges of the plates range a little above o below the star, turn the whole instrument on the ball an socket, the right way to bring the range precisely upon it and when done, the variation may be read off from the needle.

The observer would do well, if time permit, to select tw stars; one before, and the other after meridian, and mak two observations, taking the mean between the two, (if there should be any difference,) for the true variation of the nee dle.

By the Sun when partly obscured by clouds.

An observation in like manner can also be made on the sun's lower limb, when partly obscured by clouds or fog, for the same purpose, by increasing the sun's declination, when south, or diminishing it when north, the amount of the sun's semi-diameter, and so set it off on the declination arc, and make an observation in the same manner as before directed, on a star, by ranging on the upper edges of the plates, to the sun's lower limb.

Small sight vanes will hereafter be made in the out edge

f these brass plates, which may be used instead of ranging y their upper edges, as above described.

By the Moon.

Under favorable circumstances, an observation may be nade on the moon, in the same manner as above described n the sun, to find the variation of the needle. But the observer must rightly estimate and allow for the effects of the noon's refraction, and parallax in altitude, upon the instrument; and on the account of the rapid change of her declination, great care should be taken to have it correctly set ff on the declination arc, for the time of making the observation.

Effects of Refraction.

I would here remark, that the refraction of the rays f light, passing from the Heavenly bodies, effect the olar Compass a little, in all observations to find the variaion of the needle, and must be allowed for, when large nough to make a perceptible difference on the instrument. To accomplish this object by the sun, one of the compass ights is marked and figured on the inside with the sun's reraction in altitude, which may be seen and read, by turning he other sight to the sun, (when the instrument is leveled n the tripod,) in such a manner that the sun's shadow from he top of it will fall on the marked sight, at which place ead the sun's refraction in minutes of a degree.

Although the effects of refraction on the Solar Compass an hardly be discovered, when the sun is two hours above he horizon, it will be useful to give the following proportions f refraction, thus found, to be allowed as hereafter directed, n two latitudes, which will enable the observer to make a ight allowance in other latitudes.

In latitude 45 degrees, proportion of refraction to be al-

lowed, when the sun is three hours from the meridian, fou fifths; four hours, three fourths; six hours, two thirds. I latitude 35 degrees, proportion of refraction to be allowe when the sun is three hours from the meridian, three fourth four hours, two thirds; six hours, one half.

And I would add, that at the equator, refraction entirel ceases to effect the instrument, except to find the apparen time. But at the poles ofthe earth, all of the refractio should be allowed.

The above proportions are sufficiently correct for practica purposes, and should be allowed on the instrument, by let ting the sun's image drop below its true place on the silve plate, and the number of minutes allowed can be seen b the tripple lines, drawn below the lines which embraces th sun's image, in ordinary observations. These lines are fiv minutes apart, as before observed. The Solar Compass can not be relied upon as accurately giving the variation of th needle between the hours of 11 A. M., and 1 o'clock, P. M. and all observations during this interval, (except for lati tude,) may be more or less imperfect, according to the dis tance of the sun from the meridian.

It is, therefore, advisable, between the hours of eleven and one o'clock, to use the needle at the variation last found

Effects of the diurnal variation of the needle.

The diurnal variation of the needle may lead to much er ror when running lines from points where its declinatio has been sometime previously found. It has been ascer tained by numerous observations, that this diurnal variatio is much more in the summer than in the winter months, an the amount of these aberrations are more or less on differen days of the same season of the year; but the order in whic this change comes about, can be a little more clearly defi

d. The north end of the needle will arrive at its most eas-
·ly declination, between one and two hours after sun rise ;
will then gradually move westerly, until one or two
:lock, P. M., soon after which, it will gradually decline
stward, and will return about half way back, at sun set,
ıere it was in the morning, and arrive at its most easterly
:lination again the next morning between one and two
urs after sun rise.

The following observations were made by myself, in latitude 42 degrees 42 minutes north, near Detroit, in July, 1839.

1839.	Thermometer.			Weather.	Weather.	Wind.	Magnetic Variation.		
Ju'y.	5½ A. M.	1 P. M.	6½ P. M.	A. M.	P. M.		5½ A. M.	1 P. M.	6½ P. M.
13	60	79	62	clear,	light showers,	W. S. W.	1° 42'	1° 28'	1° 42'
14	59	72	67	clear,	flying clouds,	N. W.	1 42	1 26	1 33
15	56	73	64	cloudy,	light showers,	N. W.	1 32	1 28	1 28
16	55	71	66	cloudy,	some cloudy,	West.	1 38	1 28	1 30
17	52	80	69	clear,	clear,	W. N. W	1 30	1 28	1 30
18	55	85½	83	clear,	clear,	West.	1 41	1 28	1 35
19	56	89	82	clear,	flying clouds,	S. W.	1 40	1 28	1 35
20	63	80	74	clear,	cloudy,	S. S. W.	1 40	1 25	1 35
21	70	82	77	clear,	cloudy,	South.	1 42	1 28	1 30
22	72	86	75	cloudy,	some cloudy,	West.	1 40	1 28	1 35
23	65	88	77	clear,	clear,	East.	1 41	1 23	1 36
24	72	86	77	rain,	clear,	W. S. W.	1 43	1 25	1 35
25	69	83	80	clear,	clear,	N. W.	1 41	1 15	1 32
26	66	88	79	clear,	cloudy,	West.	1 40	1 23	1 35
27	69	80	76	clear,	shower,	West.	1 41	1 30	1 37
28	64	86	80	clear,	clear,	West.	1 42	1 24	1 30
29	66	87	78	cloudy,	clear,	West.	1 41	1 21	1 30
30	69	90	79	clear,	showers,	W.			

By inspecting the above table, it will be seen that the va-
ıtion of the needle, sometime previously found at any place,
nnot be relied upon to run the line with ; hence the neces-
y of knowing its variation at the time the line is being run.
› guard against errors of this kind, the surveyor would do
:ll, at the end of each line or point where the variation of
: needle is found, and a line to be run from it at some fu-
re day or hour, to take a bearing on some object in the
rection of his line if it can be had, if not, on some other
ject, and make a note of the same. On resuming his
›rk, he can (if the sun should be obscured by clouds so as
prevent finding the variation of the needle,) observe the
me bearing again, and the difference in its course, if any,
the diurnal change, and must be allowed for on the course,
extending the line.

Local causes, also, so frequently change the direction of
e needle that it is not safe to extend a line far without an
servation to find its declination, and it will frequently be
ınd that a little delay for this purpose will more than com-
nsate for all the supposed advantages of running the line
thout it.

Commencing and executing surveys.

In all surveys made with the Solar Compass, the latitude
the starting point should be determined by the same instru-
ent with which the survey is to be executed, and the sur-
yor should remember that in running any other than an
st and west line, he is continually changing his latitude,
d that every ninety-four chains of northing or southing,
ll change his latitude one minute of a degree, or 5 minutes
d 12 seconds for six miles, and a corresponding change
latitude must be set off on the latitude arc for any other

distance, when an observation is made, to find the variatio of the needle or for running lines by the solar apparatus.

How to compensate for difference of latitude.

To expedite business however, the following adjustme and method of compensating for the changes of latitude f one minute has been successfully practiced.

At or near noon, set the Solar Compass for an observatio and see that the sun's image falls precisely between t lines on the silver plate, then alter the declination on t arc one minute, then by means of the leveling screws at t ball and socket, bring the sun's image between the lines the plate again, and observe how much the bubble has m ved in the N. and S. or latitude level, to make one minu difference of latitude, and mark the same on the edge of t opening; this should be done both ways from the middle the opening, and when done, it may be used for a change latitude, instead of so frequently setting off the difference latitude on the latitude arc. During the progress of a su vey, the surveyor should, if the weather permit, make observation every day at noon, to see if his latitude is rig and it is very important to a good observation, between t hours of nine o'clock A. M. and three o'clock P. M., to ha the latitude very accurately set off on the latitude arc.

Where the country to be surveyed is open, and t weather permits, it is best to run the lines by using the so apparatus instead of the needle, thereby avoiding all cau that affect the direction of the latter.

Directions to purchasers of Solar Compases.

Inasmuch as certain proportions, adjustments and fixtu are indispensable to a good Solar Compass, I will point th out, and leave the purchaser to apply the same, to any strument of this kind. In doing this, I cannot do better th

give the proportions, &c., of the improved Solar Com-
ass, referred to in the preceding pages, while treating of
s adjustment.

The latitude arc has a radius of five inches, and its divi-
ons to every fourth of a degree, and has a vernier, that
eads to minutes.

The declination arc has a radius of four and three fourth
ches, and its divisions and vernier reads the same as on
e latitude arc.

The lenses have a focal distance of about five and one
ourth inches; consequently the brass plates that hold the
enses, are the same distance apart. An observation on the
un should be made, to see if the lenses give a clear and
ell defined image of the sun, without any penumbra about
, on the silver plate. The silver plates are attached to the
rass plates by three small screws to each, and are movable,
p or down, for the purpose of adjustment. The revolving
mb, on which these fixtures are placed, turns on a male
nd female centre, about one and three fourth inches long,
nd about three eighths of an inch in diameter, and does not
epend, as in some instruments, on a circular arc, for its
orrect movement.

The hour arc has a radius of two and a half inches, and
s divided into half degrees.

Two tube spirit levels, three and three fourths inches long,
nd about three eighths of an inch diameter, are placed on
he upper plate of the compass, at right angles with each
ther, and may be adjusted by means of screws at the end of
ach.

A clamp is attached to the socket of the compass, to keep
he upper plate, with the solar apparatus, from moving, while
he sights, with the lower plate, are turned in any direction

the line require to be run. The upper plate is also divid on its edge, to every five degrees of a circle, and has a bra centre pin, rising a little above the needle box; by this a rangement the surveyor can readily see the approxima course of any object in view, without turning the sights its direction.

A small hole is made in the side of the compass box, ne the north end of the needle, also in the edge of the upp plate, under the glasses, over the verniers, to let off, evaporate the sweat or moisture that may accumulate und these glasses, and obscure a clear reading of their divisions these holes may be stopped with paper, which will genera ly absorb the sweat, but if it does not, unstop the holes, a turn them a little upwards, and the dampness will disappe in a few minutes. The above proportions and fixtures, e perience has proved to be necessary to a good Solar Co pass; and these proportions ought not to be diminished, b may be enlarged with some advantage in point of accur cy.

Report of a Committee of the Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

REPORT ON WM. A. BURT'S SOLAR COMPASS.

The Committee on Science and the Arts, constituted by t Franklin Institute of the State of Pennsylvania, for t promotion of the Mechanic Arts, to whom was referred f examination a Solar Compass, invented by WM. A. BUR *of Mount Vernon, Michigan*: REPORT,

That they have examined the instrument of Mr. Bur which is a modification of that for which he received th

cott's Medal in 1835. The instrument in its principal arts has been already described. The improvements introduced by its inventor tend to render the instrument more imple in its use, and more permanent in its adjustments. The method is susceptible of any degree of accuracy disired. n the model submitted to the committee, which was the orkmanship of Mr. Wm. J. Young, the principle of reversion is applied throughout, and serves to remove all danger f index error in any of its adjustments. In a clear day, in latitude not yet determined, this instrument, without the se of a telescope, is adequate to the determination of latiude within two minutes, and differences of latitude perhaps o one minute. The line of sight being brought in the direction of an object, and the instrument adjusted for the sun's ctual declination, and the latitude of the place, (determined y a previous culmination of the sun with this instrument,) he exact azimuth from the true north or south is read, and he reading of the compass is of no further use than to serve s a check to the comparative azimuths determined astronomically, and also to furnish a permanent record of the variation of the compass for the particular station. The instrument is simple in its construction and use—requires, when properly understood, no inconvenient expenditure of ime—and in districts abounding in magnetic iron ore, is almost indispensable. It seems to be a very important improvement over the ordinary surveyor's compass, and deserving of great commendation. Above all, the committee annot omit to mention the exceeding value of surveys made with this instrument, in fixing the variation of the compass, nd thus furnishing, besides the particular result, viz: the oundary and contents of the field or plot, the permanent

record also of the magnetic variation. When such result are increased, and the instrument more generally used which its intrinsic merit fully warrants, a most importan addition will be made to the stock of our knowledge on thi highly useful element, viz: the magnetic declination an its periodical changes in a great variety of localities.

By order of the Committee.

WILLIAM HAMILTON, *Actuary.*

Philadelphia, Dec. 14, 1840.

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SURVEYOR GENERAL'S OFFICE,
Cincinnati, Dec. 7, 1840.

I have seen and examined Burt's "*Solar Compass,*" in vented by William A. Burt, Esq., of Michigan, and cons der it a very important and valuable improvement in th surveying compass. It has been in use in the survey of th public lands in this surveying district, for the last three o four years, by Mr. Burt and several others of my deput surveyors, and is found to be much superior to the compa in common use; and I take great pleasure in recommendin it to all who feel an interest in the advancement of scienc

E. S. HAINES,
Surveyor General.

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I have examined Mr. Burt's Solar Compass, and full concur in the opinion of it above expressed.

SAM'L WILLIAMS.
Chief Clerk.

We have used "*Burt's Solar Compass*" in surveying the ublic lands for the last two years, and take pleasure in earing testimony to its great superiority over the compass n common use.

JOHN MULLETT,
SYLVESTER SIBLEY,
JOHN HODGSON. } *Deputy Surveyors.*

Cincinnati, Dec. 9, 1840.

I have used Burts' "Solar Compass" since its first introuction, and have carefully observed its peculiarities, and ie principles on which it acts, and can, with confidence reommend it as *indispensable* to those engaged in running ing and standard lines in a new country; such as Indian oundary, state lines, and township lines of the public surtys, &c.; and much superior to the common compass, for l surveying purposes; and by carefully following the dictions for its adjustment and use, so plainly laid down in e foregoing pages, the Surveyor will feel a confidence in is instrument, which he cannot in ordinary surveying inruments, and which will continue to increase, as he bemes more and more acquainted with its use.

JOHN MULLETT,
Dep. Surveyor, U. S.

Detroit, Feb. 27, 1844.

This work for sale at the Surveyor General' office, Cinnnati, Ohio; Surveyor General's office at Dubuque, Iowa erritory; by Wm. J. Young, Philadelphia, and by Wm. Burt, Mount Vernon, Macomb County, Michigan.