Tableau 2. Effet de congélations et décongélations répétées en présence de glycérol sur la survie de *N. gonorrhoeae*

Souches	Survie (unités viables/ml) Nombre de congélation-décongélation			
	0	1	2	3
G_1	$2{,}6\times10^8$ (100%)	$2{,}4\times10^8$ (92%)	$2{,}8\times10^8$ (100%)	$2{,}4\times10^8$ (92%)
G_2	$0{,}2\times10^8$ (100%)	$0{,}2\times10^6$ (1%)	$\leq 2\ \times10^4$ (-)	$\leq 2\ \times10^4$ (-)
G_3	$3{,}0\times10^8$ (100%)	$2{,}8\times10^8$ (93%)	$1{,}8\times10^8$ (60%)	$1{,}2\times10^8$ (40%)
G_4	$5{,}8\times10^8$ (100%)	$5{,}6\times10^8$ (97%)	$5{,}0\times10^8$ (86%)	$5{,}2\times10^8$ (90%)

Tableau 3. Effect de la durée de congélation en présence de glycérol sur la survie de *N. gonorrhoeae*

Souches	Survie (unités viables/ml) Avant congélation	Après congélation 8 jours
G_1	$0{,}98\times10^8$ (100%)	$0{,}34\times10^8$ (35%)
G_2	$0{,}51\times10^8$ (100%)	$0{,}22\times10^7$ (4%)
G_3	$0{,}15\times10^9$ (100%)	$0{,}10\times10^8$ (7%)
G_4	$0{,}11\times10^9$ (100%)	$0{,}10\times10^8$ (10%)

G_4 semble légèrement accrue. Ces résultats diffèrent de ceux d'Elmros et collaborateurs[4,5] qui décrivent une inhibition de la lyse (augmentation de la stabilité mécanique) et une survie accrue dans des conditions expérimentales sensiblement identiques aux nôtres. Ces différences entre les résultats indiquent donc clairement que le maintien de la stabilité mécanique et de la viabilité du gonocoque par ces cations bivalents n'est pas un phénomène général mais dépendrait de certains paramètres qu'il reste à déterminer, et parmi lesquels on retrouve la nature des souches utilisées. Lorsqu'on examine l'effet de la congélation et de la décongélation, répétées, à 2 h d'intervalle, sur la survie de suspensions de gonocoques des 4 souches (tableau 2), on note que celles-ci varient dans leur sensibilité à ce traitement. Ainsi les souches G_1 et G_4 apparaissent relativement résistantes, alors que la perte de viabilité pour la souche G_3 est de l'ordre de 60% après la troisième décongélation et que cette perte est de 99% pour la souche G_2 après la première décongélation. Ces résultats démontrent clairement qu'il ne peut être pris pour acquis que des suspensions de gonocoques préparées dans les mêmes conditions que les nôtres, ne subissent aucune fluctuation du nombre de leurs unités viables comme l'ont décrit La Scolea et Young[6]. La sensibilité différentielle de ces souches de gonocoques se réflète de même par leur survie lorsque congelées en présence de glycérol durant 8 jours (tableau 3). Pour les 4 souches on note en général une baisse de viabilité dont l'amplitude décroît pour les souches dans l'ordre suivant: G_2, G_3, G_4 et G_1. Il appert que si le glycérol est un agent largement utilisé pour la conservation des suspensions de gonocoques, l'utilisation systématique de celles-ci pour la mise en évidence d'une inhibition de la croissance du gonocoque par des espèces bactériennes de la flore urogénitale par la méthode décrite par Kay et Levison[7] est sujette à caution. En effet, dans cette méthode des inocula à partir de suspensions de gonocoques, en bouillon nutritif additionné de glycérol, conservées congelées, sont utilisées pour ensemencer toute la surface de géloses nutritives sur lesquelles des souches, productrices éventuelles d'inhibiteur(s), sont inoculées par la suite. Le nombre d'unités viables des suspensions de gonocoque variant en fonction de la durée de la congélation et des souches le nombre de cellules cibles variera entraînant une variation du rapport inhibiteur(s)/cellules cibles, pouvant mener à une interprétation erronée des résultats.

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Experimental alteration of biomagnetic interactions among bean seeds

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Summary. Interactional patterns among bean-seed *(Phaseolus vulgaris)* clusters distributed on a table differed statistically significantly between when in clockwise rotating fields (table or magnetic) and when in counterclockwise fields or as nonrotating controls. It is postulated that clockwise rotation shortens the range of interactions.

The generation of electromagnetic fields by organisms and their reception of these fields has been described between sharks and their prey[2], among electric fishes[3,4], and among bean seeds absorbing water in adjacent vessels[5]. Sharks which use these fields in the capture of prey have been demonstrated to be capable of sensing electric fields as weak as 0.01 μV/cm. The electric fishes employ their fields for exploration of the physical environment, communicating their location and socially integrating the local population. These latter fishes are able to alter characteristics of the oscillating fields they produce. The field effecting interactions between groups of bean seeds is not obviously affected by placing each group in a separate Faraday cage[6], and even by adding a mumetal lining, and hence is postulated to be both biomagnetic and dynamic[7]. The present study was designed to learn whether uniform rotation would affect the bean interactions.

Materials and methods. The relative rates of water-absorption by bean seeds distributed as 4 pairs of samples around the periphery of circular wooden tables (figure 1) were determined. The tables differed slightly in size and the distances among the samples exhibited the range described in figure 1. Various experimental series included stationary tables, clockwise (CW) and counterclockwise (CCW) horizontally rotating (0.33–2 rpm) tables, and stationary tables on which an 18-cm horizontal alnico bar magnet rotated (0.33–2 rpm) either CW or CCW at the table center at the level of the beans. The experimental magnetic field very slightly exceeded the geomagnetic one. The CW and CCW rotating table or magnet experiments were always paired, with identically sized tables, and performed simultaneously a small distance apart in the same room. All experiments were performed in temperature-regulated, air-conditioned (21–23 °C) laboratories and under fluorescent illumination (40–50 f.c.).

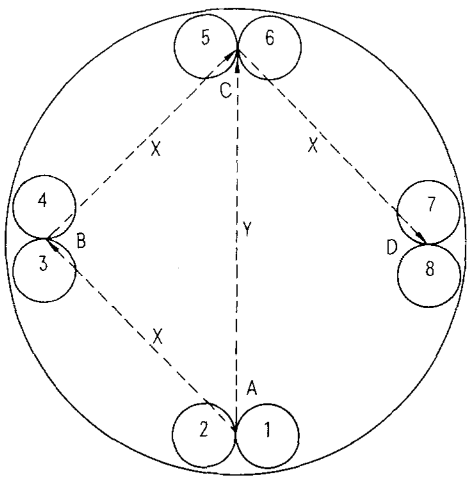

Fig. 1. The arrangement of vessels of beans on the circular tables. The order of submergence of the beans was A1 ... D8, at 1-min intervals. The distance X ranged from 45–70 cm, and Y, from 64–100 cm.

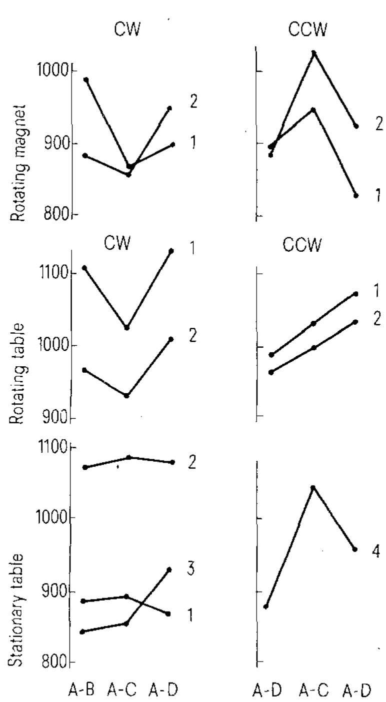

Fig. 2. The sums of the differences, without signs, between A, on the one hand, and B, C, and D, on the other, for about 180 days (= 8.5–10 months) of data. CW and CCW indicate clockwise and counterclockwise rotation, respectively. The numbers 1 to 4 indicate different 180-day studies.

Table 1. The experiments, starting times, numbers of days, and sums (without signs) of the day by day differences between the percentage water uptake in the B, C, and D groups from the A group, for stationary tables

Experiment	Start	Days	Sums (A–B)	Sums (A–C)	Sums (A–D)
I	10/73	32	164.8	143.8	152.9
	12/73	32	155.2	162.4	114.2
	2/74	31	136.2	163.0	139.5
	3/74	31	111.3	134.0	168.5
	5/74	32	140.2	127.9	154.0
	6/74	31	174.2	154.5	132.1
II	6/74	30	127.6	155.3	154.3
	7/74	27	81.2	90.3	88.8
III	11/73	31	160.8	172.0	178.6
	1/74	31	165.6	163.9	192.1
	2/74	31	192.6	188.0	160.1
	4/74	31	149.3	155.8	166.9
	5/74	32	193.6	158.5	137.5
	7/74	32	139.0	170.6	163.8
	8/74	30	135.7	129.2	152.6
IV	8/74	32	152.8	166.4	145.1
	9/74	31	119.8	100.8	149.4
	11/74	31	154.1	128.1	163.6
	12/74	31	141.0	158.5	155.1
	2/75	31	143.7	140.5	162.7
V	6/75	30	149.3	205.3	197.1
	7/75	30	156.6	161.1	160.8
	9/75	30	163.1	239.3	193.6
	10/75	30	162.7	188.5	184.6
	12/75	28	221.3	186.4	196.5
	2/76	27	182.9	225.9	160.8

Table 2. The experiments, starting times, numbers of days, and sums (without signs) of the day by day differences between the percentage water uptake in the B, C, and D groups from the A group, for rotating magnets

Start	Days	CW A–B	A–C	A–D	CCW A–B	A–C	A–D
6/74	25	137.2	104.5	125.1	122.0	124.3	137.7
7/74	25	134.6	136.4	106.1	109.4	123.7	87.7
8/74	30	183.6	137.4	162.1	158.8	168.2	174.5
9/74	30	159.1	188.1	161.7	160.5	169.5	168.9
10/74	30	205.0	157.2	174.3	162.6	177.0	128.5
12/75	30	169.5	142.8	169.0	182.6	182.1	131.5
6/75	28	137.1	124.7	144.5	122.6	145.7	112.5
7/75	29	82.4	72.0	81.2	85.8	52.8	71.0
6/75	30	170.0	139.7	127.8	131.6	214.4	166.6
7/75	30	158.7	163.6	141.7	162.3	145.3	138.2
9/75	30	181.8	169.1	251.0	154.0	261.9	226.3
10/75	30	155.3	187.8	203.7	227.1	208.8	209.9

Table 3. The experiments, starting times, numbers of days, and sums (without signs) of the day by day differences between the percentage water uptake in the B, C, and D groups from the A group, for rotating tables

Start	Days	CW A–B	A–C	A–D	CCW A–B	A–C	A–D
1/73	30	195.4	187.0	209.7	170.7	146.9	149.3
3/73	30	159.0	148.1	164.6	152.5	174.0	213.4
4/73	30	183.6	152.8	192.2	156.7	152.8	143.7
5/73	30	219.3	163.2	200.4	146.4	168.8	217.5
1/73	30	196.6	192.5	206.0	185.6	186.0	158.9
3/73	30	154.1	184.0	156.4	177.2	205.3	192.4
5/73	30	145.7	143.7	158.0	179.6	192.7	180.5
6/73	30	198.0	204.5	200.9	206.3	221.3	199.7
6/73	30	151.6	137.9	162.4	130.9	148.3	148.1
8/73	30	166.5	141.6	181.2	135.8	120.6	182.0
9/73	30	145.9	155.8	145.7	172.8	164.1	169.4
10/73	30	155.7	146.0	163.4	137.4	150.4	159.2

20 bean seeds were randomly oriented in preweighed aluminium-screen trays, weighed to the nearest cg, and submerged in temperature-equilibrated tap water at 1-min intervals around a table. 4 h later, always over the noon h, all the samples were individually wet-weighed and the amount of water absorbed was determined as the difference between final wet-weight and initial dry weight +15 cg (=wetting). The percentage weight increase by water uptake was calculated for each of the 4 pairs on a table and the values for the 2nd, 3rd and 4th pairs were converted to differences from the 1st pair submerged. In view of the mutuality of interactions[5,6] the 3 differences from the 1st pair, without sign, were each added to obtain the sum of the positive and negative differences for unit sequences of about 30 and 180 days.

Results and discussion. The data, including all 5 experimental conditions, are shown in tables 1–3 along with starting dates and numbers of days. The mean results for longer periods, about 180 days, are depicted in figure 2. Employing a 2×3 χ^2-test, no significant difference was found between the 2 runs on the CW rotating tables, on the CCW rotating tables, or with the CCW rotating magnet, nor was any difference found among the 1st 3 stationary-table runs. For the CW rotating magnet, despite the A to C difference being the smallest in both cases, there was a 5% probability that these differed from one another. Among the stationary-table results a significant difference ($p < 0.01$) occurred only between the 3rd and 4th series.

Now examining for possible statistical significance the differences from their means for the 3 values for all data for each of the 5 experimental conditions, p-value differences from random were: CW magnet, $p < 0.05$; CCW magnet, $p < 0.001$; CW table, $p < 0.02$; and CCW table, $p < 0.05$. For the 1st 402 days for the stationary table there was no difference, but for the last 393 days, $p < 0.01$.

Again with all data, the inversion of the mean pattern for the 3 consecutive sums between CW and CCW rotating magnets was highly significant ($p < 0.001$), as was similarly the difference between the CW table and the CCW magnet ($p < 0.001$). The beans on the stationary table differed from those on the CW rotating table ($p < 0.01$) and from those on the CW magnet table ($p < 0.005$). The mean pattern for the stationary table resembled the mean of the 2 CCW fields.

It is postulated that 1 basic pattern for the 4 pairs on each circular table conforms to a negative correlation between the successive pairs around the periphery of the table, with the 1st and 4th pairs interacting in a consistent fashion because of the even number of pairs. This could be predicted to be the dominant pattern of interactions when the range of field effects is shorter (CW table and magnet). On the other hand, when the interactional range is longer (CCW table and magnet, and stationary table) the 3rd pair would tend to become negatively correlated (deviate most) with the 1st pair while the 2nd and 4th either remained positively correlated (CCW magnet), or, the 3rd and 4th pairs become negatively correlated with the 1st 2 pairs (CCW table). On the stationary table the beans span the gamut of interactions seen for the 2 CCW fields. The 2 CCW rotating fields appear to press toward opposite extremes the interactional patterns observed under the control conditions.

The 2 directions of either table or magnet rotation have been reported to produce different effects on plant growth[8,9], bean water uptake[10], planarian orientation to light[11], and hamster-rhythm manifestations[12]. It is notable that this differential effect of rotation, postulated to be an adaptation of life to a spinning planet[10], should also apply to magnetic interactions.

Opposite effects of table and magnetic rotation such as noted here for the CCW fields on interactions have been interpreted to establish geomagnetism as the reference for rotation in studies of bean water uptake[10]. The apparent absence of a differential effect between CW table and CW magnet rotation is unexpected.

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Dynamic biomagnetism associates bean seeds

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Summary. Water uptake by bean seeds *(Phaseolus vulgaris)* over 4 h in 4 adjacent Faraday cages and in 4 similar, but mumetal-lined, Faraday cages disclosed comparable interactional patterns among both cage types. This indicates a role of dynamic, or fluctuating, biomagnetic fields. An inverted relationship over time between the 2 cage types is probably due to geomagnetic attenuation.

The discovery that fields responsible for interactions between closely adjacent groups of bean seeds could penetrate from one Faraday cage into another[2] led to the hypothesis that the effective field was magnetic. This hypothesis would require that the seeds generate a biomagnetic field[3,4] and that other nearby seeds receive and exhibit a response to these fields. In a closely apposed series of 4 Faraday cages beans within 1 cage mutually induced in immediately adjacent cages an opposite response to the fluctuations in an atmospheric-field factor. This second factor could be either the geomagnetic field or background radiation, to both of which organisms are extraordinarily sensitive (magnetism[5-11]; high-energy radiation[12-14]. Associations of organisms with others nearby by electromagnet-