No.1. SQDN.
'A' FLIGHT.

Form 619.

1740899 SGT. J.S. HITCHCOCK.

Navigation.

ROYAL AIR FORCE.

Small Notebook for use in Schools.

T. 4154. Wt. IIIII. 2/39.

Navigation.

Leeds ~~1°38'W~~	53°47'N	01°33'W.
St. Annes Head	53°22'N	03°55'W.
Heligoland	54°12'N	08°06'E.
Luxembourg	49°37'N	06°08'E
Dunkerque	51°03'N	02°25'E
Kiel	54°20'N	10°10'E
Pointe Hauke Race	50°23'N	01°34'E.

Outer Gabbard

Shiltgat

Bee's Head.

Change of Lat. & Long.

Ch. of Lat. is arc of merid. intercepted by //s of Lat. through the two places. If going from N-S ch. is S, if S-N ch. is N.

Ch. of Long is smaller arc of equator intercepted between merids. of the two places named E or W.

For the same names, subtract to find change.

For different names, add.

Example. Ch. Lat. = 14°57'S, Ch. Long. 5°50'E.

Ch. Lat. = 20°42'N, 29°22'E

Ch. Lat. = 14°30'S, 344°57'W.

(15°03'E)

One point where rule does not apply is where ch. of long. is greater than 180°.

Ch. of long. = 320°W but with smaller arc it = 360−320°W = 40°E.

FROM	45°30'S	40°20'W
TO	60°27'S	15°30'E
Ch. lat.	14°57'S	Ch. long. 55°50'E

FROM	30°33'N	30°42'W
TO	51°15'N	01°20'W
Ch. lat.	20°42'N.	Ch. long. 29°22'E.
FROM	10°17'N	168°11'E
TO	04°13'S	176°46'W
	14°30'S	15°03'E.

Variation.

Methods of Calling.

1. Isogonals, lines joining points of similar variation.
2. Statement in words.
3. Compass rose.
4. Marginal diagram.

Estimate variation along the normal between the two isogonals. Correct for date.

Variation changes at different parts of globe. Also changes at same place with time.

West is a − variation, East is a + variation.

True	Var.	Mag.
182°	12°E.	170°
312°	−06°(W)	318°
130°	13°W	143
89°	09°W	098°

Deviation is ∠ between Magnetic meridian & axis of compass needle. East +, West −.

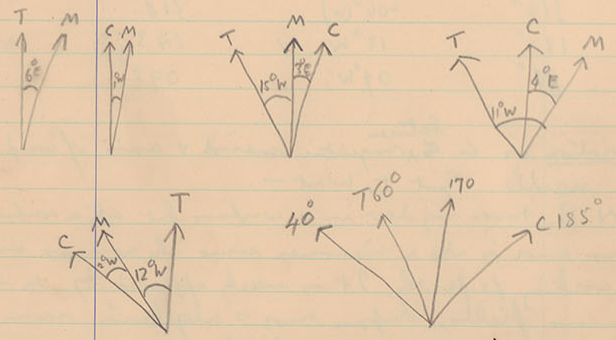
N.B. Never say dev. in a compass but at a compass. Compass error is also a misnomer since the compass may be working perfectly. It is merely affected by extraneous fields. Compass error = algebraic sum of V & D.

Two basic principles

1. Dev. in aircraft changes with course. 2. Magnetic fields produced in a soft iron bar affect the compass.

All bearings written in groups of 3 figures followed by M, T, or C.

T.	V.	M.	D.	C.
176°	13°W	189°	2°E	187°
254°	9°W	263°	3°E	260°
037°	+06°	031°	1°W	032°
008°	15°W	023°	3°E	020°
332°	+11°	321°	+4°	317°
358°	12°W	010°	2°W	012°



On a course of 170° the bearing of an object is 40° by bearing compass. The true bearing is 060° & the variation is 10°E. The course is 185° by pilots compass. Find deviation of pilots compass.

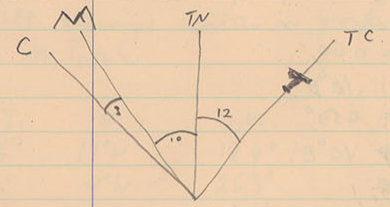
True bearing = 060
Variation = 10°E.
Magnetic = 050°
Deviation at B.C. = 10°E.

Course at Bearing Comp. = 170°
Mag. Course = 180°
Pilots Compass = 185°
Dev. at P.C. = 005°W.

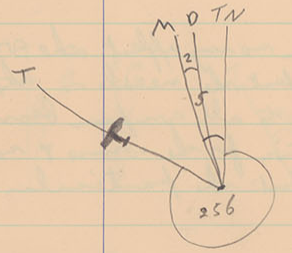
The bearing of an object can in no way affect the compass needle. What does affect the needle is the course of the aircraft ∴ to all compass bearings we must apply the deviation for the course & must look at the deviation against the particular bearing.

Problems.

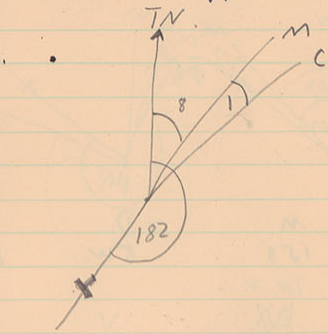
① T. Course	V	M.	D.	C.
012°	10°W	022°	3°W.	025°



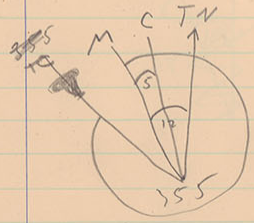
② TC.	V	M	D	C
256°	5°W	261	2°E	259.



③ TC.	V	M	D	C
182°	8°E	174°	1°E	173.

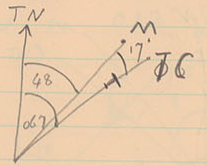


④ TC	V	M	D	C
355	12°W	007°	5°E	002°



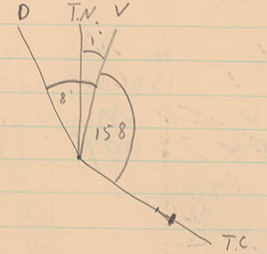
⑤

T.C.	V	M	D	C
067°	19°E	048°	—	048°



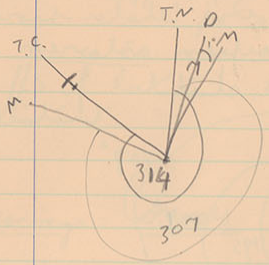
⑥

T.C.	V.	M.	D.	C.
159°	1°E	158°	8°W	166°



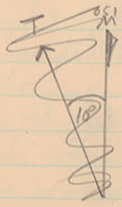
⑦

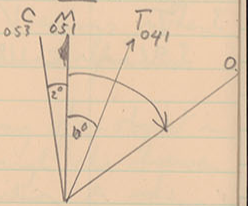
T.C.	V.	M.	D.	C.
314°	7°E	307°	1°W.	308°



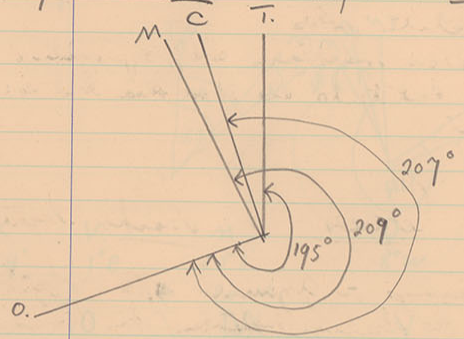
①

T.	V.	M	D.	C.
041	10°W	051°	2°W.	053°

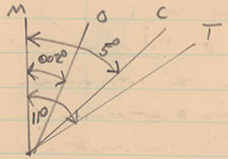




2. T. V. M. D. C.
195° 14°W 209° 2°E 207°



3. T. V. M. D. C.
351° 11°W 002° 5°E 357°



meridians

On navigation mercator st. lines converging towards the related poles. //s of latitude are curves concave // towards related pole.

On mercators meridians are // equidistant st. lines, //s of latitude are // st. lines but are not equidistant.

Bearings Courses & Tracks. Section 6.

Great Circle Bearing or Azimuth of an object is the ∠ at the observer between his meridian & the grt. circle joining his position to the object.

Visual bearing & wireless D.F. bearing when corrected for quadrantal error & coastal refraction are great circle bearing.

Mercatorial or rhumb line bearing of an object is the ∠ between the meridian through the observer & the rhumb line joining his position to the object. Only on mercators projection is a rhumb line laid down accurately as a straight line. The Course of an aircraft is the ∠ in the horizontal plane between the meridian through the aircraft & the ~~effective~~ fore & aft ~~line~~ axis (abbrev. is Co.)

Track of an aircraft is the ∠ in the horiz. plane between the meridian through the aircraft & a line representing the actual path of the aircraft relative to ground.

Bearings, courses & tracks should be taken from maps & charts with reference to the line of geographical meridian, but for obvious reasons the readings in a plane are refered to one of the two compasses which the plane usually carries.

Measurement of Lat & Long.

Long.

Kolberg. 1/2 scale 15°36'E, 15°34'E.
1/1 mle. Bolton Dale 15°33'E 15°36'E

Always measure from nearest meridian to the nearest scale.

Wind straight edge, 15°35'E. Arrange st. edge to pass thro' place & reads same value for long. on both scales.

Lat.

On radiators the same method can be used for measuring lat & long. i.e. as above. On other maps use compasses for measuring latitude.

Bearings, Courses, & Tracks must be reported in groups of 3 figures followed by (T), (M) or (C).

Section 7. Maps.

Navigation maps are based on some form of conic ~~conical~~ projection.

Scale of maps may be indicated in one of following ways.

① Representative fraction (R.F.)

This is the ratio of the distance between two points on the map to the distance on the surface of the earth between the two actual positions. R.F. = $\frac{\text{map}}{\text{ground}}$.

e.g. a 1 inch map R.F. = $\frac{1''}{63360''}$

¼ inch map R.F. = $\frac{\frac{1}{4}}{63360} = \frac{1}{253,440}$

N.B. In the R.F. the numerator & denominator must be of the same units & the numerator must be unity.

② Scale Lines are printed in the margin of maps & are usually 3 of them showing (A) Statute miles, (B) Nautical miles (C) Kilometres.

(3) Statement in words.
e.g. "Scale of 10 statute miles to one inch."
= $\frac{1}{633600}$.

On any aviation map the scale can be taken as accurate at any part of the sheet & in any direction, except mercators.

Methods of showing relief.

1. Contours & form lines
2. Layer tinting.
3. Spot heights.
4. Hachures.
5. Hill shading.

A contour is a line running along surface of land at some height above mean sea level throughout its length. They are determined by accurate survey.

Form lines are approximate contours usually only partly surveyed & filled in by visual estimation, hence they are not entirely reliable.

always interpolate for the course, & apply it to the bearing. never interp. for bearing.

Problems.

1. V. 9°W. Course by pilot's C. 165°. ~~Dev at P.C. 2°E.~~
Dev. at pilot's C. 135° 2°E
180° 1°W
225° 2W.

Bearing of Lighthouse by observers compass at same instant is 193°.

Dev. at observers compass
135° 0°
180° 3°W
225° 2E.

(a). Find T course = 156°
(b) Find T bearing = 182°.

2. (a) Deviation at observers compass = 4°E.
∴ Mag. bearing = 078°
∴ True bearing = 067°.
(b) Dev. at observers compass = 4°E
∴ Magnetic = 316°
~~∴ True bearing =~~
∴ Dev. at pilot's compass = ~~321°~~ − 316°
= 5°W.
~~∴ Magnetic at pilot's compass = 316°~~

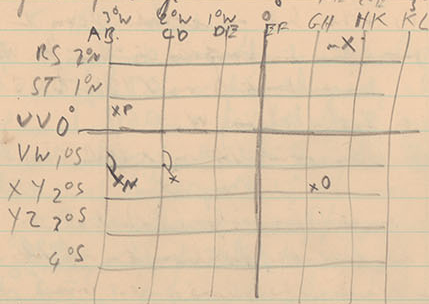
Maps.

Vertical interval is the difference in altitude between adjacent contours. The plan or map distance between contours is called the horizontal equivalent.

Make sure whether spot heights are in metres or feet (if metres × 3.3 to get feet).

Methods of Reporting Position. Graticule Ref. System.

Each deg. Lat. between 70°N & 70°S is represented by a pair of letters, also each degree of long.



Point M reported as RS GH 3540.

Always measure from bottom left hand corner.

The Navy reports the bearing of a position and its distance from the nearest // meridian intersection.

E.g. point M reported as 135 VWAB 14 where 135 is the ∠ & 14 the distance.

The RAF method involves 4 separate cases.

(a) Latitude N Long. E (straightforward method).
(as RS GH 3540)

(b) Lat. N Long. W. subtract westerly minutes from 60 & use letters for the next higher degree of West Longitude.
E.g. point P reported as UV AB 4005

(c) When Lat. is south, Long. E similar procedure is adopted to that for West Long.
E.g. point O is XY GH 1005.

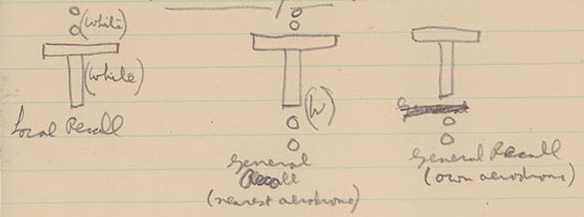
(d) Lat. S, Long. W.
E.g. point N is XY AB 3515

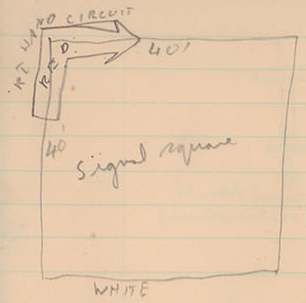
Method used for Ships (RAF)

The bearing of a position from some prominent land or sea mark, the name of the mark, & distance of position from mark. E.g. position of aircraft bearing 185°T from ST. Catherine's Pt. & 20 miles distant reported as

185 St. Cath. 20 (always in T)

Recall Signals.





all clear

land will come.

Landing prohibited

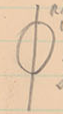
Beacon on ground that T is out.

GAS but can land. Turn to windward side + wait.

Operations in progress.

smoke candle (change of T', circuit, or air raid).

(Air raid warning).



Parachute Drifting.

Yellow pyramid (Enemy plane)

(white) Dive bombing.