Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR DIVISION

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Table I. Mean Sunspot Numbers for November 2001
[boldface = maximum, minimum]

Day	N	Raw	s.d.	K-corrected	s.d.	s.e.
1	36	142	6.8	111	3.4	0.57
2	33	154	8.8	120	4.0	0.70
3	30	152	8.6	123	4.9	0.89
4	41	165	8.2	132	3.8	0.59
5	31	174	6.8	145	4.6	0.83
6	33	186	7.9	147	3.4	0.59
7	30	220	11.6	169	6.4	1.17
8	25	239	12.6	**189**	5.6	1.12
9	31	213	9.3	174	4.8	0.86
10	31	220	10.9	174	3.9	0.70
11	26	190	14.1	150	5.4	1.06
12	23	181	9.6	143	2.4	0.50
13	31	174	8.8	132	3.6	0.65
14	28	169	9.0	132	3.6	0.68
15	26	149	9.9	118	4.0	0.78
16	29	140	7.0	109	3.5	0.65
17	32	129	6.3	101	3.3	0.58
18	28	139	7.1	109	3.4	0.64
19	28	119	7.5	92	3.3	0.62
20	28	107	6.7	83	2.9	0.55
21	31	116	5.8	92	3.1	0.56
22	27	143	7.4	112	3.5	0.67
23	32	125	5.9	103	3.0	0.53
24	28	97	4.7	**77**	2.4	0.45
25	30	110	4.5	91	2.9	0.53
26	24	114	7.0	86	3.3	0.67
27	24	111	6.4	88	3.3	0.67
28	20	172	11.7	131	6.1	1.36
29	17	192	13.2	146	7.9	1.92
30	16	180	14.4	148	6.6	1.65
31	---	---	---	---	---	---

Means: 157.4 124.2

Total No. of Observers: 62

Total No. of Observations: 849

Table II. November Observers

```
12 AAP  P.Abbott
 9 ANDE E.Anderson
11 BARH H.Barnes
 8 BATR R.Battaiola
10 BEB  R.Berg
 7 BEGM M.Begbie
 2 BLAJ J.Blackwell
 7 BMF  M.Boschat
20 BOSB B.Bose
21 BRAB B.Branchett
21 BRAR R.Branch
17 BROB R.Brown
 2 BURS S.Burgess
19 CARJ J.Carlson
30 CHAG G.Morales
17 CKB  B.Cudnik
 7 CLZ  L.Corp
16 COMT T.Compton
26 CR   T.Cragg
 5 DEMF F.Dempsey
20 DGP  G.Dyke
22 DRAJ J.Dragesco
23 ELR  E.Reed
15 FEEC C.Feehrer
 9 FERJ J.Fernandez
19 FLET T.Fleming
23 FUJK K.Fujimori
22 GIOR R.Giovanoni
11 GOTS S.Gottschalk
 4 HALB B.Halls
 3 HAYK K.Hay
14 HRUT T.Hrutkay
25 JAMD D.James
14 JEFT T.Jeffrey
19 KHAR R.Khan
 1 KUZM M.Kuzmin
12 LARJ J.Larriba
10 LERM M.Lerman
15 LEVM M.Leventhal
13 MALK K.Malde
 7 MARE E.Mariani
26 MARJ J.Maranon
26 MCE  E.Mochizuki
 7 MILJ J.Miller
16 MMI  M.Moeller
 4 MUDG G.Mudry
17 OBSO IPS Obs.
10 RICE E.Richardson
22 RITA A.Ritchie
 7 SIMC C.Simpson
 2 STEF G.Stefanopoulis
15 STQ  N.Stoikidis
24 SUZM M.Suzuki
 2 SZAK K.Szatkowski
 6 SZUM M.Szulc
20 TESD D.Teske
 5 THR  R.Thompson
13 URBP P.Urbanski
13 VALD D.delValle
18 VARG A.Vargas
15 WILW W.Wilson
13 YESH H.Yesilyaprak
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Reporting Addresses

Sunspot Reports **-- email:** solar@aavso.org
postal mail: AAVSO, 25 Birch St. Cambridge, MA 02138
FAX ***(AAVSO):*** (617) 354-0665

SES Reports **-- email:** noatak@aol.com
postal mail: Mike Hill
114 Prospect St. Marlboro, MA 01752

Magnetometer Reports **-- email:** capaavso@aol.com
postal mail: Casper Hossfield
PO Box 23, New Milford, NY 10959
FAX: (973) 853-2588 or (407) 482-3963

Table III. Means of Raw Group Counts (RG) and Ratios of Spots to Groups (S:G) in November

ay	RG	S:G	Day	RG	S:G	Day	RG	S:G	Day	RG	S:G
1	5.9	14.1	9	10.8	9.7	17	8.2	5.7	25	6.8	6.2
2	6.2	14.8	10	12.0	8.3	18	8.4	6.6	26	6.1	8.7
3	6.0	15.3	11	10.6	7.9	19	6.8	7.5	27	5.7	9.5
4	7.0	13.6	12	10.1	7.9	20	6.4	6.7	28	8.0	11.5
5	8.3	11.0	13	10.1	7.2	21	6.9	6.8	29	10.1	9.0
6	8.8	11.1	14	10.1	6.7	22	7.6	8.8	30	9.6	8.8
7	10.4	11.2	15	8.9	6.7	23	7.6	6.4	31	---	---
8	11.4	11.0	16	8.8	5.9	24	5.8	6.7	Mn.	8.3	9.0

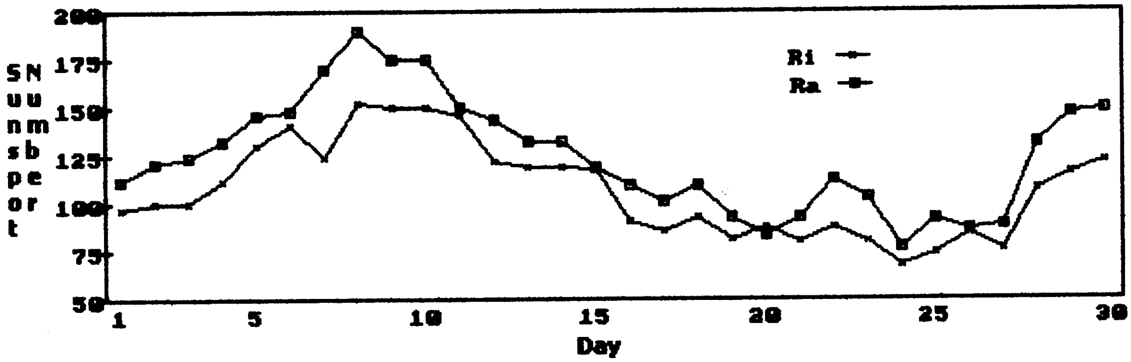

Fig. 1. Comparison of Ri (provisional) and Ra Estimates for November.
(Ri Source:http://sidc..oma.be/index.php3)

Smoothed Mean Sunspot Number (Rsm) for May 2001: 118.5

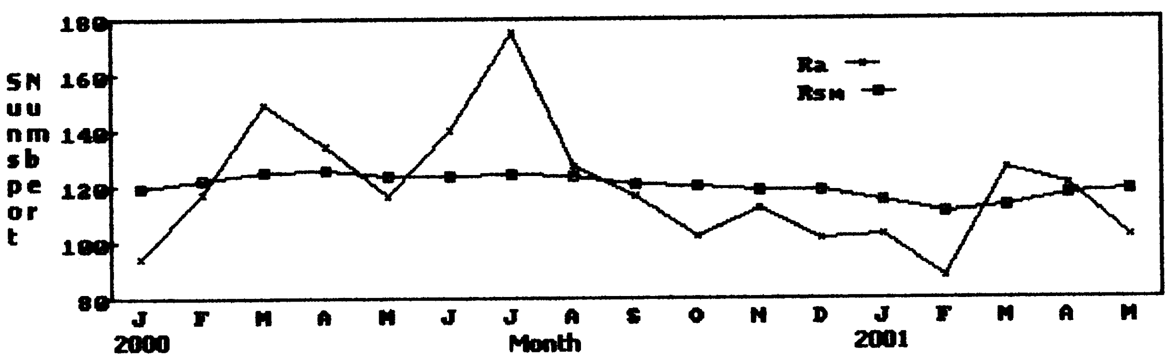

Fig. 2. Monthly Ra and Smoothed Mean Sunspot Numbers (Waldmeier method).

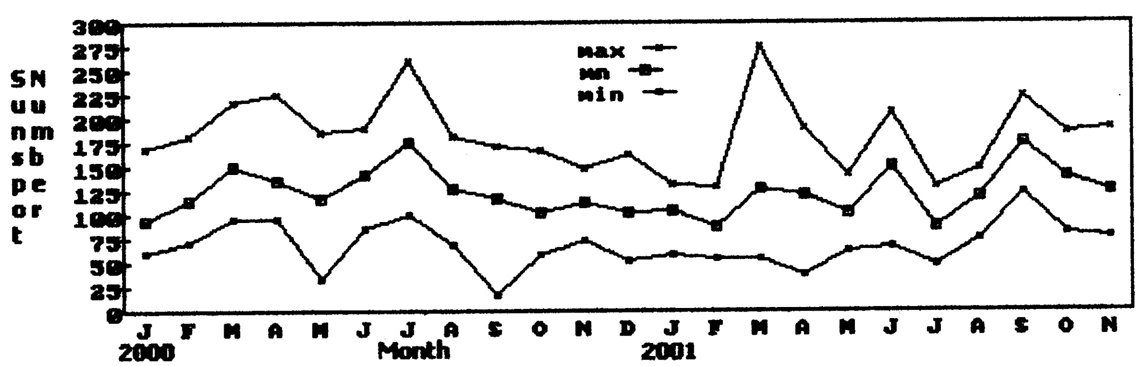

Fig 3. Maximum, Mean, and Minimum Ra Values for Each Month from January 2000 to Present.

Sudden Ionospheric Disturbance Report

Michael Hill, SID Analyst
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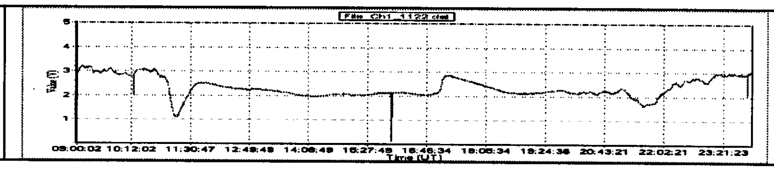
Marlborough, MA 01752 USA
noatak@aol.com



Sudden Ionospheric Disturbances (SID) Recorded During November 2001

(Analysis performed by Michael Hill, SID Analyst)

Date	Max	Imp	Date	Max	Imp	Date	Max	Imp
011201	0652	1+	011208	0704	2	011221	1111	1
011201	1208	2+	011208	0754	1-	011221	1818	1+
011201	1410	2	011208	1020	1-	011222	1709	3
011201	1933	1+	011208	1042	2	011224	1800	2
011201	1943	2+	011208	1230	3	011225	0940	2+
011202	0805	2+	011208	1408	2+	011225	1000	2
011202	1706	1-	011208	1502	2+	011225	1538	1
011203	1530	1-	011208	1903	1+	011227	1548	2
011203	2032	2+	011208	1935	1+	011228	1450	1
011204	0645	2	011209	0631	2	011228	1546	1+
011204	1353	2	011209	0943	3	011228	1639	2
011204	1540	1+	011209	1837	2+	011229	0526	2
011204	1614	3	011210	1955	2+	011229	1038	2+
011205	0915	1+	011211	1534	2	011229	1406	1
011205	1144	2+	011211	1735	1-	011229	1807	2
011205	1507	2+	011211	1754	2	011230	1412	2
011205	1806	2	011211	1903	2+			
011205	2103	2	011213	0630	2			
011206	0300	2+	011213	0927	2			
011206	1353	1+	011213	1703	2			
011206	2108	3+	011214	0926	2+			
011207	1535	1	011214	1801	2+			
011207	1807	1	011220	1357	2			
011207	1959	2	011220	1440	2			
011207	2150	2+	011221	0842	1			

The events listed above meet at least one of the following criteria

1) Reported in at least two observer reports
2) Visually analyzed with definiteness rating = 5
3) Reported by overseas observers with high definiteness rating

Observer	Code	Station(s) monitored
A. Clerkin	A29	NAA
J. Winkler	A50	NAA, NPM
D. Toldo	A52	NAA, NWC
J. Ellerbe	A63	ICV
A. Panzer	A83	NAA
W. Moos	A84	FTA
M. Hill	A87	NAA
T. Poulos	A95	NAA
R. Battaiola	A96	HWU
J. Wallace	A97	NAA
M King	A99	GQD

Importance	Duration (min)
1-	< 19
1	19 – 25
1+	26-32
2	33-45
2+	46-85
3	86-125
3+	> 125

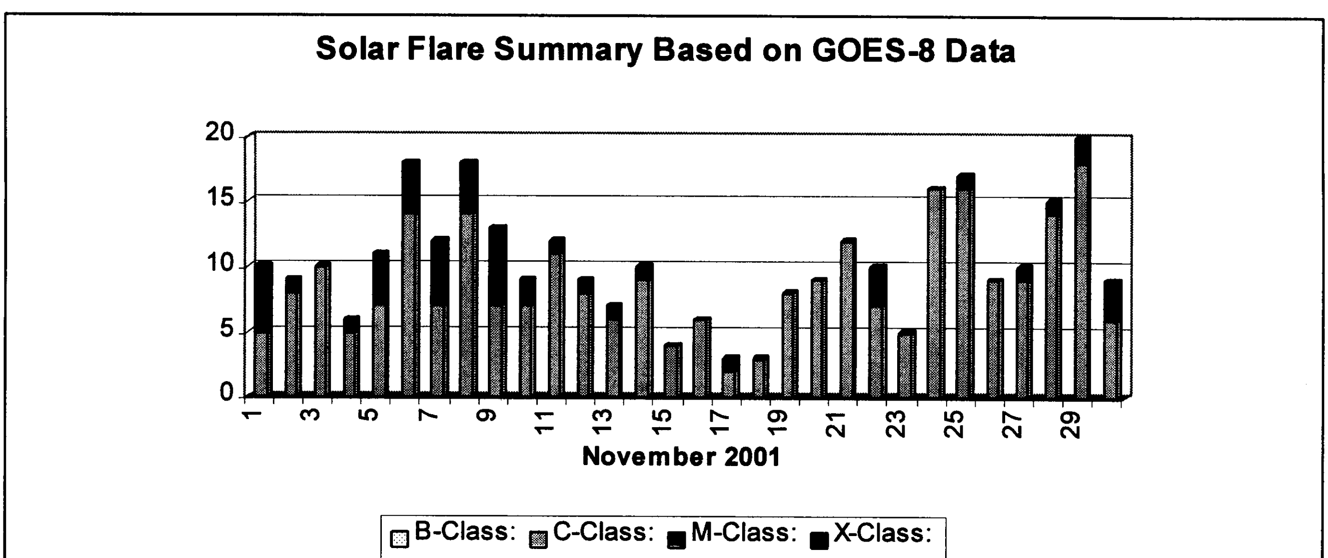
Solar Events

Although the sun has been active this month with a few notable large flares there were far less SID events than the last two or three months have seen. There were a total of 308 X-Ray events recorded by the GOES-8 spacecraft. Of those, 43 were M-Class events along with 2 X-Class events. Analysis of observer's reports resulted in 66 correlated SID events. Most of these had an importance rating of 2 and 2+ but there were four events with an importance rating of 3 and one of 3+. From this it can be readily seen that, in a qualitative sense, our data quite closely matches the GOES-8 flare data, and I see this as a testament to the strength or our current observing group. Keep up the good work.

I would also like to ask at this time that all observers make sure, if you do not do so already , to follow the prescibed guidelines with respect to report generation and the format of such reports. All reports must be in standard AAVSO format. Data analysis programs expect not only certain contents but that the contents be located in certain colums. Other guidelines server to make the job of analysis easier on the analyst. That's me guys. Whether you use an existing report generation program, of which there are now a number of options, or one of your own creation, these guidelines must be followed

- Proper formatting as defined in SID Bulletin Vol56 #8 (Aug 2000) or at the AAVSO web site at the following link: http://www.aavso.org/committees/solar/reducing.stm.
- One station of data per report
- Filename to follow the convention: AxxxNNN.dat
  where xxx = observer ID, NNN = station
  i.e. A87NAA.dat
  (files with **.txt** extensions are also accepted)
- If possible eliminate reports of stations with unknown designation, currently labeled as staion XXX. I would rather keep records based only on known stations. This is just a request.

That said, I wish you all a happy holiday seaon and of course a Happy New Year.
Good observing to all.



SOLAR BULLETIN of the American Association of Variable Star Observers. Vol. 57, No 11, November, 2001

SUDDEN IONOSPHERIC DISTURBANCES SUPPLEMENT

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SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING NOVEMBER 2001

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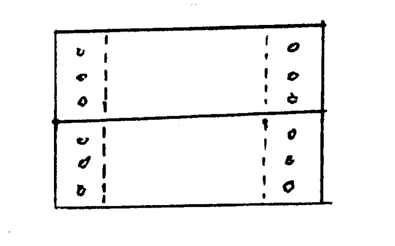
The McWilliams Torsion Balance magnetometer

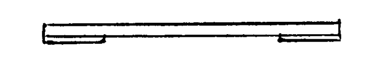
A new Solar Division kit is now available for those who would like to build a McWilliams torsion balance magnetometer. This is a simple but nevertheless accurate and sensitive magnetometer that has been used by the AAVSO Solar Division for over 20 years. It will make magnetograms that will look exactly like those made by a nearby US Geological Survey Magnetic Observatory that uses professional fluxgate magnetometers. The price of the kit is $5 and includes Software on floppy disks to record the magnetogram on a computer at the standard chart speed of ¼ inch/hour in Rustrak chart recorder format. The hard to find .006-inch diameter music wire needed for the torsion wire also comes with the kit as well as a hard copy of these 6 pages of complete instructions how it can be built. The drawings and instructions that follow are meant to be a guide and need not be followed exactly. I have tried to give complete detailed instructions how you can build it, set it up and adjust it but if you run into any problems please contact me at my address above for help. What I show are sketches and dimensions I used that were good enough to produce a good working magnetometer. The drawings are hand sketches that are not to scale. They are only meant to give you a rough idea what the magnetometer will look like. Most people who would build a homemade magnetometer are not apt to follow somebody else's plans very closely anyway. I made my magnetometer from wood and brass hardware because it is nonmagnetic (a requirement) and easy to put together. I used wood in sizes I found at Home Depot and in a hobby shop that catered to adults who fly radio controlled model airplanes. The text below provides other sources for the materials you will need. There are also instructions how to set up and test the magnetometer and how to avoid some common problems.

CHH

1) THE BASE.

The base for the magnetometer is made from two pieces of pine that are ¾" X 5 ½" X 16". These are held together with two cross pieces of Aspen ½" X 2 ½ X 11" fastened from the bottom with flat head brass wood screws. The reason for making the base from two pieces is to prevent warping.



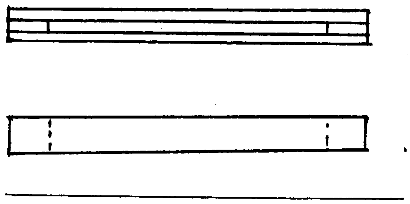


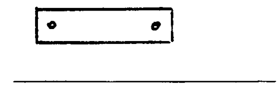
Top and side views above of the base are shown above held together with 12 #8 brass flat head wood screws 1" long.

2) THE TORSION WIRE SUSPENSION MAST.

The mast is made from two pieces of small size Aspen wood that is carried by Home Depot. The slotted mast is formed from two pieces ½" X 1 ½" X 14" with 1" long spacers of the same size wood at either end.

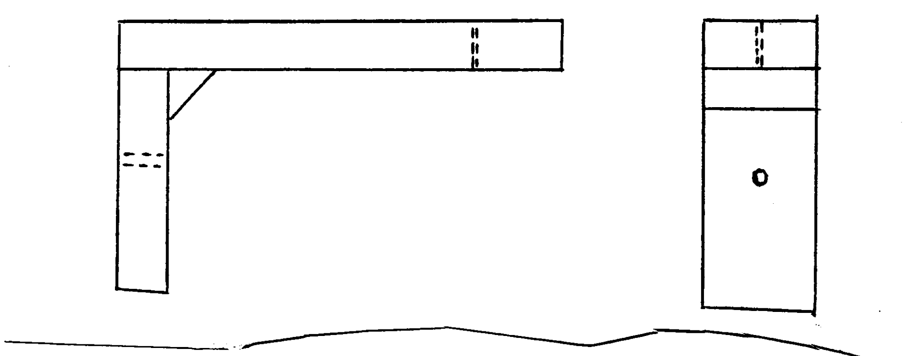
The two 14" long pieces and their spacers are held together with 5-minute Epoxy glue from Home Depot. After the glue is hard the mast is glued to a small base made from the same size Aspen 5" long with two holes for mounting on the base with the same size brass wood screws mentioned above. It is important to mount the mast so the torsion wire it will suspend will hang exactly over the center of the base board.





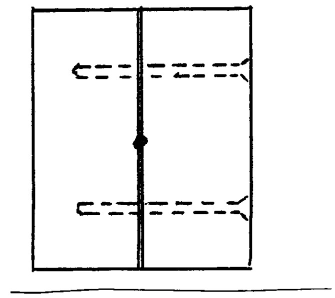
The mast is made slotted so the cross arm that suspends the torsion wire can be adjusted up and down to vary the sensitivity of the magnetometer. Sensitivity is directly proportional to the length of the wire and varies as the fourth power of the diameter. In the past a 15" length of guitar string from a music store has been used as the torsion wire. The thinnest these come is .008" diameter. I managed to buy a spool of .006" diameter music wire from a company that sells piano repair parts. They were reluctant to sell it to me. I had to go to their supply house in person and pay cash. This hard to get .006 music wire comes with the kit. Because the spring constant as a torsion wire varies as the fourth power of the diameter, the .006 wire needs to be only about 5-inches long to equal the sensitivity of the 15-inch long .008 wire. The 14-inch slotted mast allows enough adjustment to accommodate 10-inches of torsion wire which should provide more than enough sensitivity. If the magnetometer is too sensitive it will go off scale when there is a big magnetic storm. It is best to start off with the cross arm adjusted for about 5-inches of .006" torsion wire. You can then adjust it for greater sensitivity if you would like to experiment. At normal sensitivity it will make tiny blips when cars pass by on the street at a distance of 20m.

3) THE TORSION WIRE SUSPENSION CROSS ARM



The cross arm is made from ½" Aspen 2 ½" wide. Side views are shown above. The horizontal arm is 6" long and the vertical piece is 1 ½ " long. These are glued together with 5-minute epoxy and reinforced with 3/8" diagonal-cut Balsa wood from the hobby shop (see below). A ¼" hole is drilled centered in the 1 ½" long end for the clamp screw. A clamp plate for the other side of the mast is ½" Aspen 1 ½" wide X 2 ½" long with a ¼" hole in the center. A ¼" brass nut and machine screw 3" long clamp the cross arm to the mast. A 1/16" hole is drilled in the middle of the cross arm 4" from the back end for the 1/16" X 1 ¼" brass tube that centers the torsion wire over the center of the base. The wire therefore hangs centered 8" from either end of the base and 5 ½" from either side. The damping bowl and wind screen are then centered on the base and the magnetic needle and shadow vane swing in the center of the instrument with the damping vane in the center of the damping bowl. The magnetometer should be set up to record magnetic storms with its base oriented so the 16" length runs east and west.

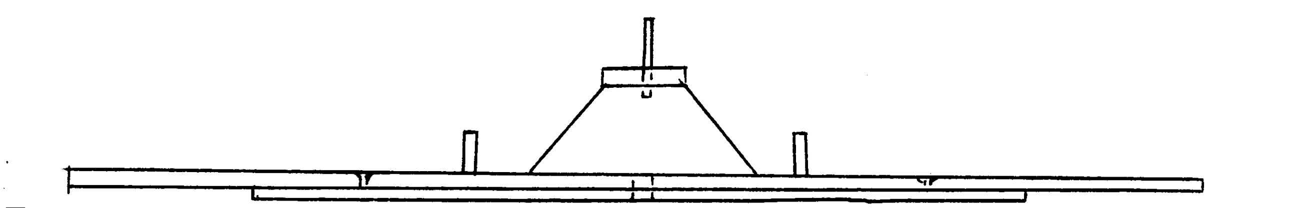
4) THE TORSION WIRE CLAMP BLOCK.



The torsion wire clamp block above sits on top of the cross arm and can be rotated to adjust the torque so the needle points east and west and the shadow vane is centered over the photocells. Two pieces of pine wood 1 ½" wide X 2" long X ¾" thick are clamped together by two #8 brass wood screws 1 ½" long to make the clamp block. This is the same wood used to make the base. With the clamp screws tight, a 5/64" hole is drilled1/2" deep centered where the two pieces meet. This is a guide hole that keeps the torsion wire clamp block centered over the brass tube while it clamps the torsion wire that comes up through the brass tube. The clamp screws are loosened and the torsion wire threaded up through the brass tube and clamp block to adjust the height of the needle so the shadow vane swings about ¼" above the photocells. A piece of scotch tape on the wire makes it easy to hold while it is adjusted. An important safety measure is to put another piece on the end of the wire so it don't poke you in the eye. The wire can be shortened by breaking off a piece. Hold it in pliers and bend it back and forth. Do not try to cut it with scissors or wire cutters. It is very hard and will dent the cutter blades.

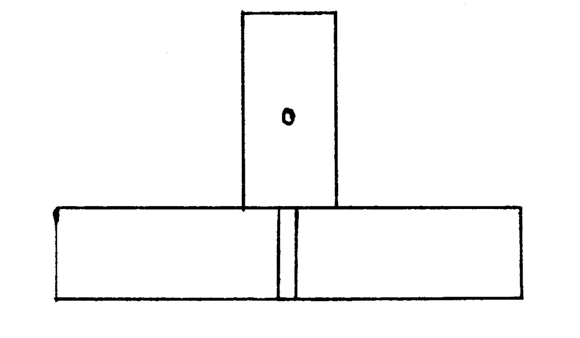
5) THE SHADOW VANE.

The shadow vane is made in two pieces held together with two brass flat head 4-40 machine screws and nuts. The upper half holds the ¼" X 4" Alnico 8 magnet which you can get from McMaster Carr Supply Company, their part #57305K74 for US$12.75. Order it with a credit card from their web site: <<WWWmcmaster.com >> By telephone 404 346 7000. By mail PO Box 740100, Atlanta, GA 30374 USA. The strength of all magnets varies with temperature and Alnico 8 is the least sensitive to temperature and causes the least drift in the magnetometer's zero line. The spring constant of music wire also varies with temperature so also causes drift unless temperature is maintained constant. Usually placing the magnetometer in a basement provides sufficient temperature regulation. If not, try making a Styrofoam box to enclose the magnetometer. To make the shadow vane you will need both Spruce (or Basswood) and Balsa wood 1/8" X ¾" wide. The shadow vane is glued together with Cyanoacrylate glue from Home Depot or the hobby shop. Balsa wood sticks better than Spruce when using Cyanoacrylate glue.



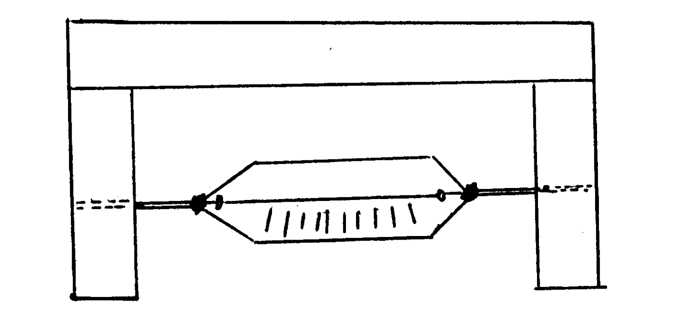
The sketch above shows a side view of the shadow vane. You can find brass tubing and all the wood for the shadow vane and damper at a hobby shop that caters to adults who build and fly radio controlled model airplanes. You will need a tiny model makers miter box and saw to cut the wood and a tiny saw with very fine teeth to cut the brass tubing so get these at the hobby shop while you are there. If a hobby shop is not near where you live you can order these things from "Balsa USA" at WWW.balsausa.com with a credit card or call 906 863 6421 for a catalog. Their postal address is PO Box 164, Marinette,WI 54153. Starting at the top of the shadow vane is a small block made from two pieces of spruce 1" long (all wood in the shadow vane is 1/8" thick X ¾" wide). The two pieces are glued together with Cyanoacrylate to make a ¼" thick block with a 1/16" hole in the center for the 1/16" X 1" long brass tube. The tubing block is glued to the top of two 45-degree Balsa supports that are glued to the middle of the shadow vane. Before any gluing is done the top piece of the shadow vane which is Spruce 12" long should be fastened to the bottom piece which is also Spruce and 7" long, with two brass flat head 4-40 machine screws. Countersink these screws so they don't stick up and interfere when you later slide the magnet in. Drill holes for these screws 3-inches from the ends of the top shadow vane piece. With the two pieces held together tightly with the screws, drill a 3/16" hole at the middle of the shadow vane but off to one side so the music wire can come down through the brass tube and go around the magnet to reach its anchor below. Glue the two 45-degree Balsa supports and the brass tubing block to the center of the top12" shadow vane piece. The brass tube should then be directly above the off-center 3/16" hole and centered on the shadow vane. Cut two pieces of Balsa ½" long and drill ¼" holes in their centers. With a sharp knife extend the holes out to one end. Glue these 1 ½" from the center of the shadow vane. They hold the magnet in the middle of the shadow vane but allow it to slide to balance the shadow vane so it hangs horizontal.

6) THE DAMPER



A side view of the damper is shown above. It is made from 1/8" X 3/4" spruce. There are three pieces. One piece is 4" long and two pieces are 1 15/16" long. Glue these together in the shape a plus sign with epoxy. The damper is hung from the center of the 7-inch bottom piece of the shadow vane on a piece of 1/8" X ¾" Spruce 1 ½" long. This is also glued with 5-minute epoxy. A hole is drilled in the center of this piece for a 6-32 brass machine screw and nut that anchors the bottom end of the torsion wire. The nut is epoxied to the side of this piece on the side opposite the off-center 3/16" hole. The torsion wire is then threaded down through the brass tube and off-center hole to the 6-32 screw where it is clamped between two brass washers. The ¼ X 4" Alnico magnet is then slid through its two holders passing the torsion wire to a position where it balances the shadow vane horizontally. Handle the .006" music wire carefully so it stays straight without any kinks. It is also dangerous to handle because it is strong and very thin and can cut like a knife. The damper bowl is a 1-quart Pyrex bowl 6" in diameter and 3" high from the supermarket. The large bowl and damper allows water to be used as the damping fluid instead of oil if this is desirable. Water makes less of a mess if you spill it.

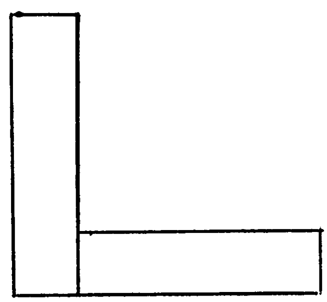
7) THE LIGHT SOURCE.

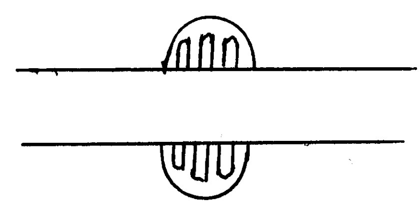


The light source is a 12-Volt dome light bulb that you can find at an auto parts store. This should be the type with a straight filament and terminals at each end such as Sylvania DE3021.The sketch above shows the light source holder made from two pieces of Aspen ½" thick by 1 ½ wide and 2" long for the sides and one piece 3" long for the top. Holes are drilled in the sides and the bulb mounted on its connection wires with solder. The connecting wires are from 24" test leads you can buy at Radio Shack. A 12-Volt DC, 500 milliamp Radio Shack wall-type power adapter (part # 273-1773) powers the light source and also the Wheatstone bridge motion sensor. The light source sits on top of the wind screen above the photocells.

8) THE PHOTCELL HOLDER.

The two Cadmium Sulfide photocells are from Radio Shack, part #276-1657. They are mounted on a holder made from two pieces of Aspen 2 ½" wide and 2 ½" long as shown below. The photocells are connected in series and three wires brought out beneath the wind screen to connect to the Wheatstone bridge. Use the same 24" test lead wires as were used for the light source.



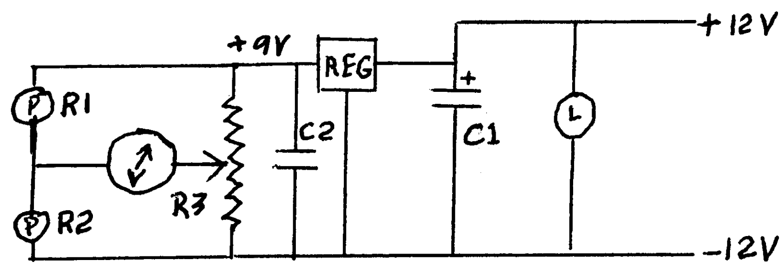


The wires of the photocells are glued to the holder with 5-minute epoxy glue so their active surface is 3 ½" above the base of the magnetometer. This is more easily done if you glue the first one in place and let the glue harden. Later the second one can be set and glued so their surfaces are the same height. It is very important to line the photocells up so their linear pattern is perpendicular to the axis of the shadow vane as shown in the sketch above. In its neutral position the shadow vane should cover ½ of each photocell. The photocells are half shaded by a ¼" X 1" extension 1/64" thick on the shadow vane. This is made from model airplane Birch plywood 1/64" thick from the hobby shop. It can be cut to size with scissors. Buy a small sheet of this and there will be enough to enclose the light source so it don't blind you when you make adjustments. Do not enclose it entirely. Air needs to circulate to cool the light source bulb. The photocells are variable resistors that are one pair of four resistors that make up the Wheatstone bridge motion detector. Their resistance is determined by how much light from the light source falls on them. If the shadow vane covers half of each cell their resistances are equal and the bridge is balanced and no current flows in the output meter which can be a center reading voltmeter. Solar activity such as solar flares or coronal mass ejection's can radiate charged particles that become trapped in the Earth's magnetic field and set up their own magnetic field which can either add to or subtract from the Earth's comparatively constant magnetic field. If its polarity is such that it adds to the Earth's field the shadow vane will rotate in a direction that lines it up in a more north-south direction. This will allow more light from the light source to fall on one photocell and less on the other. This will unbalance the bridge and current will flow in the voltmeter. If the charged particles set up a magnetic field that subtracts from the Earth's, the total field strength will be diminished and the torsion wire will rotate the shadow vane in the opposite direction and unbalance the bridge so the voltmeter swings in the other direction from its neutral point. The Wheatstone bridge motion sensor therefore indicates the polarity of the changed particle field as well as its intensity. The magnetometer can be calibrated with a Helmholtz coil so the intensity can be read in absolute units, nanoteslas, nT, so the recording can be compared with magnetograms made by the nearest US Geological Survey Magnetic Observatory.

9) THE WIND SCREEN

The shadow vane must be protected from air currents. I have used Plexiglass from Home Depot that is 3/32" thick to make my wind screen. It is a rectangular bottomless box 6 ½' X 15" X 5 ½" high. It is centered on the 16 X 11" base and held in place by eight ½" lengths of 3/8" diagonally cut Balsa wood. In other words the cross section of the strip of Balsa wood is half of a 3/8" square cut along a diagonal. Eight ½" lengths, two at each corner, center the wind screen on the base board and are glued to it. Four center the Pyrex damper bowl on the base and within the wind screen. Eight more ½" long hold the top in place. Four pieces 5 ½" long of this same diagonal balsa wood is used to glue the four corners of the 6 ½" X 15" bottomless box that is the wind screen. The top is made in two pieces each 7 ½"long. A small round file is used to make clearance for the torsion wire where it passes between the two top covers. Clearance for the three wires from the photocells to pass under the wind screen is also made with the small round file. Make clearance holes just big enough in the hope you can keep spiders from getting in and making webs on the shadow vane. It is not unusual for this to happen eventually. If you notice the magnetometer seems to have lost sensitivity check for spiders doing their thing and get rid of them.

THE WHEATSTONE BRIDGE MOTION SENSOR.



The resistance of the photocells is about 12000 ohms when shaded and about 1300 ohms when illuminated by the light source. The two in series are about 5000 ohms when half of each is shaded. The 5000 ohm potentiometer is used to center the output voltage on the recorder scale when there is no storm. The 9-Volt voltage regulator maintains a constant voltage across the Wheatstone bridge. R1 and R2 are the Cadmium Sulfide photocells available from Radio Shack, part #276 – 1657. R3 is a 5000 ohm potentiohmeter. C1 is a 35 V 470 mfd electrolytic capacitor and C2 is 0.1 mfd. The voltage regulator is 9 V. If you have trouble with the light source bulb not lasting very long put a resistor in series with it to cut the voltage down.

11) SETTING UP AND ADJUSTING.

Push one end of the .006 music wire down through the1/16" brass tube in the shadow vane and through the off center 3/16" hole. Clamp the end between two brass washers on the 6-32 anchor screw. Push the other end up through the brass tube on the cross arm and on up through the torsion wire clamp. A piece of scotch tape on the torsion wire about an inch above the clamp will make it easier to adjust the wire so the shadow vane extension is over the photocells and clears them by about 1/8". Set the magnetometer so the 16"length of its base is along an east and west line. Determine which end of the magnet is the north-seeking end by suspending it on a thin thread. Slip the magnet into the shadow vane and set it so the vane is level and clears the photocells by about 1/8". The north-seeking end will swing toward the north. Rotate the torsion wire clamp to bring the shadow vane back to point east and west and with the shadow vane extension centered over the photocells. Find a place for the magnetometer where temperature is relatively constant and as far from driveways as possible. Cars moving in and out of driveways put offset in the magnetometer trace. If you live alone you can park your car on the street. If you have nearby neighbors or a family with several cars you will probably just have to learn to live with the offsets, unfortunately. If cars move on a regular schedule you can correct the offsets with pieces of iron near the magnetometer.

When you have the magnetometer working and make your first good recording of a magnetic storm please send me a copy to publish in the SID Supplement section of the Solar Bulletin.