IS BAVIC REMARKABLE?

David R. Saunders

THE BAVIC configuration of UFO reports was first described by Michel,[11] and is defined by the geographical locations of six particular UFO sightings, all occurring in France on September 24, 1954. The phenomenological details of these sightings serve to establish them as more or less typical UFO reports, and are otherwise irrelevant to this discussion. BAVIC takes its name from BAyonne and VIChy, located at the extremes of the configuration; the other pertinent observations were at Lencouacq, Tulle, Ussel, and Gelles.

The BAVIC configuration is of interest because of its apparent linearity. The close conformity of all six geographic locations to a single straight line (or great circle) is striking. Confronted by his discovery not only of BAVIC but of other strongly linear configurations occurring on other dates in the fall of 1954, when France experienced a major UFO-flap, Michel concluded that such linearity is a meaningful feature of the UFO phenomenon, and in 1958 he introduced the concept of orthoteny to the literature. Since then, Condon,[1] Davis,[2] Fontes,[4] Julian,[5] Maney,[6] Mebane,[7] Menzel,[8], [9], [10] Michel,[12], [13], [14] Ribera,[17], [18] Seeviour,[21] Vallée,[23], [24], [25], [26] Vogt,[28] and others have debated the merits of this concept.

The pivotal issue in this debate has typically been approached by "calculating the probability" that such orthotenic configurations could have occurred "by chance." Various members have been proposed as estimates of such a probability—some smaller and some larger. Comparatively large estimates, such as Menzel's,[8] may be obtained by using a crude index of the linearity of the configuration in combination with an elegant correction for the effect of selecting the best-looking result(s) for discussion. Comparatively small estimates may be obtained by reversing these biases. Even granting the assumption that the concept of probability may be applied, a proper estimate of its magnitude could be obtained only by being thorough on both sides. In fact, the assumption is invalid and arguments based upon it are irrelevant.*

It is suggested elsewhere[20] that the remarkability of an empirical result is the excess of information in that result over what might have been expected on some relatively simpler basis, such as pure chance. In order to determine whether BAVIC is remarkable in this technical sense, we will need to obtain two quantities in informational metric: (1) the amount of information, I_o,

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represented by the linearity observed in the six-point configuration itself, and (2) the amount of information, I_e, that could be expected because these six points are selected from a larger pool so as to maximise I_o. If I_o exceeds I_e by a sufficient margin, it will be reasonable to conclude that I_o reflects some effect, such as orthoteny, not accounted for in I_e. Within limits, the meaning of "sufficient margin" is a matter for personal choice; however, in a research area claiming few established facts, to require a 10-bit excess is moderately conservative.

Calibration of the Observed Informationl I_o

The basic problem here is to define an index of linearity that will have certain desirable properties: (i) It must be computable for any number of observation points—not just three-point combinations. (ii) It must vary continuously as a function of the data alone, without the mediation of arbitrary constants, such as, for example, the width of a "corridor." (iii) It must be independent of the absolute size of the configuration to be evaluated. (iv) The relative likelihood of obtaining different values of the index under chance conditions must also be obtainable. All of the previously proposed indices are deficient in one or more of these reports.

An index of linearity which does meet all of these requirements may be obtained in the following way, for N points in a plane: (1) Let X_i and Y_i be the horizontal and vertical coordinates of the i^{th} observation, as measured in any convenient but consistent units. (2) Find the centroid (centre of gravity) of the observations; this is simply the point whose X-value is the average of the given X_i-values. and whose Y-value is the average of the give Y_i-values. (3) Find the line (which will always go through the centroid) for which the sum of squared deviations from the line is a minimum. (4) Relocate the coordinate axes so that the new origin is at the centroid and the best-fitting line is used as the x-axis. Call the new coordinates of the i^{th} observation x_i and y_i. Then y_i is the deviation of the i^{th} point from the line, and the sum of squared y's has been minimised. (5) For the required index, calculate

$$F = \frac{(N - 2)\ \Sigma x^2}{(N - 1)\ \Sigma y^2}$$

* The essential reason behind this assertion is that when we consider the *past*, particular events either did occur (probability = 1) or did not occur (probability = 0); intermediate values for probability become meaningless in this situation. This point is more fully discussed in Chapter 22 of *UFOs? Yes.*[19]

Combinations of points that display good linearity will yield large values of F; random combinations of points will yield F's of approximately unity. By measuring x_i and y_i in radians, we may define F in identical fashion for observations made on the surface of a sphere.

It will be evident from its construction that F meets our first three requirements; it is a dimensionless ratio, free of arbitrary constants, and will produce graduated results for any N greater than 2. (If N is less than 3, F will always reduce to the mathematically indeterminate form, 0/0; this need not concern us.) Statisticians will recognise that F also meets our fourth requirement, as it is in the form of a "variance ratio for specified degrees of freedom." The distribution of F-values that may be expected from random sampling, making certain reasonable assumptions, is well known and has been extensively tabled.[16] Translating the "reasonable assumptions" into the present context, they merely require us to conceive a *random* set of observations as drawn from a bivariate *normal* distribution having *zero* correlation between the X and Y coordinates. This assumption actually seems more reasonable than the assumption of a uniform probability density throughout, say, France, although the latter assumption has often been made.

Suppose we now compute F for the BAVIC data. The result will depend on the precise values taken for the X_i and Y_i coordinates, which will depend in turn on their method of determination. Three cases will be considered. In Case 1, we have used all the coordinates available in the *Times of London* World Atlas,[22] hereafter abbreviated TOLA; these values are both relatively imprecise (as they are reported only to the nearest minute) and relatively free of any conscious or unconscious bias caused by feedback from the hypothesis motivating our analysis. (Gelles is not listed in TOLA.) In Case 2, we have used the coordinates published by Vallée,[26] who has studied BAVIC extensively. In Case 3, we have used the coordinates from our own reading of the large-scale Michelin maps,[15] as recorded in UFOCAT-70 prior to any of these analyses; this reading *does* take account of some information more precise than mere place-names, principally for the Vichy sighting, but this information appears to be independent of the other observations associated with BAVIC.

The major computational labour has been performed by computer, according to instructions written in the Fortran language, and producing results as shown in Tables 1, 2 and 3, respectively. Without reproducing the entire Fortran code here,* a few comments seem to be in order:

(1) Menzel[9] has noted certain difficulties with Vallée's[24] computational solution for least squares great circles; Menzel's recommended solution enjoys similar difficulties! Menzel's errors are measured by moving north or south from point to fitted circle, rather than by moving perpendicularly the shortest distance. Theoretically, this does not affect the positioning of the fitted circle. However, even for a constant configuration of observation points, the *apparent* goodness-of-fit gets worse and worse as the inclination of the circle increases. When the inclination is close to 90° the estimated coefficients of the circle do become unstable, and in the limit at 90° they become mathematically indeterminate. Once noted, these problems are easily overcome. The errors given in the Tables are stated in kilometres, measured perpendicularly from point to line; the signs of the errors may be interpreted by noting that positive errors are for data points on the same side of the fitted great circle as the earth's rotational north pole.

(2) The most convenient specification of a least squares great circle is obtained by stating the coordinates of either pole. Point to circle distances are easily calculated by taking 90° minus point to pole distances; poles are specific locations that may be listed along with other geographic coordinates; poles may themselves be used as data points in subsequent analyses. The computed positions of both BAVIC poles are given in the Tables.

(3) When a good combination of data points has been reduced to F, the resulting F will be beyond the range of existing tables. In view of the very small "probability" values that will be encountered in this part of the analysis, the computer programme that substitutes for the F-table[3] may be written "double-precision." The output from this final section of the programme is expressed in "bits" of information, and is the I_o we set out to obtain.

Determination of the Expected Information, Ie

I_e is much simpler to obtain than I_o. It may be shown quite generally that if chance prevails and we repeat an experiment K times, the average probability level associated with the most extreme result will be $p_e = 1/(K+1)$. Upon transformation into I-metric according to the relation, $I = \log_2((1-p)/p)$, this gives $I_e = \log_2 K$.

In the present problem, K is the number of ways we could have selected six different observations dated September 24, 1954, from the available French data. The larger the pool of such observations, the larger I_e will be, and the less excess information we will recognise in the corresponding Ie.

The maximum number of admissible observations appears to be 15‡; this means that K = C (6 out of 15) = 5005, and $I_e = 12.29$ bits; this figure will be used for Cases 2 and 3. In Case 1, since 4 of these 15 locations, including 1 of the 6 BAVIC locations, are not listed in TOLA, K = C(5 out of 11) = 462, and $I_e = 8.85$ bits.

Interpretation of I_o minus I_e

Considering Case 1 first, we find that I_o exceeds I_e by more than 17 bits. This difference is the weight of the evidence favouring a non-chance explanation for the BAVIC configuration. A remarkability of this magnitude implies that we would have to replicate the entire procedure over 100,000 times just to obtain a fifty per cent probability of matching or bettering the linearity of BAVIC with random data; in this context, "entire procedure" means picking 11 locations randomly from a bivariate normal distribution having zero correlation

* A listing of the Fortran programme may be obtained from the author.

‡ All but one of these observations may be found in a single source (reference 26, p. 119); the fifteenth observation was at Becar (reference 27, Case 153).

Case 1

Menzelian Least Squares Great Circle for BAVIC Using Tola Coordinates N = 5

Raw Data in UFOCAT Format

					Error
1 Tola	Bayonne	RF64	1′28	43′30	1·542
1 Tola	Lencouacq	RF40	0′23	44′05	—1·705
1 Tola	Tulle	RF19	—1′46	45′16	—·090
1 Tola	Ussel	RF19	—2′18	45′32	—·897
1 Tola	Vichy	RF03	—3′25	46′07	1·153

42·01455 = Node | RMS Error = 1·573

—55·57047 = Inclination | RMS Length = 198·116

132·01455 34·42953 = Northern Pole | Variance Ratio = 15856·943

—47·98545 —34·42953 = Southern Pole | Information Level = 26·093

TABLE 1

Case 2

Menzelian Least Squares Great Circle for BAVIC Using Vallée Coordinates N = 6

Raw Data in UFOCAT Format

										Error
1V1A139M	5409241500	Bayonne	RF64	1·474	43·491	7	3	5		—·029
1V1A141M	5409242100	Lencouacq	RF40	0·408	44·102	1	1			·287
1V1A143M	5409242300	Tulle	RF19	—1·750	45·260	1	1	2	*	—·163
1V1A142M	5409242200	Ussel	RF19	—2·309	45·547	3	1			·187
1V1A372M	5410181730	Gelles	RF63	—2·765	45·771	1	1	1	*	—·744
1V1A140M	5409241500	Vichy	RF03	—3·433	46·119	7	1	1		·837

42·18454 = Node | RMS Error = ·591

—55·49056 = Inclination | RMS Length = 189·755

132·18454 34·50944 = Northern Pole | Variance Ratio = 102953·475

—47·81546 —34·50944 = Southern Pole | Information Level > 30·000

TABLE 2

Case 3

Menzelian Least Squares Great Circle for BAVIC Using Michelin Coordinates N = 6

Raw Data in UFOCAT Format

											Error
1M2	096	540924 A	Bayonne	RF64	4·24 M	48·32	M	3	+1	H	·082
1M2	095	540924 S	Lencouacq	RF40	3·05 M	49·00	1	1		L	·183
1M2	094	5409242300	Tulle	RF19	0·64 M	50·29	1	1			—·284
1M2	093	54092423	Ussel	RF19	0·03 M	50·61	3	1		H T	·305
1M2	092	540924 N—	Gelles	RF63	—0·48 M	50·86	+2	1		G	—·251
1M2	091	540924 A	Vichy	RF03	—1·22 M	51·23	M	1			·130

42·24673 = Node | RMS Error = ·271

—55·45732 = Inclination | RMS Length = 189·915

132·24673 34·54268 = Northern Pole | Variance Ratio = 491814·380

—47·75327 —34·54268 = Southern Pole | Information Level > 30·000

1V2	200	520922 N	Bayonne	RF64	4·24 M	48·32		1	20		—·082
1V	1008A	5408122400	Dôle	RF39	—5·496	47·092		1		4A	1·581
1M2	006	5408190045	Dôle La-Carondelet	RF39	—3·51 M	52·33	2	1	10	G	2·044
1V	1079A	540918	Vichy	RF03	—3·433	46·119		1		4A	1·309
1V	1087E	540919	Paray-Le-Monial	RF71	—4·119	46·452		1		4A	1·532
1V	1103D	5409222030	Dôle	RF39	—3·51 M	52·33	2	1		4A	2·044
1V	1125D	5409232145	Brive-Le-Gaillarde	RF19	0·89 M	50·18		1		4A	1·317
1M2	127G	54092920	Montagney	RF25	—4·41 M	52·76	+3	1		G	4·418
1M2	128G	54092920	Rigney N486	RF25	—4·26 M	52·65	1	1		G	·742
1M2	161	541002	Vichy	RF03	—1·22 M	51·25					1·765
1V	1406D	5410061000	St. Marcel	RF71	—2·84 M	51·97		X		4A=	—2·365
1V	1583D	5410141500	Chalon	RF71	—4·848	46·787	+	1		4A	·843
1H3	465M	541014	Les Brosses-Tillots	RF71	—2·38 M	51·78		1		E	—·325
1V	1640A	5410151750	Brive-Le-Gaillarde	RF19	0·89 M	50·18			45	+	1·317
1V	1636A	5410151500	Tulle	RF19	—1·750	45·260		1		4A	·136
1V	1704M	5410172030	Dôle Gray	RF39	—5·496	47·092	3	1		4A	1·581
1M2	340	541018	Cisternes-La-Forêt	RF63	—0·42 M	50·88	2	1		L	3·813
1M2	339	541018	Gelles	RF63	—0·48 M	50·86		1		L	—·251
1V1A	500E	6208291345	Le Vauriat	RF63	—2·920	45·860	3	4	10		·723

TABLE 3

and isolating the best 5-point line that may then be formed.

On the information scale, *proof* is the same as infinite information. Since experiments are finite, empirical proof is generally impossible to achieve. As a practical matter, in most fields of research, a remarkability of 5 to 10 bits suffices to reject chance in favour of some alternative explanation; judgment may enter at this point. However, even dealing with UFOs, 17 bits should be more than enough. As a practical matter, it is entirely reasonable to conclude from the TOLA analysis alone that BAVIC is not a chance happening.

If this conclusion is valid, the Case 2 and 3 analyses should look even better than Case 1. If this conclusion is not valid, the Case 2 and 3 analyses should look about the same as Case 1 for, if BAVIC is really just a random sampling fluctuation, the provision of more "accurate" coordinates for the sightings would be at least as likely to blur the linearity as to enhance it. It is important to observe, therefore, that the remarkability for Case 2 is about 19 bits and for Case 3 is about 24 bits. The gain of 7 bits as we go from Case 1 to Case 3 may be interpreted as confirming the correctness of the previous conclusion.

Under the assumptions of our analysis, the main conclusion seems to be inescapable. Let us make the assumptions explicit and examine them.

(1) We have assumed, in keeping with Michel's initial formulation of orthoteny, that we may legitimately confine our analysis to the UFO reports of a single date. Certainly it is imperative that we count *all* the reports of that date, or even potentially of that date, as members of the pool from which the BAVIC observations are selected. No one, to our knowledge, has ever cited more than 15 French reports on the date in question, so we have regarded this as the correct number. However, if the true number were 30 instead of 15 (and if none of the new reports fitted BAVIC), this would increase I_e by only 6.89 bits for Cases 2 and 3, and would not alter the conclusion.

(2) September 24 is only one of the dates in the French flap of 1954 for which numerous reports have been collected. It is not unfair to suggest that, in effect, this date has been selected for analysis because the comparable results for other dates are less remarkable. If this is so, and we recognise a total of from 16 to 32 dates potentially suitable for analysis, it is proper to augment I_e by 4 to 5 bits for each Case. This might again act to reduce our feeling of confidence, but would not be enough to alter the conclusion.

Moreover, having allowed such increments in I_e, we may now also note that there *are* positively remarkable linear configurations for various of the other dates, even though the pertinent computations are not reported here. On balance, the gain from these other lines will more than offset the indicated increase in I_e.

(3) Perhaps the very idea of associating BAVIC with a date is inappropriate. Linearity, after all, is a spatial property and not a temporal one. Perhaps we should regard BAVIC as selected from all the reports in the whole 1954 flap. Approximately 500 such reports are known. Certainly if I_e were based on combinations of 6 out of 500, this would kill the conclusion.

However, if we open the door to observations from other dates, it is no problem to find numerous other reports that do fit the BAVIC line just as well as the first six—such reports that are also known to UFOCAT-70 are listed in the bottom section of Table 3. BAVIC apparently includes about 5 per cent of all the reports in the 1954 flap, with a root-mean-square deviation for witness location of approximately 1 kilometre. Again it turns out that reanalysis of the data from a broader perspective actually increases the net remarkability and strengthens the conclusion. We see no prospect of cancelling BAVIC's remarkability by increasing I_e.

(4) It is reasonable to observe that the distribution of potential UFO sighters in France does not exactly conform to a bivariate normal frequency model—nor to any other mathematically specifiable model. So be it. This is not a devastating observation. The *exact* specification of what we choose to mean by randomness is important only if we wish to state *exactly* the amount of information represented in I_o. If our bivariate normal assumption is only approximately true, then our estimate of I_o is likewise approximate. This is one of the reasons for insisting that I_o exceed I_e by an appreciable margin. Nevertheless, whenever the margin is big enough we are simply going to discard the random model—if it is incompatible with the data, it holds no further interest. Our goal is always to work towards the specification of a model that *is* compatible with *all* of the data.

In this connection it is important to note that our calculation of I_o by way of F is particularly sensitive to only *one* kind of non-randomness, namely, linearity. Departures from randomness in other ways will have only trivial consequences. Thus, to be effective, criticism of the model of randomness must specifically indicate how the real situation is relatively too capable of yielding highly precise linear configurations.

In fact, the BAVIC line does not correspond to any natural or artificial feature, such as a mountain range or river or highway. Neither does it correspond to an alignment of important population centres. It seems unlikely, therefore, that our conclusion results from use of a poor model to represent chance. We see no prospect of eradicating BAVIC's remarkability by reducing I_o.

Summary

Our answer to the original question is, "Yes, BAVIC is remarkable." The body of this paper spells out our rationale for this answer, which is based solely on the internal properties of the BAVIC configuration and on the circumstances of its discovery. If this is more than a methodological exercise, then our scientific purpose has been to decide whether new research presupposing the "reality" of BAVIC is likely to be fruitful. The results here reported are distinctly encouraging for such research.

BOULDER, COLORADO, January 23, 1971.

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MYSTERY AEROPLANES OF THE 1930s Part III – The Landings

John A. Keel

On Wednesday, January 10, 1934, the Scandinavian "Ghostfliers" reportedly landed in several isolated areas in northern Norway and Sweden, according to *Dagens-Nyheters* (Stockholm) and the other newspapers* which were closely following the wave of mystery aeroplane sightings. Item 20 in our catalogue is datelined January 11, 1934, from Skellefteå, Sweden: "A report was received from the village of Norsjo, Monday evening, describing a bright light which was visible over the entire area. It was exceptionally strong and moved over the southern horizon. A man employed by the Royal Telegraph Service in Norsjo watched the mysterious light over the swamp at Kvammar. He saw it from his car on the highroad. The police searched the swamp during a violent snowstorm but found nothing . . . An unconfirmed rumour from Anderstjarn, south of Norsjo, tells of a landing by the ghostflier on the ice. Some traces were found after the machine was seen."

The "unconfirmed rumours" were quickly replaced by substantial eyewitness reports which prompted the Norwegian government to dispatch the cruiser *Eagle* to the landing sites.

22. January 11, 1934. Trondheim, Norway. Two landings of ghostfliers were reported from northern Norway, Wednesday evening. One machine landed near the island of Gjeslingen, outside Rorvik, and the other at a place called Kvaloj in the area Namndal. The report from Gjeslingen says that the people there saw a great beam of light and heard the sound of a strong engine. The machine landed and remained on the water quietly for an hour and a half. Its light went out after it landed but the general opinion of the witnesses was that the object was still there. The second ghostflier took off 15 minutes after landing at Kvaloj and vanished southwards.

27. January 13, 1934. Oslo, Norway. An attempt to catch the mysterious flier ended in failure on Friday. One mysterious flier was seen to alight near the island of Sleipskar on Friday evening. The island is only a few kilometres south of Gjeslingen, where one of the machines was seen to land the day before.

Earlier in the evening beams of light and engine roars were reported in the same area. When the aeroplane was seen to land on the water a message was sent immediately to Rorvik. The cruiser *Eagle* was docked there. Unfortunately, a pilot was not available when the message was received. These waters are too dangerous, because of the many reefs, for a ship to sail them without a pilot.

People all over Rorvik saw the mysterious aeroplane between two and three in the morning. It seemed to be heading towards Sweden. Around 10.00 p.m. the plane flew over Isfjorden, near Adalsnas. It was a biplane, equipped with pontoons, and vanished over Romsdaksfjorden. Five persons witnessed its flight. It was at high altitude.

28. January 14, 1934. Rorvik, Norway. Two aeroplanes have landed near Rorvik, reported the police of the state. One landing place is situated near Vikna, Kvalpsundet, and the other at Oksbosen in Flatanger.

The duty-cruiser *Eagle* left the harbour at high speed for a close investigation, but an accident occurred as the ship neared the landing site. The cruiser ran aground. A salvage vessel was sent from Rorvik but the *Eagle* disentangled itself under its own power.

The search for the aeroplane was futile, but people on the nearby islands still seriously assert that an aeroplane had landed at Vikna.

Futile hunt

The ill-fated *Eagle* never did catch up with the ghostflier. Nor did the Swedish Air Force squadron which was sent to northern Sweden to track the planes down. Police and army units turned out repeatedly in the flap areas in futile attempts to locate the planes and their possible bases. Some of the eyewitnesses said the planes were equipped with pontoons or skiis, and several reports described formations of two or three planes.

36. January 15, 1934. Skellefteå. For the past two months a person in Skellefteå has been watching three aeroplanes flying in formation over the area. One plane usually flies in front of the other two and at a slightly higher altitude. It looks, says the observer, as if the lead plane directs the others with light signals. The witness asserted that this has been going on for a couple of months and the aeroplanes' routes follow the railways in the area.

Classic UFO-style "searchlights" were a common feature in many of the reports, and, like modern UFOs, the objects frequently visited rugged mountainous regions. The lights, accompanied by engine noises, were widely seen over the Nedelpad (Sweden) area on Thursday, January 11. One group of witnesses said a phantom plane circled over the mountain of Bykullen that night and the mountain top was "bathed in light". Approximately thirty minutes later it appeared over Tyndero on the sea coast.

There was a brief lull in the sightings in mid-January 1934. Then, on Sunday, January 22, the planes returned with a vengeance and were widely seen throughout northern Norway and Sweden. At 10.00 a.m. there were daylight sightings over Vindeln and Viriajam. "The plane flew over at low altitude on a course towards Norway. No marks or insignia of any kind were visible," according to one report. At 6.00 p.m. the busy pilot entertained the people of Bengtsforsen, Jamtland and Indal, circling as he splayed his bright lights about the countryside. At midnight, a group of 30 soldiers near the fort of Boden reported seeing the object. Authorities were upset over the repeated appearances of the ghostflier over the "restricted" Boden area. That same night the residents of Repvag, Norway, "saw an aeroplane