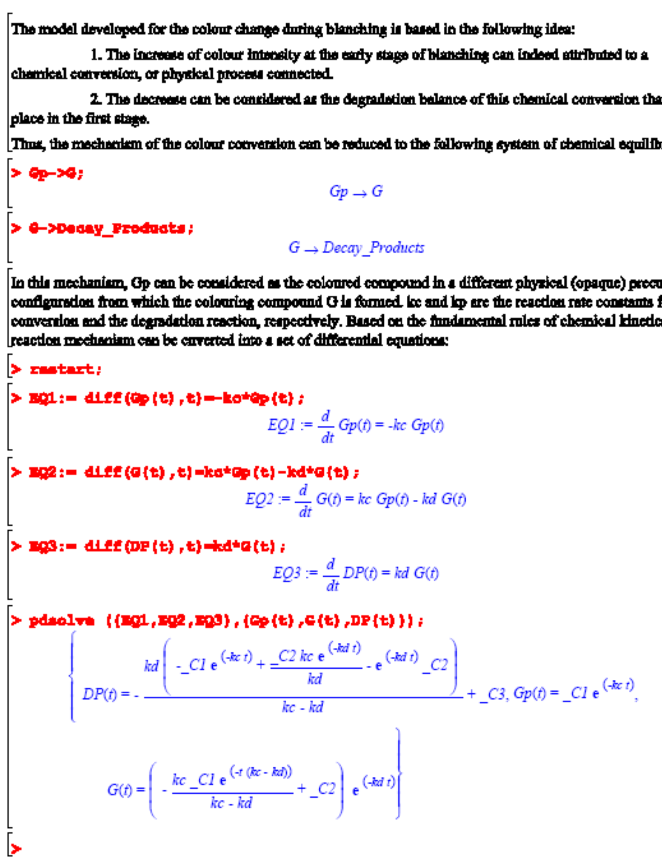
Vive la chimie (et la physique) !

La chimie physique est vraiment merveilleuse !


The model developed for the colour change during blanching is based in the following idea:

1. The increase of colour intensity at the early stage of blanching can indeed attributed to a chemical conversion, or physical process connected.

2. The decrease can be considered as the degradation balance of this chemical conversion tha place in the first stage.

Thus, the mechanism of the colour conversion can be reduced to the following system of chemical equilib

```
> Gp->G;
```

$$Gp \to G$$

```
> G->Decay_Products;
```

$$G \to Decay\_Products$$

In this mechanism, Gp can be considered as the coloured compound in a different physical (opaque) precu configuration from which the colouring compound G is formed. kc and kp are the reaction rate constants f conversion and the degradation reaction, respectively. Based on the fundamental rules of chemical kinetic reaction mechanism can be converted into a set of differential equations:

```
> restart;
> EQ1:= diff(Gp(t),t)=-kc*Gp(t);
```

$$EQ1 := \frac{d}{dt} Gp(t) = -kc\, Gp(t)$$

```
> EQ2:= diff(G(t),t)=kc*Gp(t)-kd*G(t);
```

$$EQ2 := \frac{d}{dt} G(t) = kc\, Gp(t) - kd\, G(t)$$

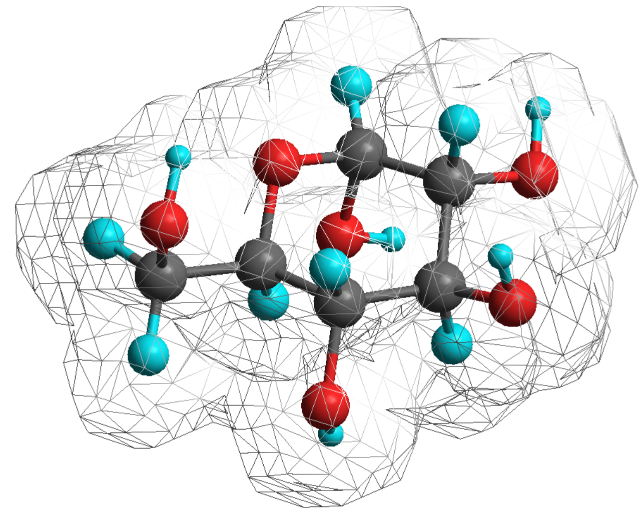
```
> EQ3:= diff(DP(t),t)=kd*G(t);
```

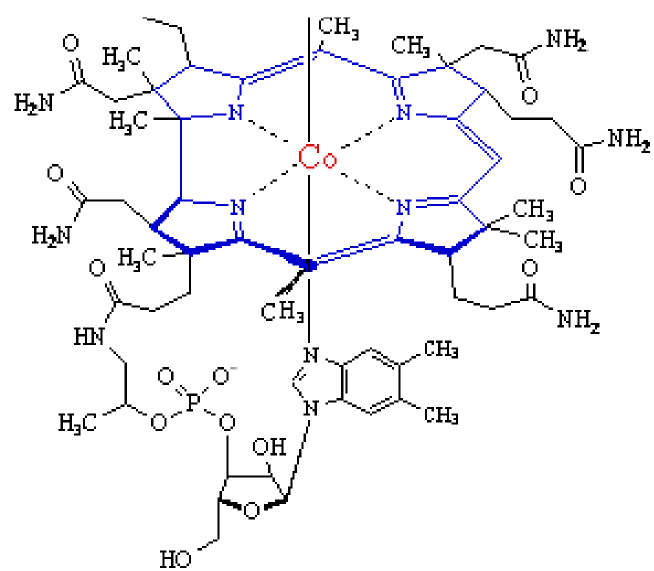
$$EQ3 := \frac{d}{dt} DP(t) = kd\, G(t)$$

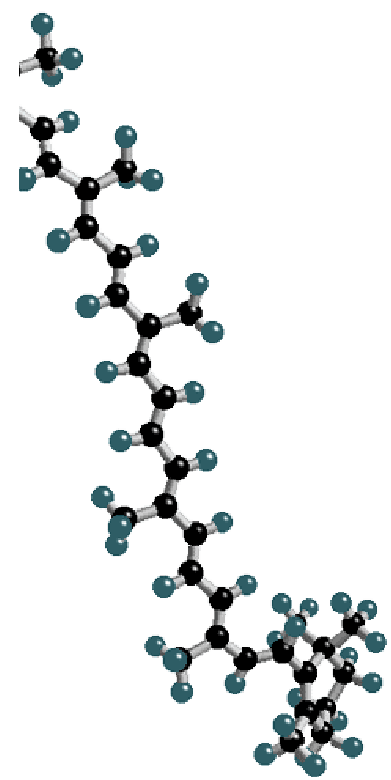
```
> pdsolve ({EQ1,EQ2,EQ3},{Gp(t),G(t),DP(t)});
```

$$\left\{ DP(t) = -\frac{kd\left(-\_C1\, e^{(-kc\, t)} + \frac{\_C2\, kc\, e^{(-kd\, t)}}{kd} - e^{(-kd\, t)}\, \_C2\right)}{kc - kd} + \_C3,\ Gp(t) = \_C1\, e^{(-kc\, t)},\ G(t) = \left(-\frac{kc\, \_C1\, e^{(-t\,(kc - kd))}}{kc - kd} + \_C2\right) e^{(-kd\, t)} \right\}$$

```
>
```







Pour des questions, des références...

herve.this@agroparistech.fr

N'oublions pas les émerveillements expérimentaux

$KMnO_4$

Des applications : le « gibbs »

Et il y a tout cela

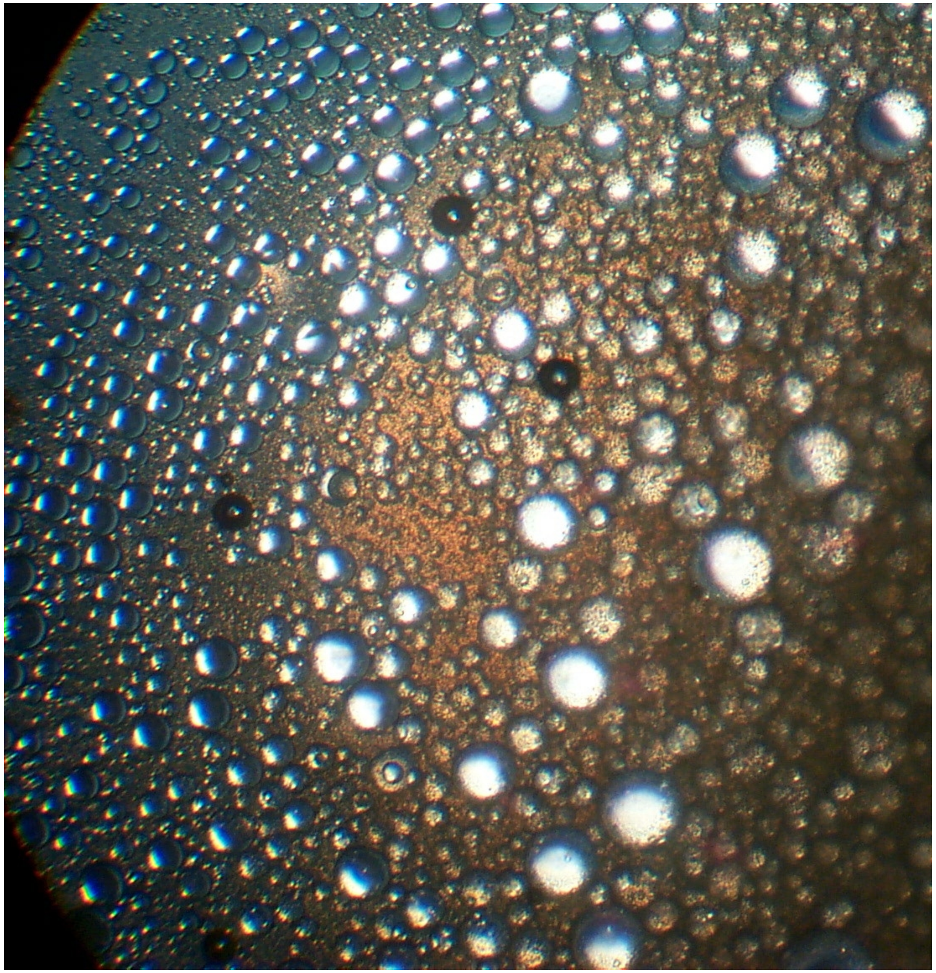
https://www.youtube.com/watch?v=Zl74NCVbA5A

https://www.youtube.com/watch?v=t5ZFoU0S5iE

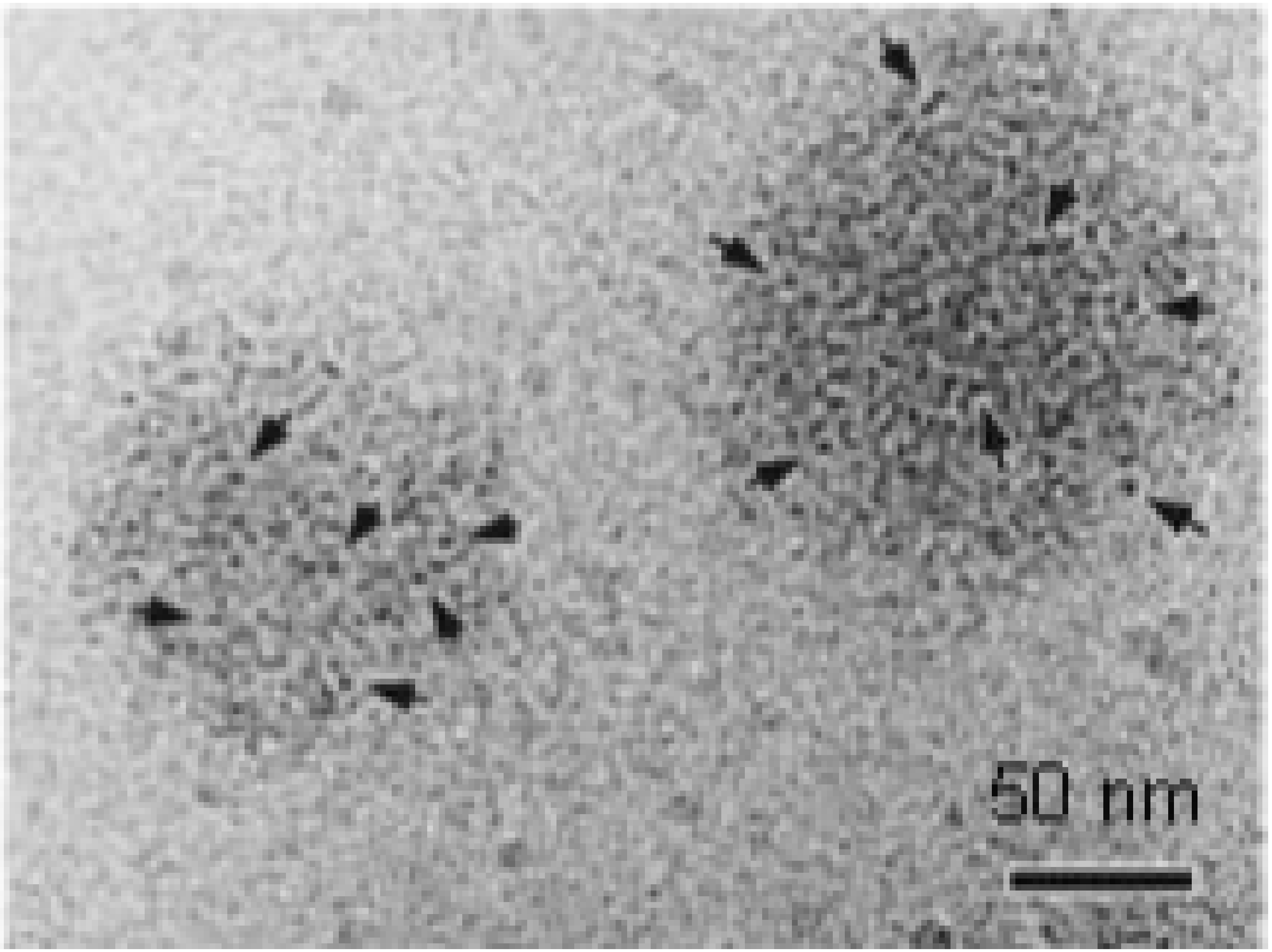
Qu’est-ce qu’un aliment ?

Une organisation macroscopique

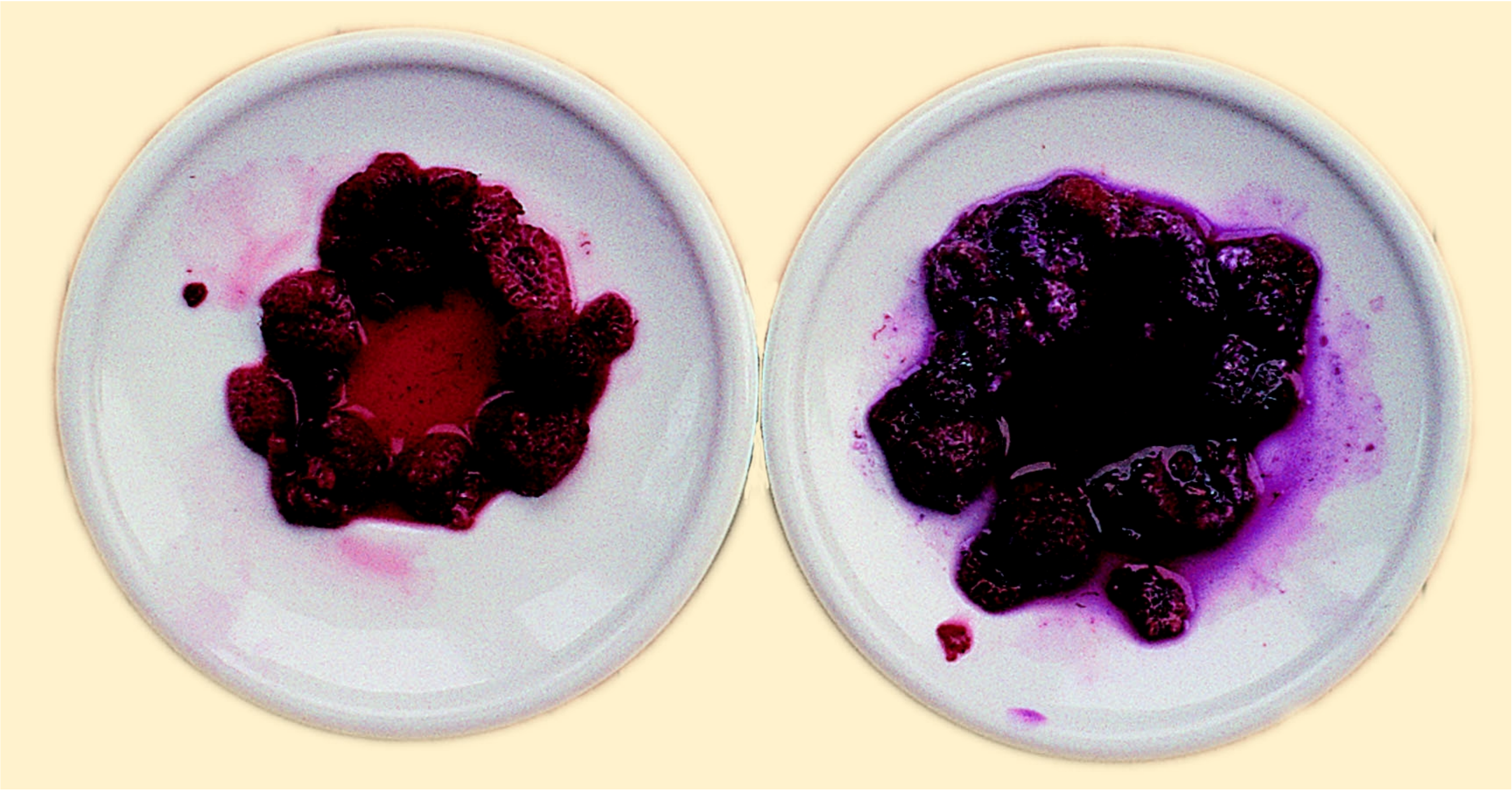
Pour chaque partie, une organisation microscopique



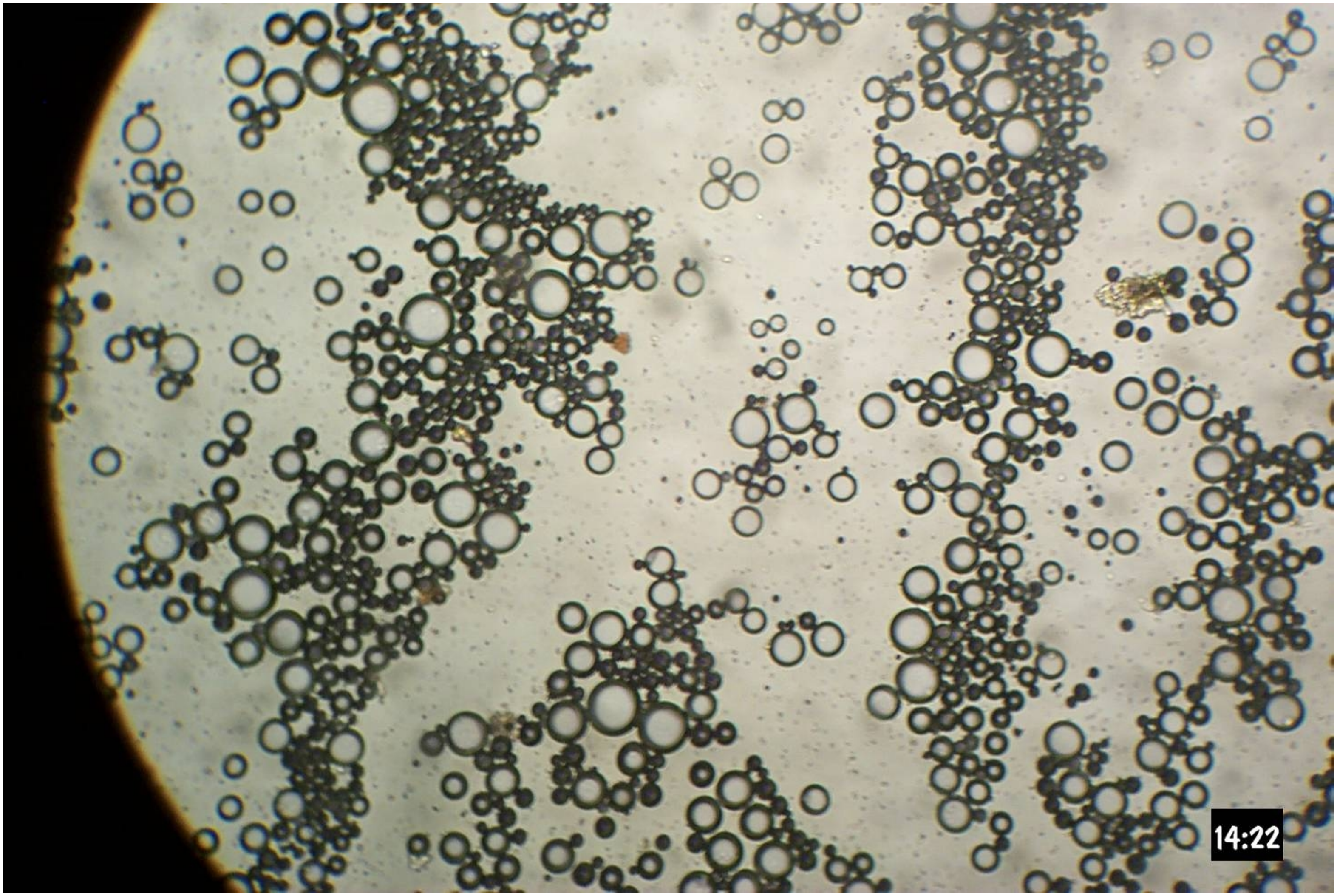
Pour chaque partie, une organisation nanoscopique



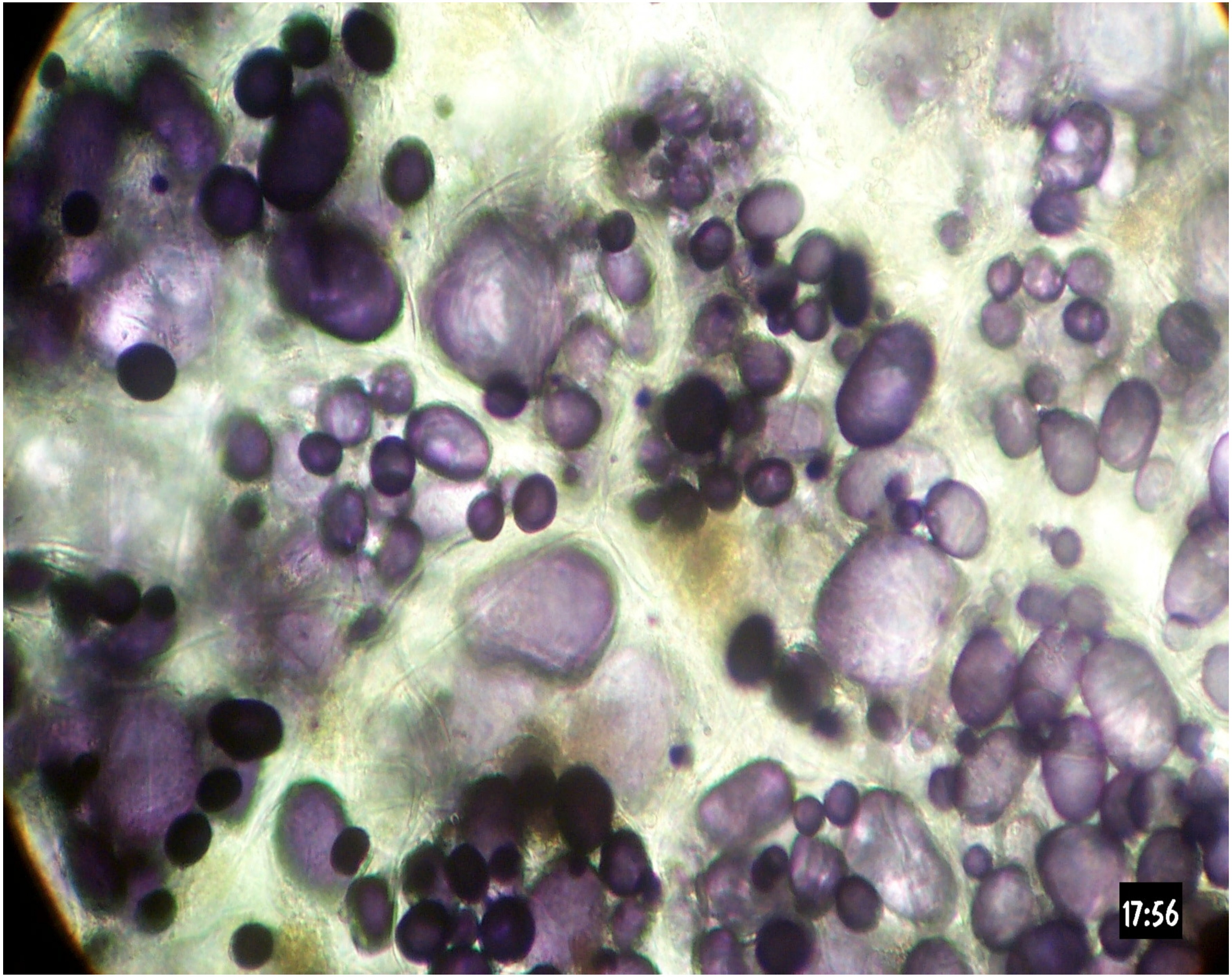
Et aussi,
une organisation moléculaire



Que sont les systèmes suivants ?



HTvK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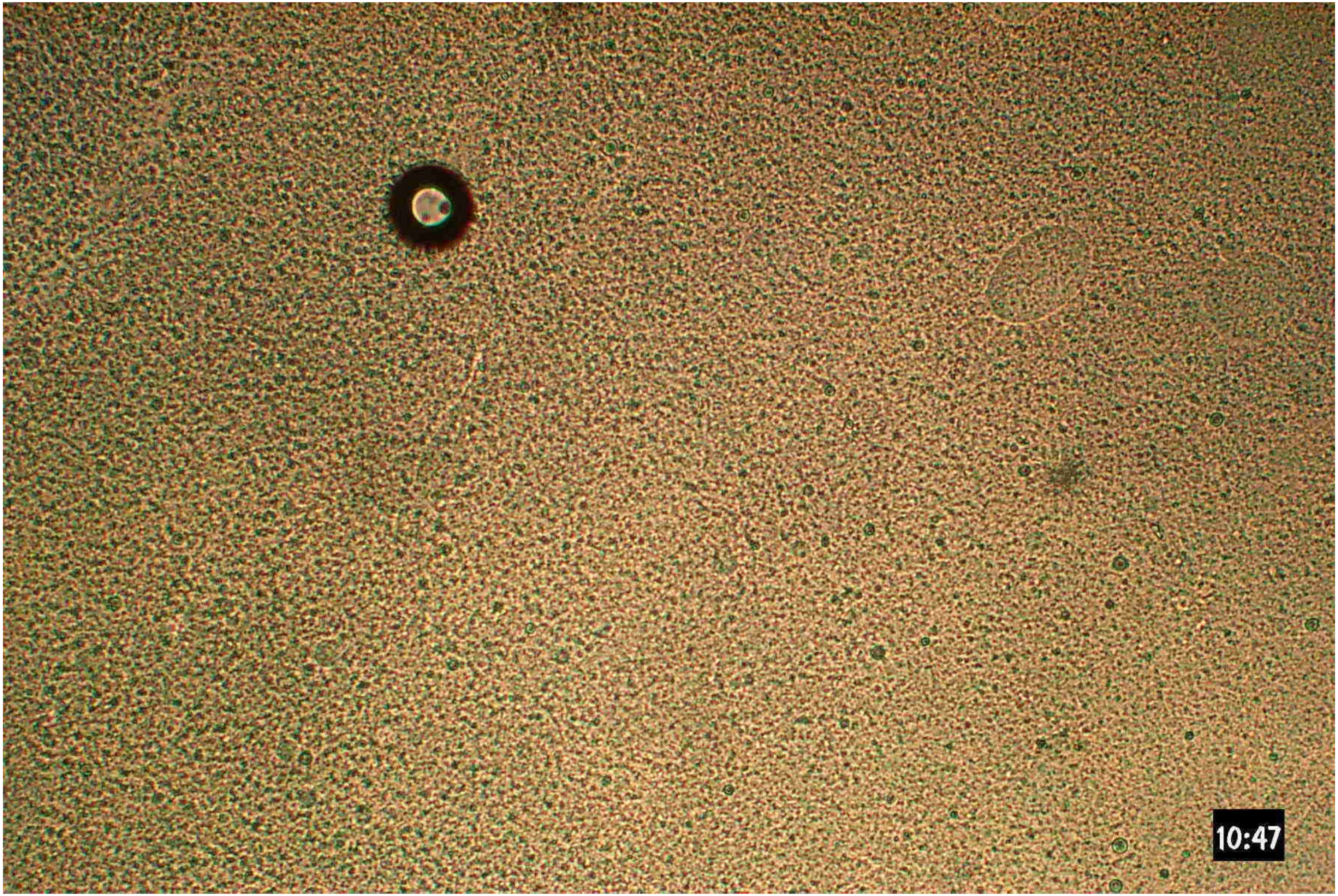
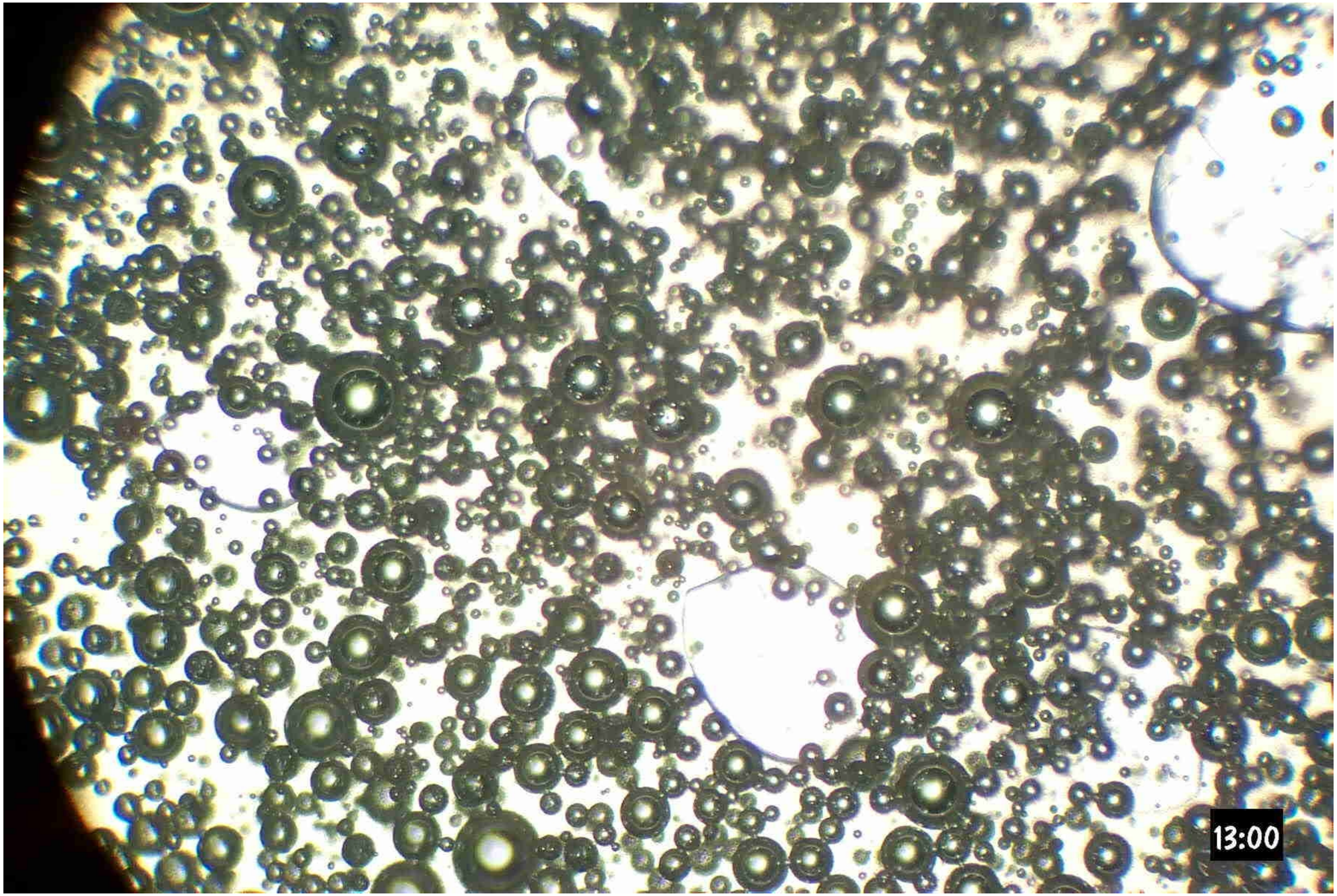
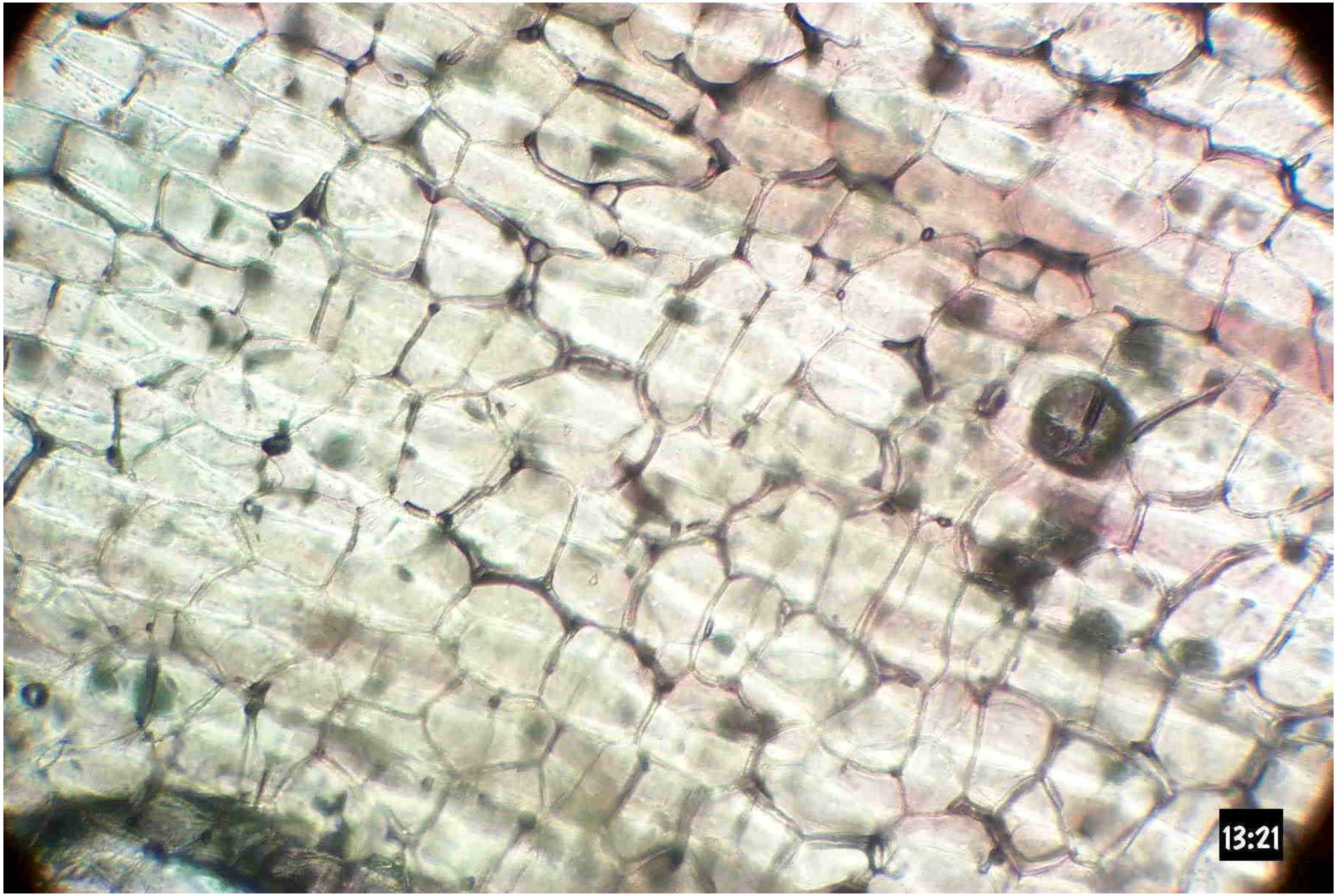

10:47

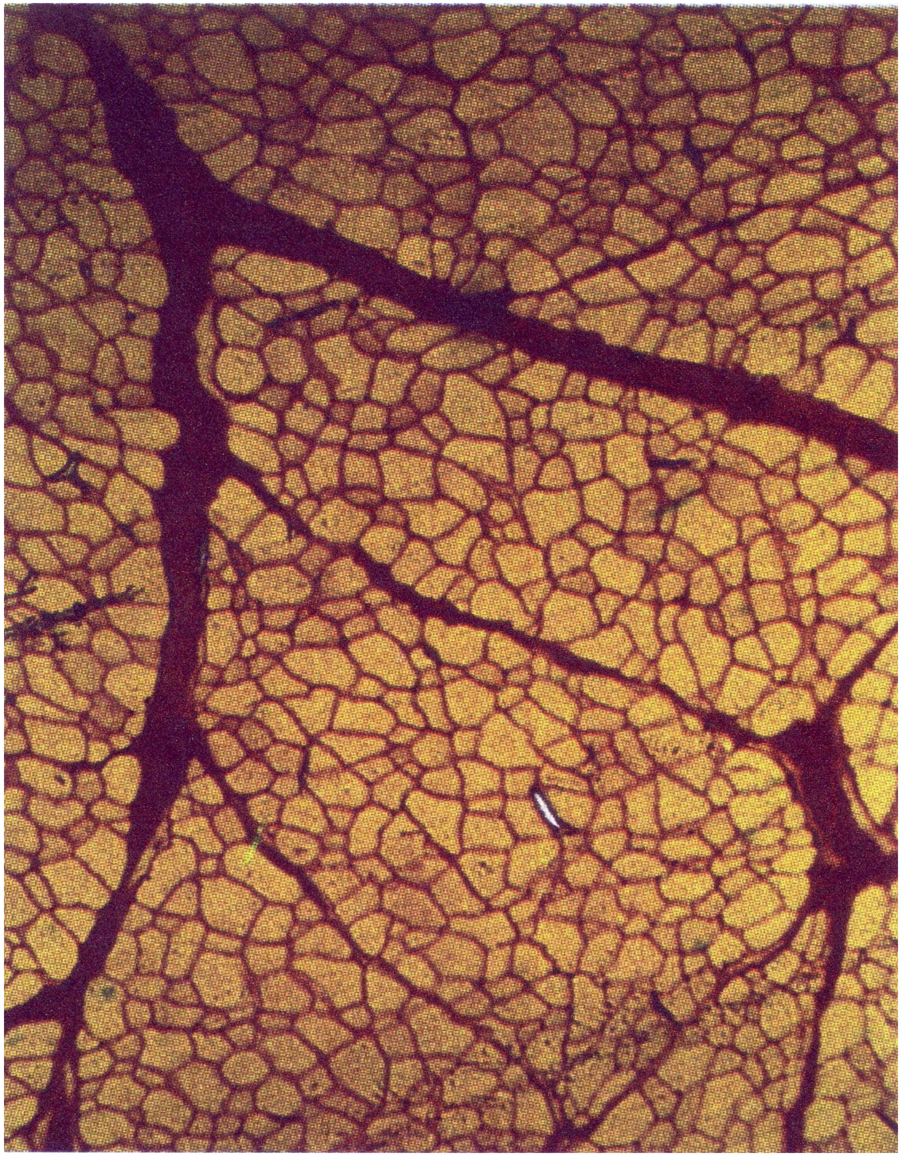

12:57


13:00

Un gel



Un gel



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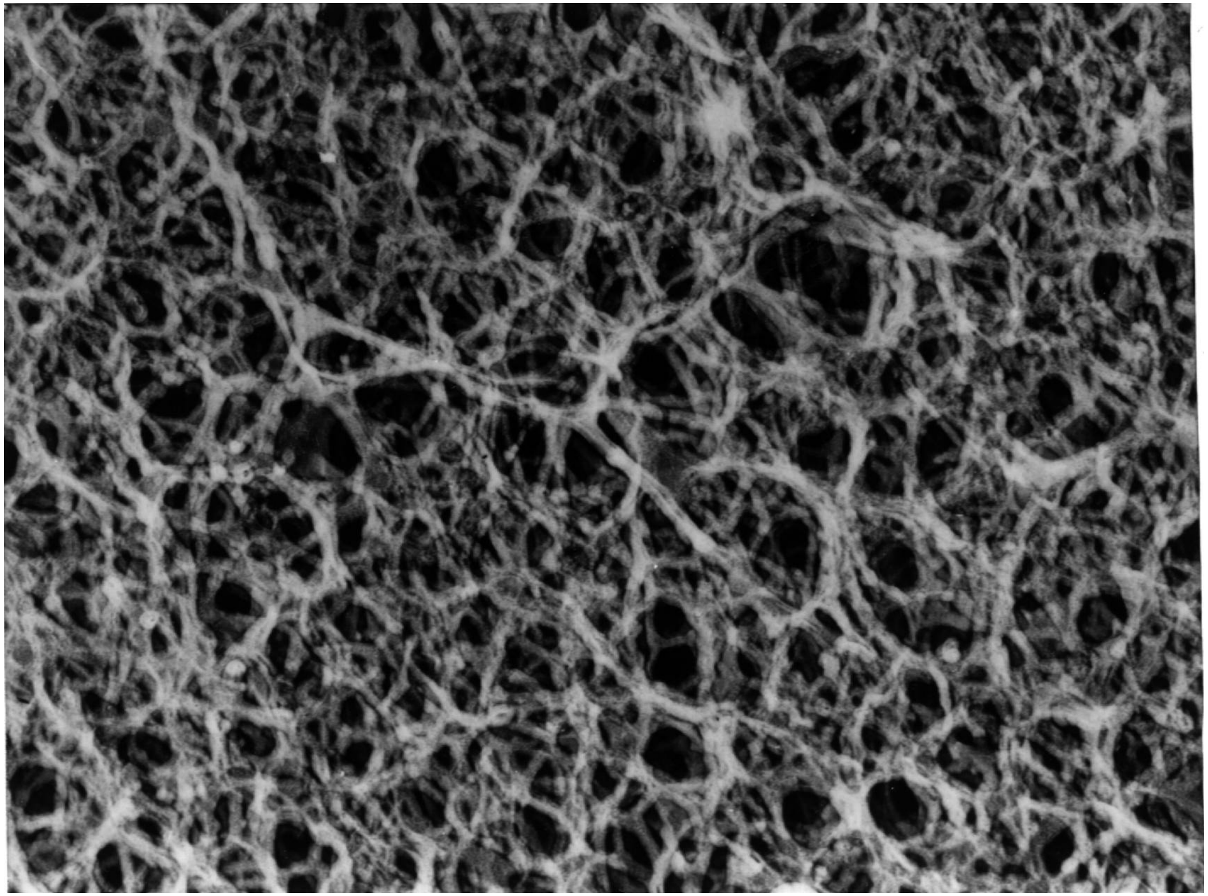
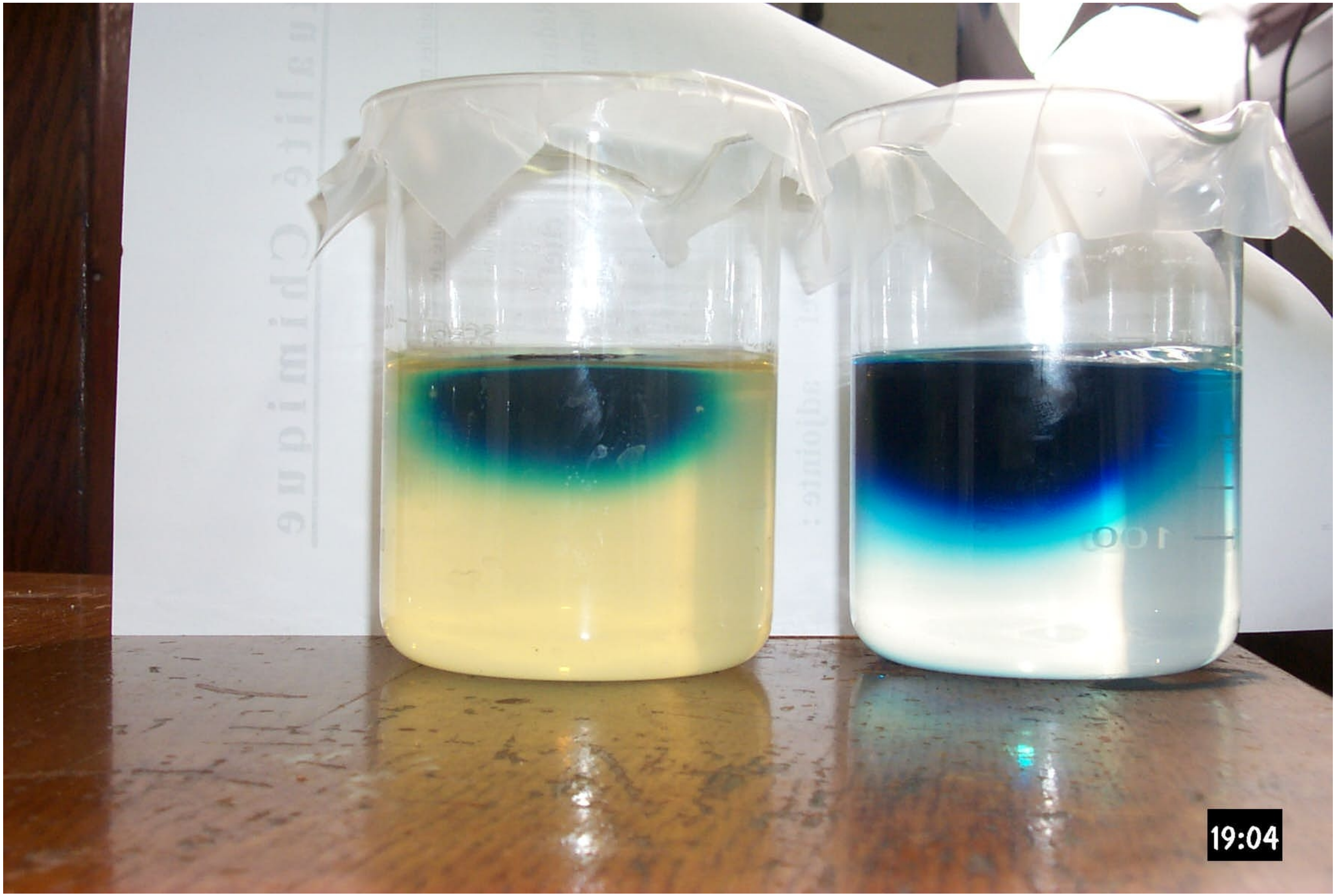
Un gel

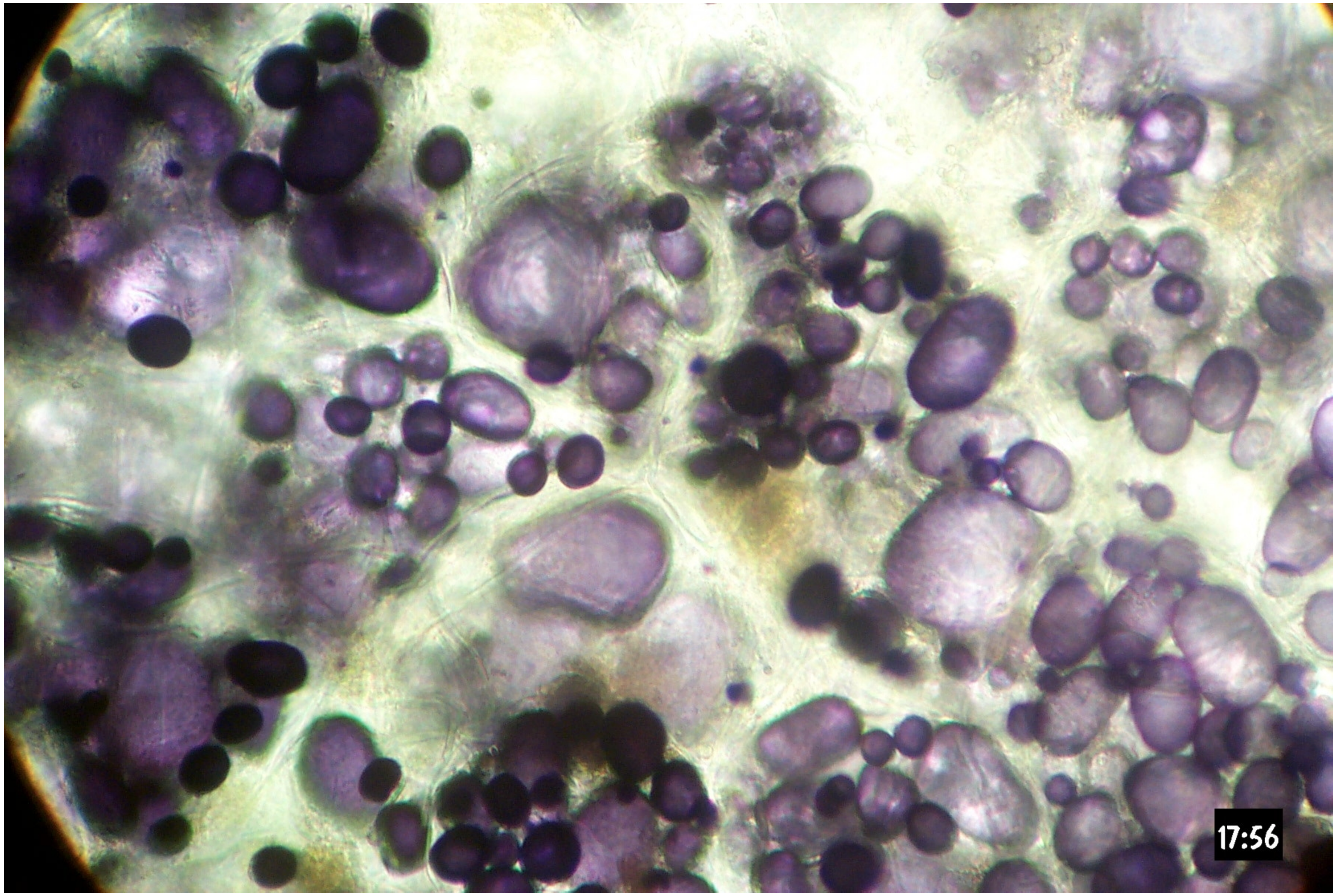


Des gels

Avec des différences

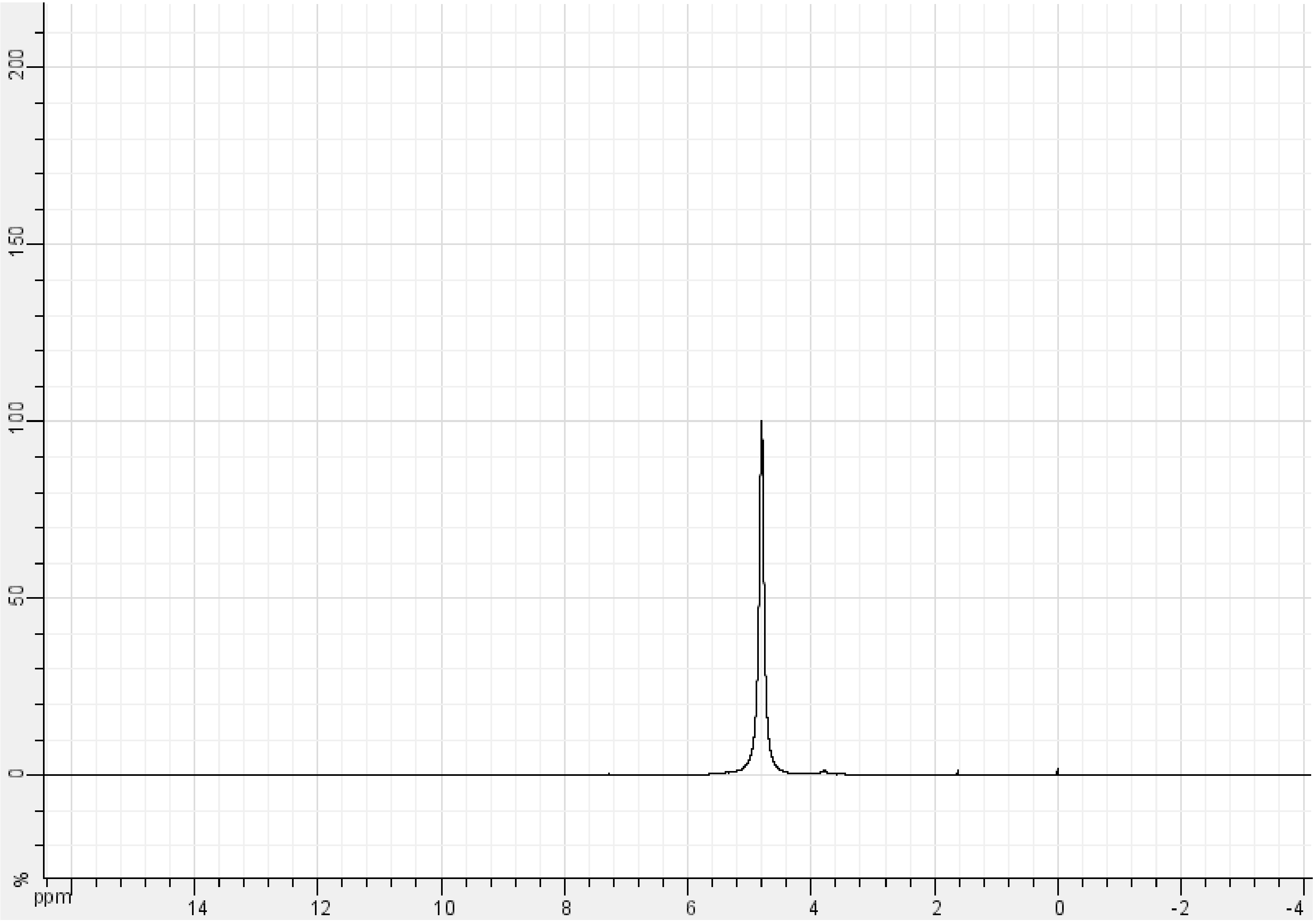


Comment décrire celui-ci ?

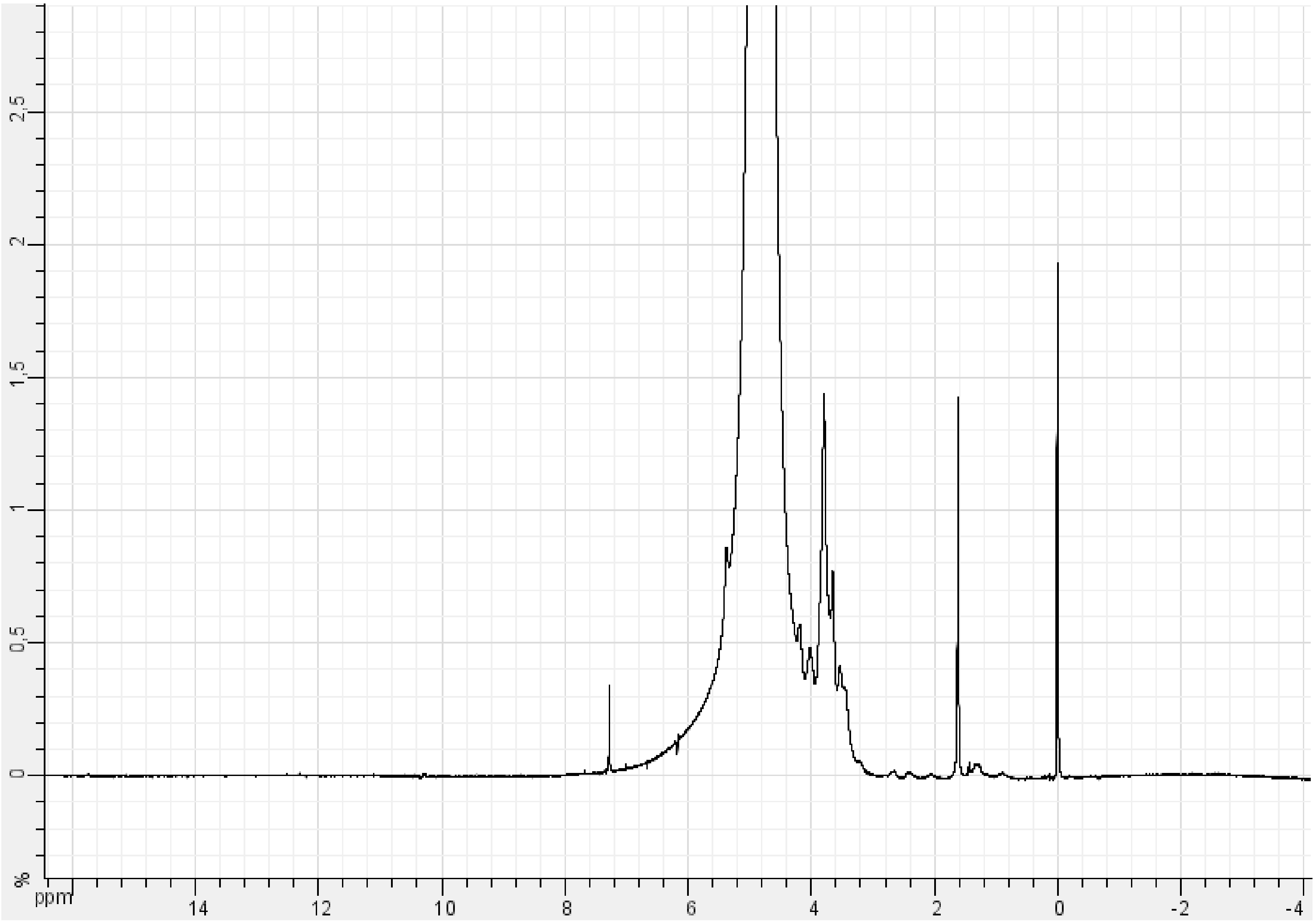


Des principes simples

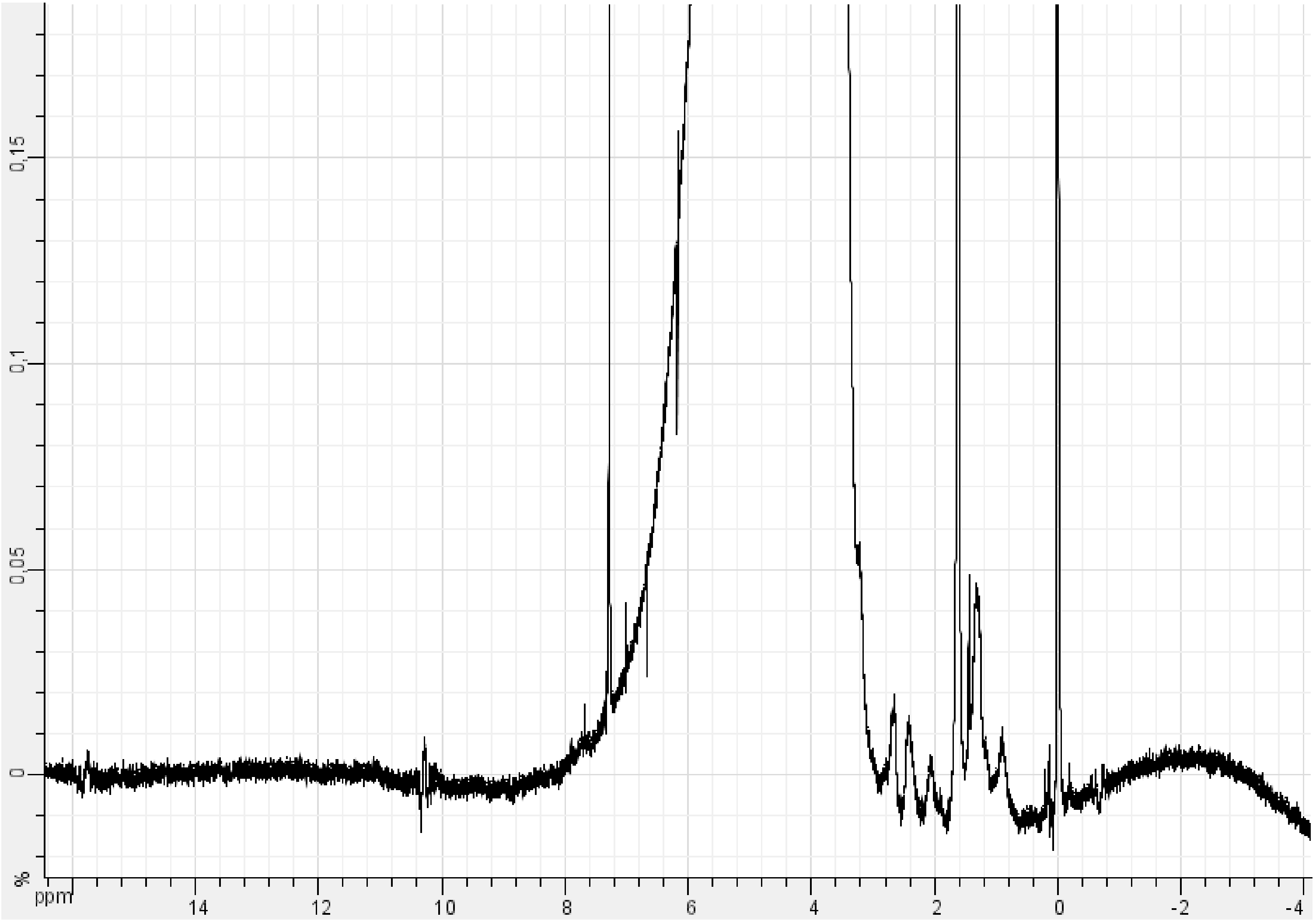
L'idée des ordres de grandeur



HTvK



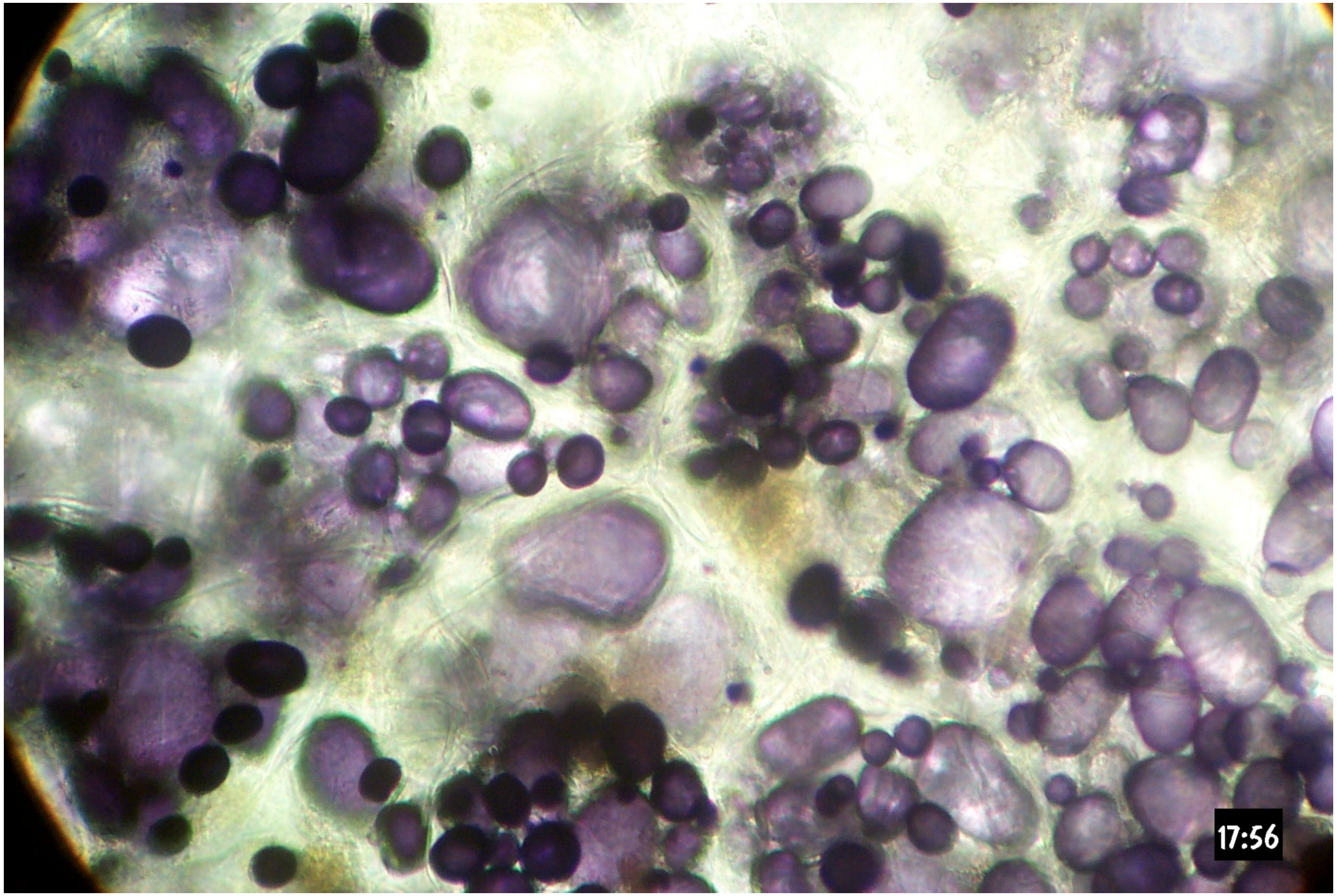
2,5
2
1,5
1
0,5
0
%
ppm
14
12
10
8
6
4
2
0
-2
-4


0,15
0,1
0,05
0
%
ppm
14
12
10
8
6
4
2
0
-2
-4

Les systèmes dispersés simples

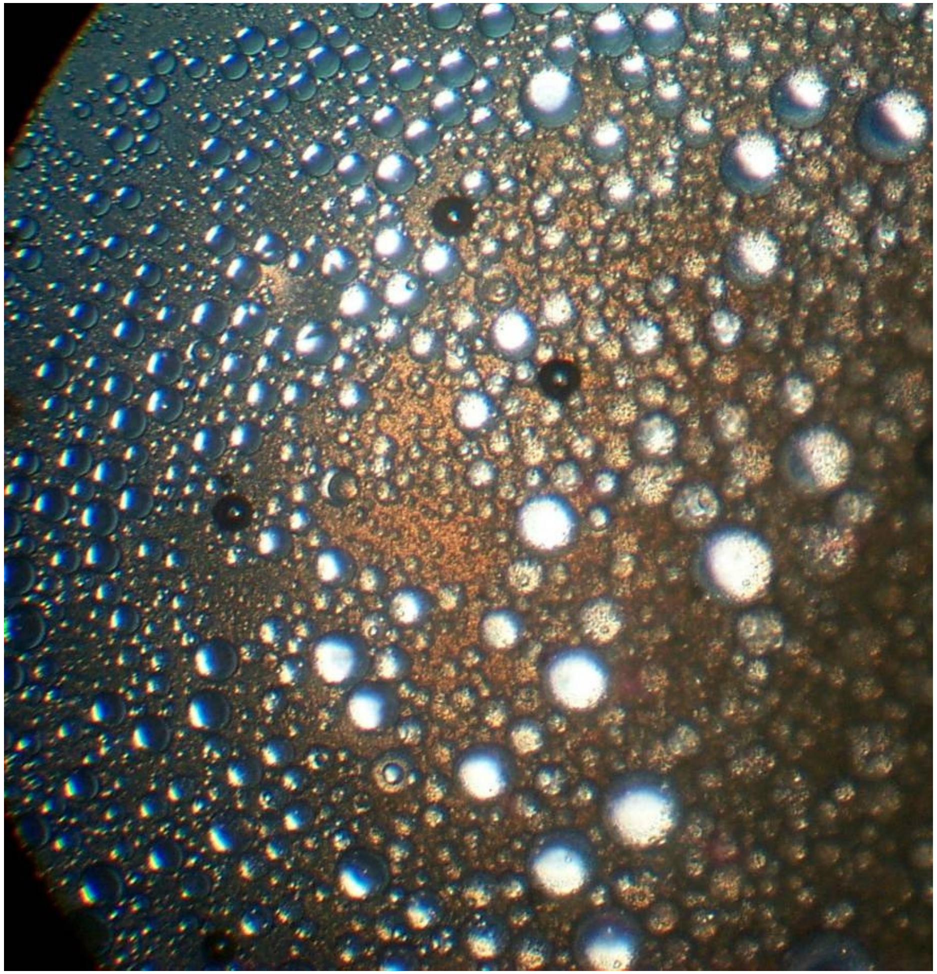
Line dispersed in column	Gas	Liquid	Solid
Gas	Gas (not a disperse system)	Liquid aerosol	Solid aerosol
Liquid	Foam	Emulsion	Suspension
Solid	Solid foam	Gel	Solid suspension

Une échelle à définir



Ici $10^{-6} < R < 10^{-4}$

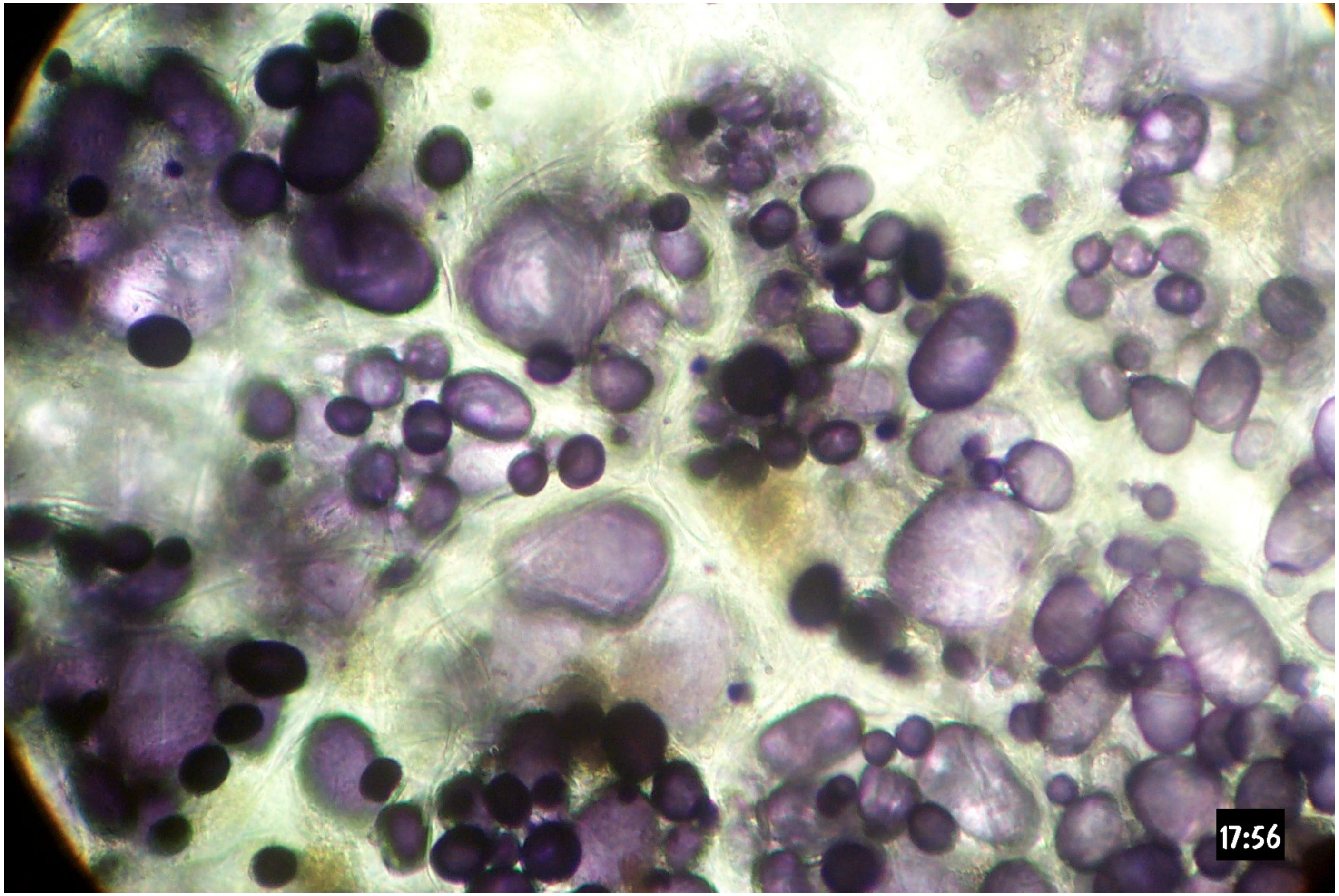
Mayonnaise = O/W $[10^{-6}, 10^{-4}]$



HTvK

De même

Pdt = (S1/W)/S2 [R < 10^{-6}]



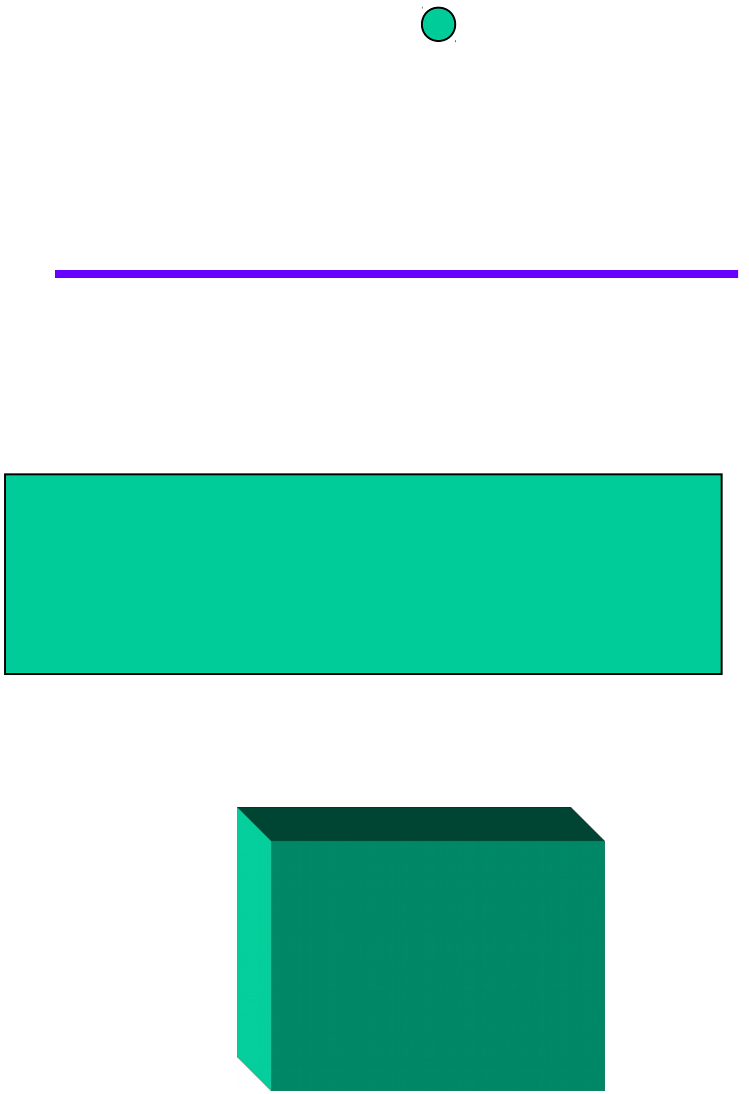
Des dimensions

- D_0 :
- object of dimension 0,
- Dots:

- D_1 :
- Objects of dimension 1,
- lines :

- D_2 :
- Objects of dimension 2,
- Plane, sheets :

- D_3 :
- Objects of dimension 3,
- cubes :



Ceci s'applique à toute échelle

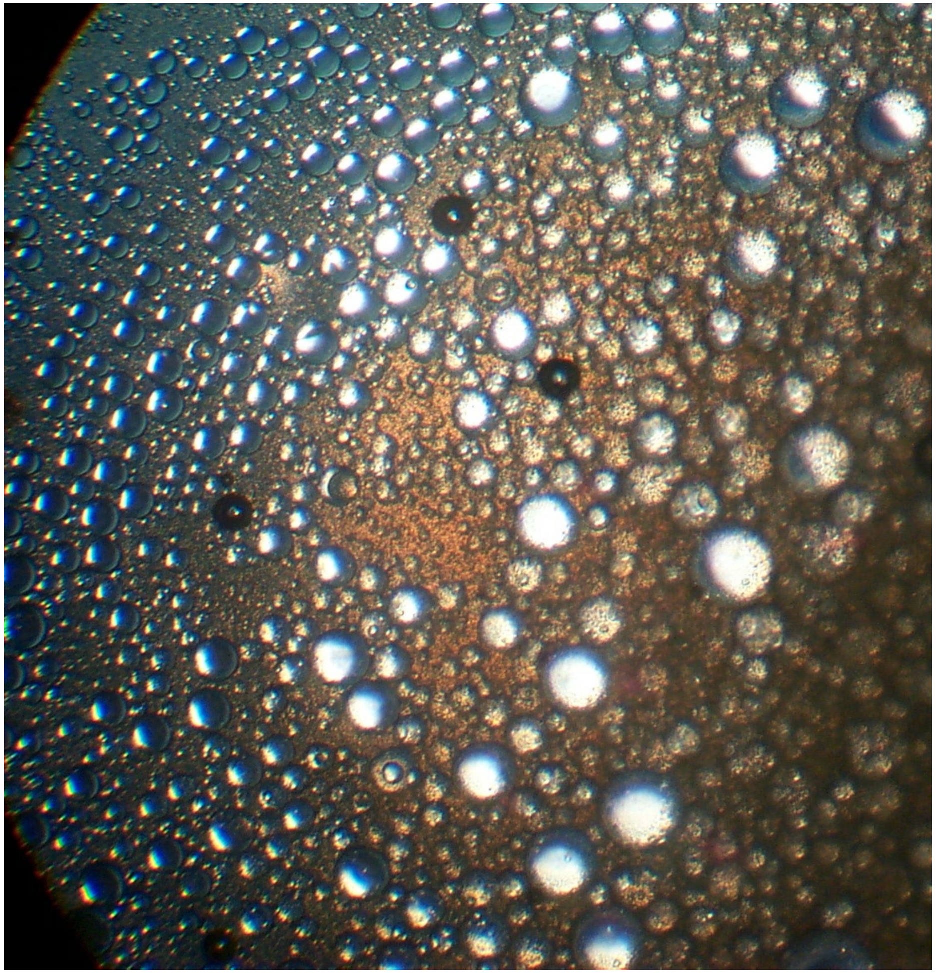
Four symbols :

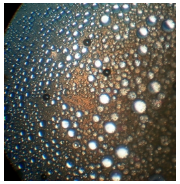
- / : dispersed into
- + : coexistence of phases, mixture
- @ : inclusion
- σ : superposition (according to x,y,z)
- x : interdispersion

Four kind of phases :	**Four kind of object:**
• G : gas	D0
• W : solution	D1
• O : oil	D2
• S1, S2, … : solids	D3

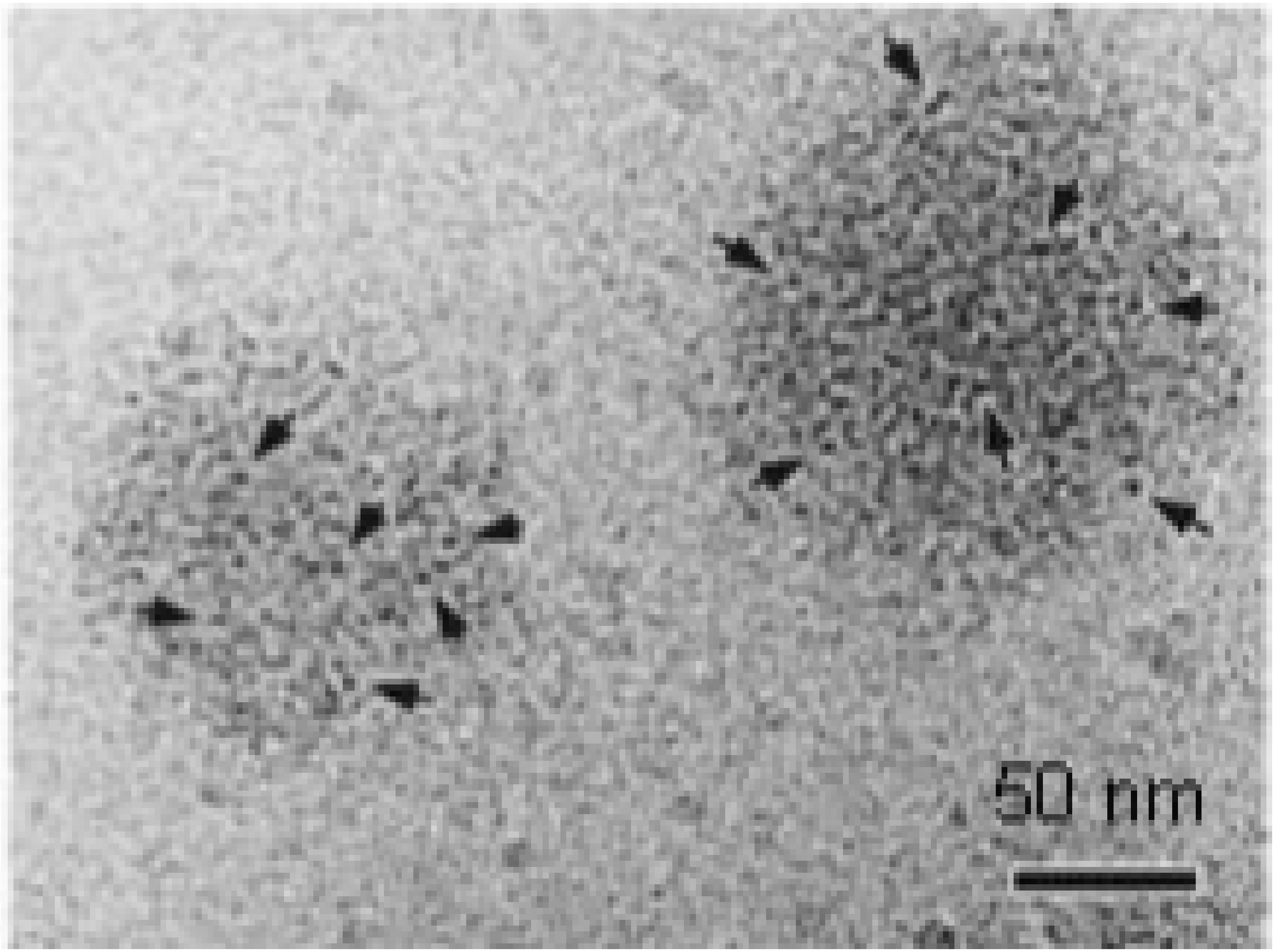
$D_3(S_1)\ \sigma\ D_3(S_2)\ \sigma\ D_2(L)$

$D_0(O)/D_3(W)$

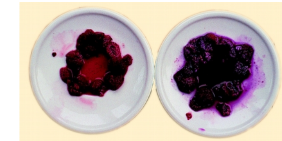


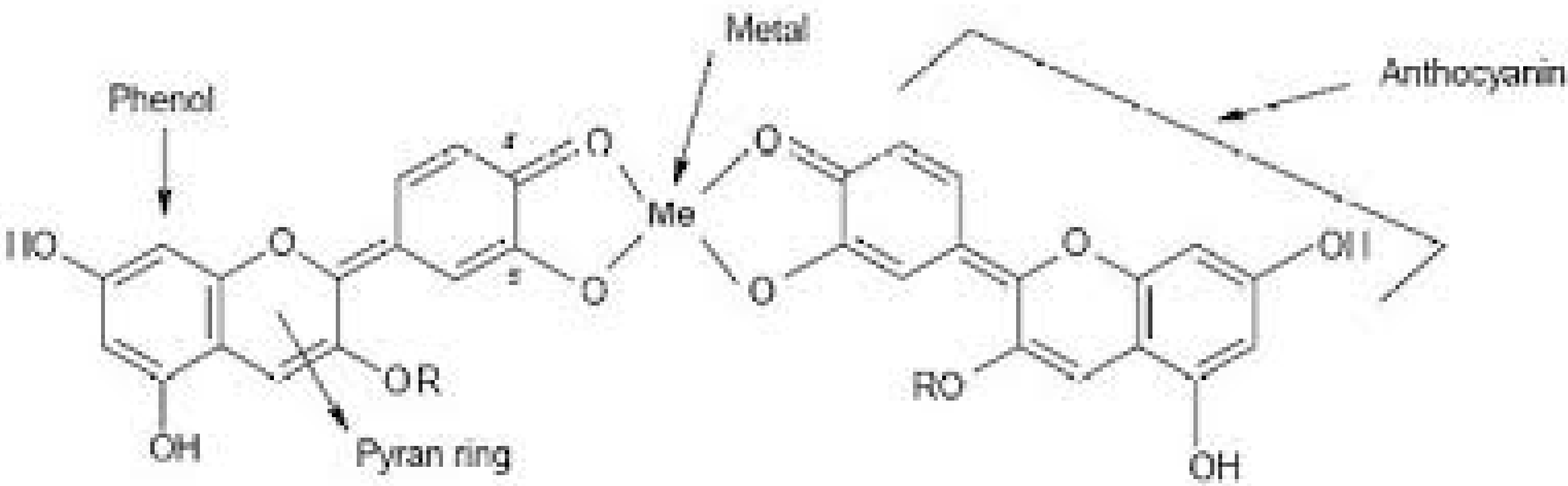


$[D_3(S_1) \times D_3(W)] / D_3(W)$



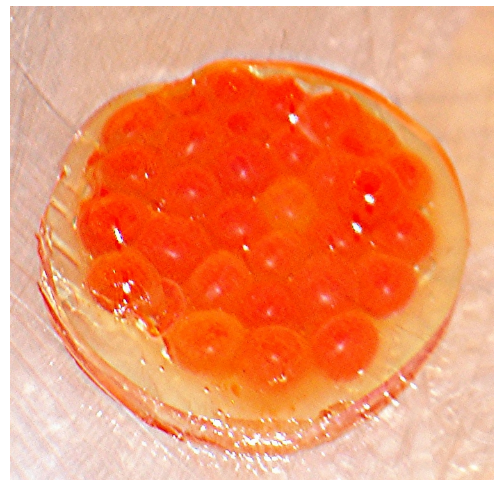
D_3(Me) σ D_3(PPh)





Jusqu'ici, on a tout réussi à décrire… mais le système est-il « complet » ?

$(D_{1,1}(W_1/S_1)@D_{1,2}(W_2/S_2))/D_3$

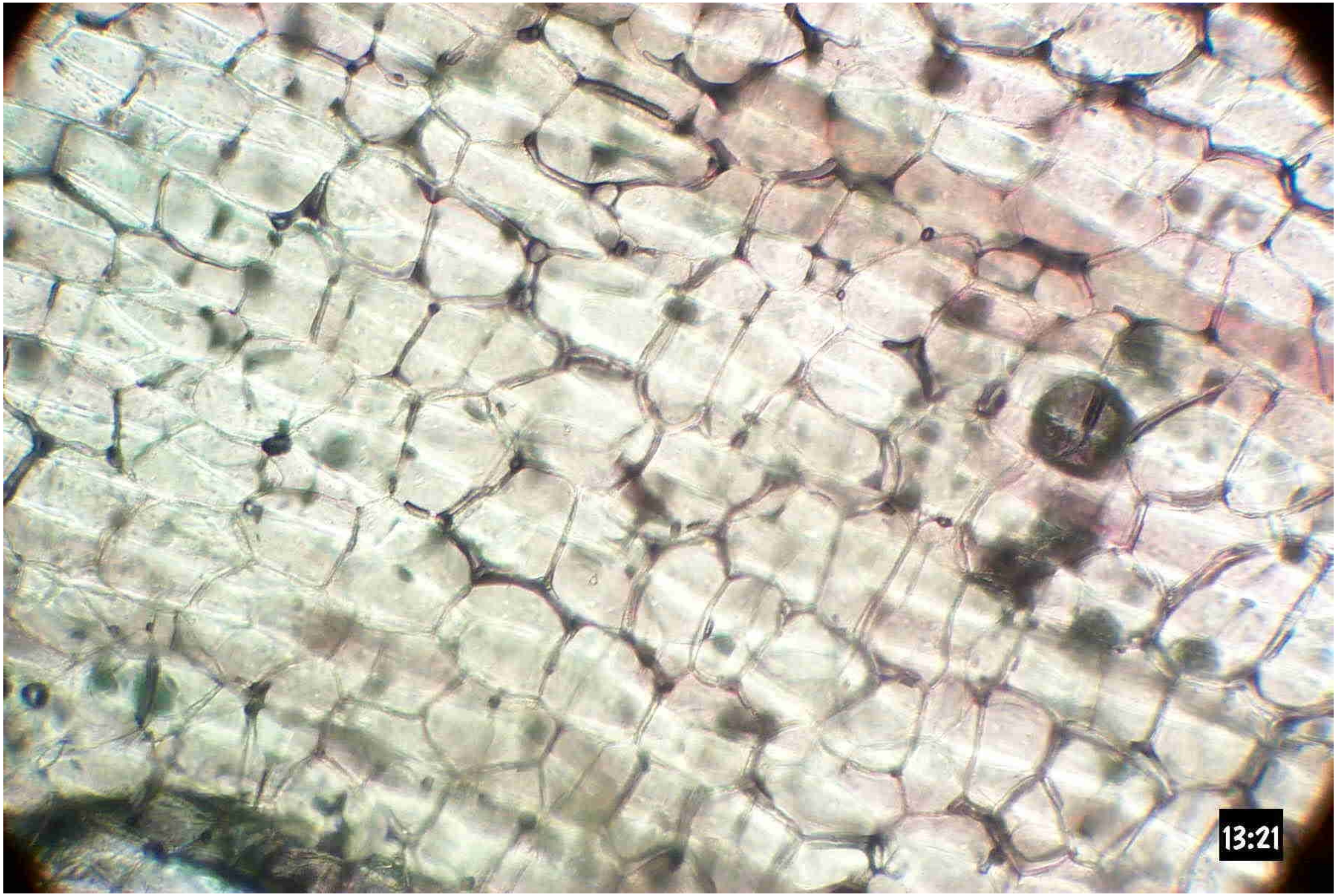


$D_0(W_1)@D_0(W_2/S_1)/D_2(W_3/S_2)$

$D_1(S)/D_3$

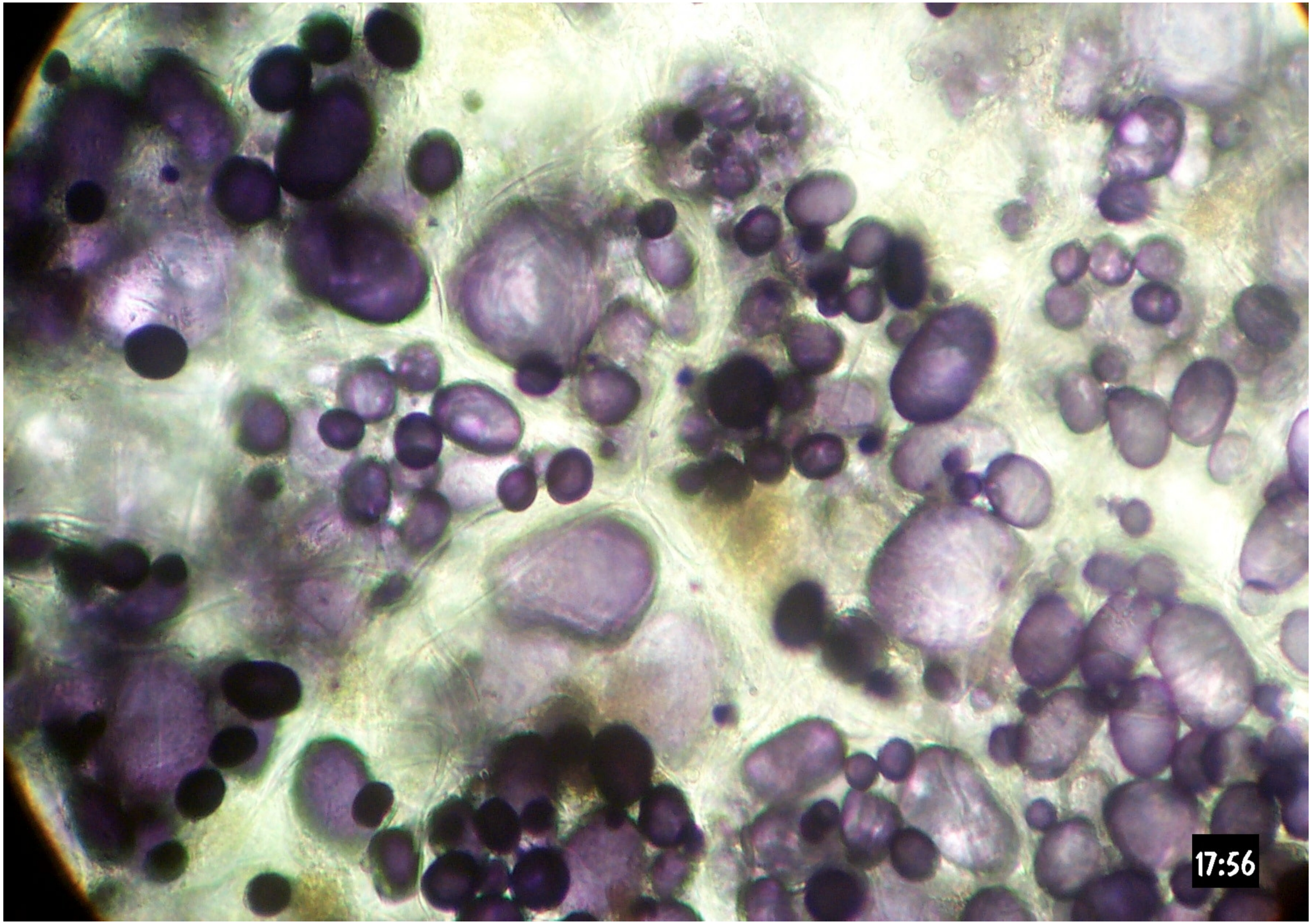
Hervé This, *Formal description for formulation*, in *International Journal for Pharmaceutics, 2007, 344 (1-2), 4-8. doi:10.1016/j.ijpharm.2007.07.046*.

Souvenons nous : des gels D0(W)/D3(S)



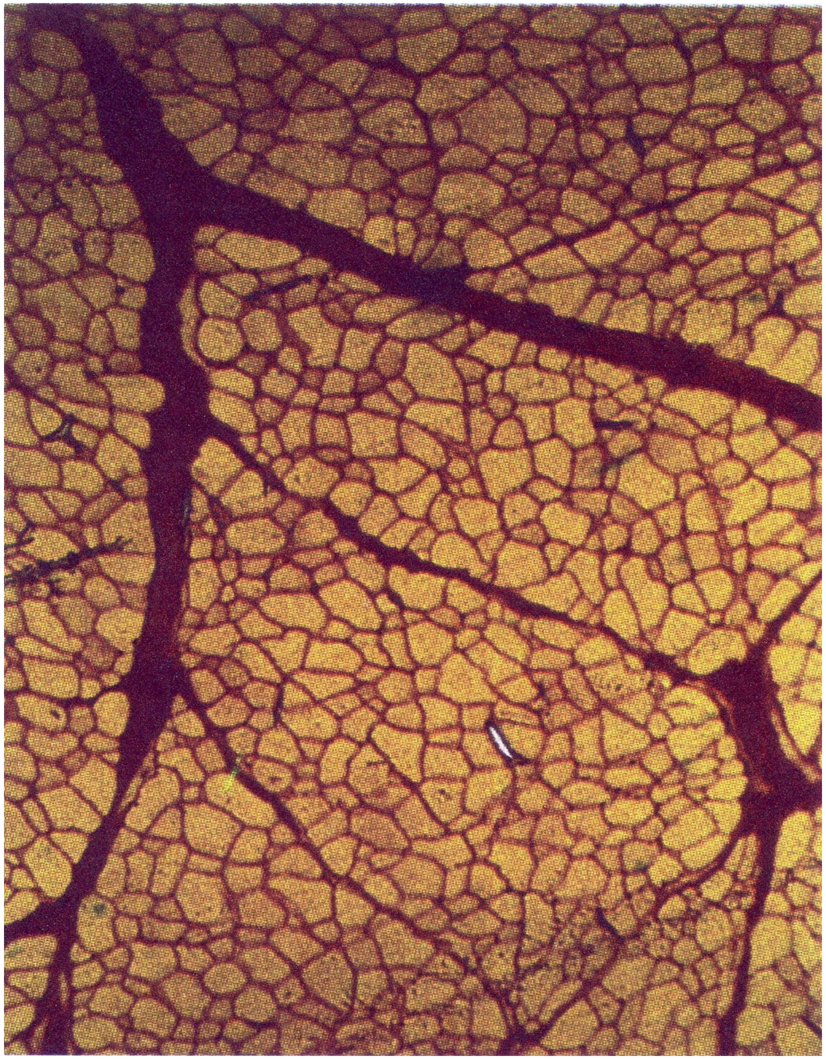
D'où des gels artificiels D0(W)/D3(S)

Parfois des gels complexes : $[D_0(S_1)/D_0(W)]/D_3(S_2)$



Parfois des gels anisotropes :

$D_1(W)/D_3(S)$



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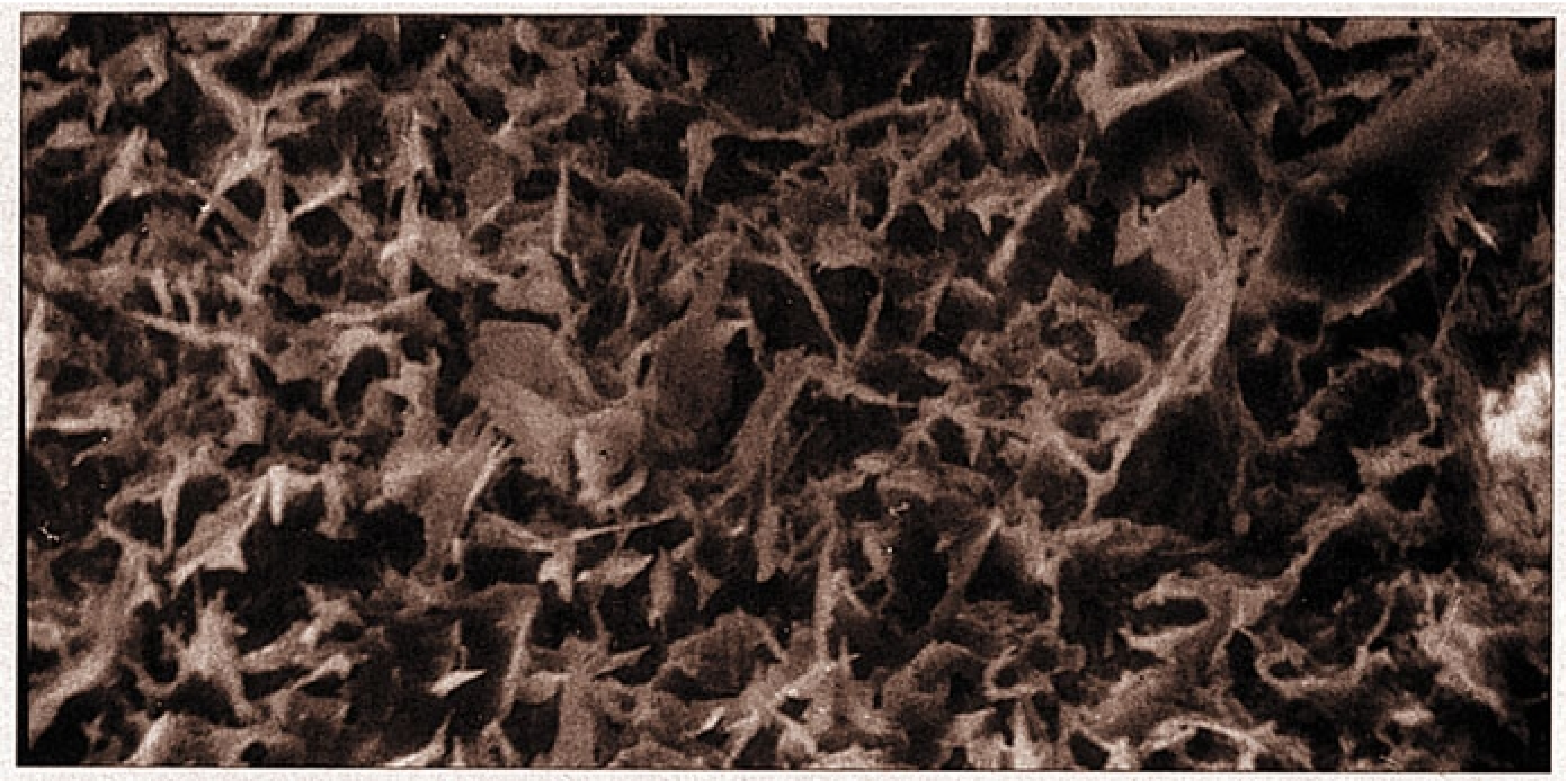
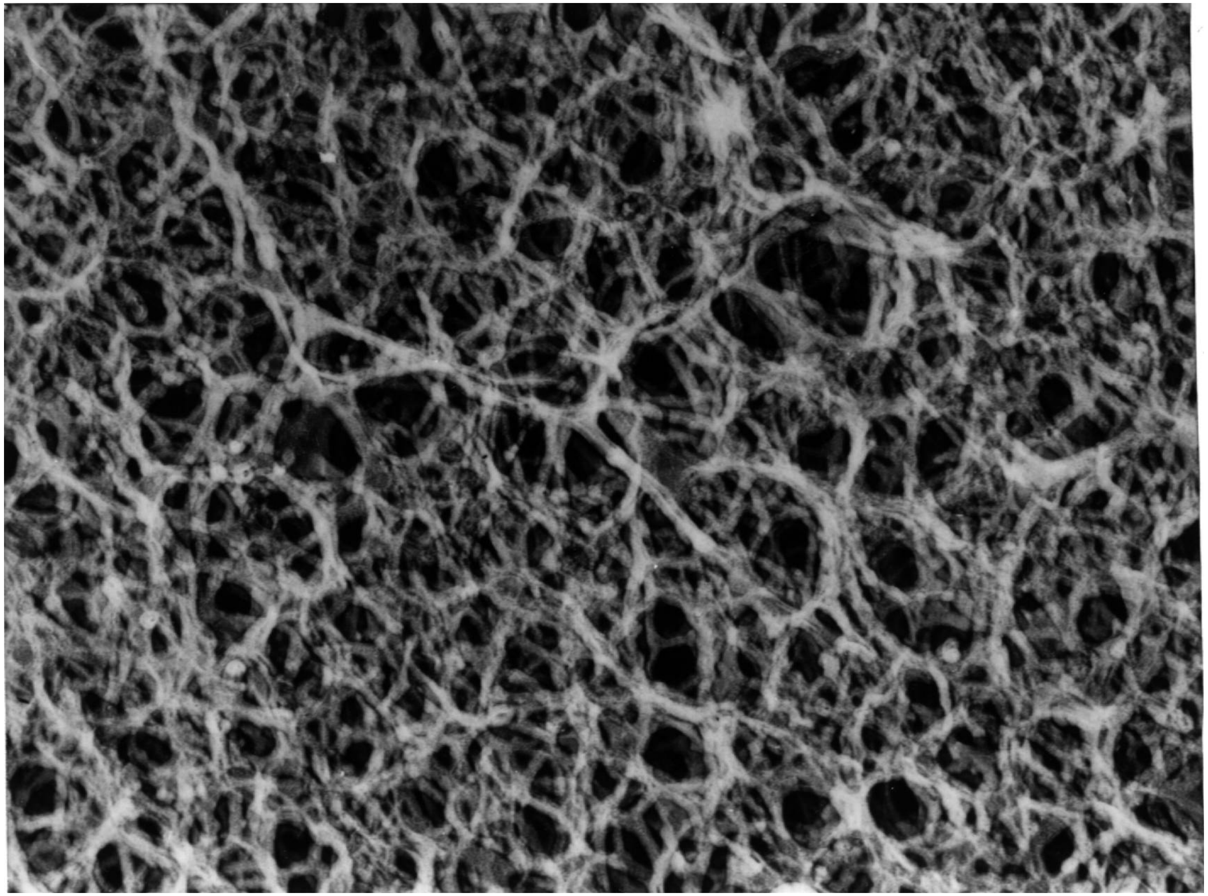
Parfois, des gels qu'on n'a pas bien identifiés : D3(O)xD3(S)

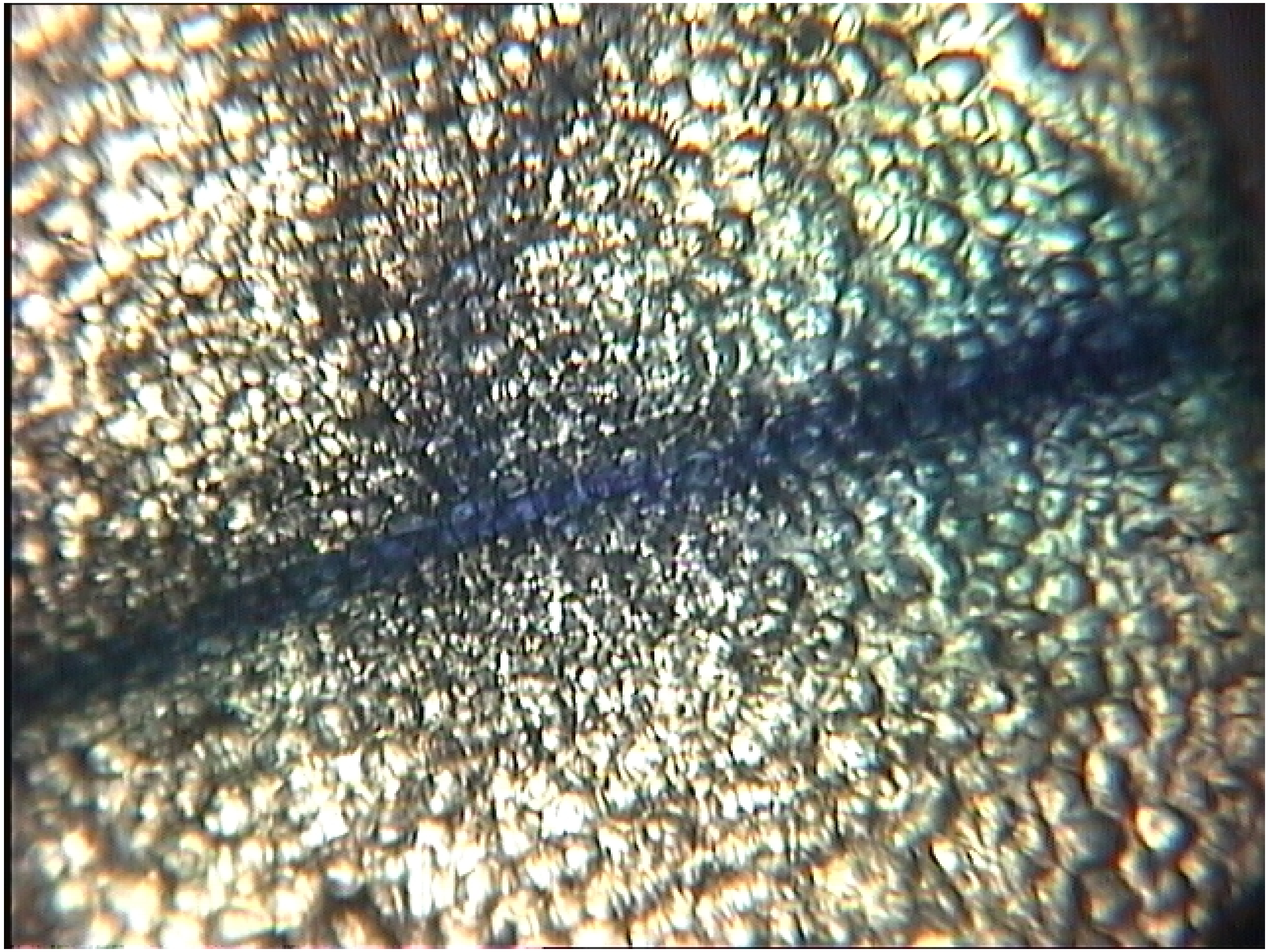


Parfois, de la diffusion est possible

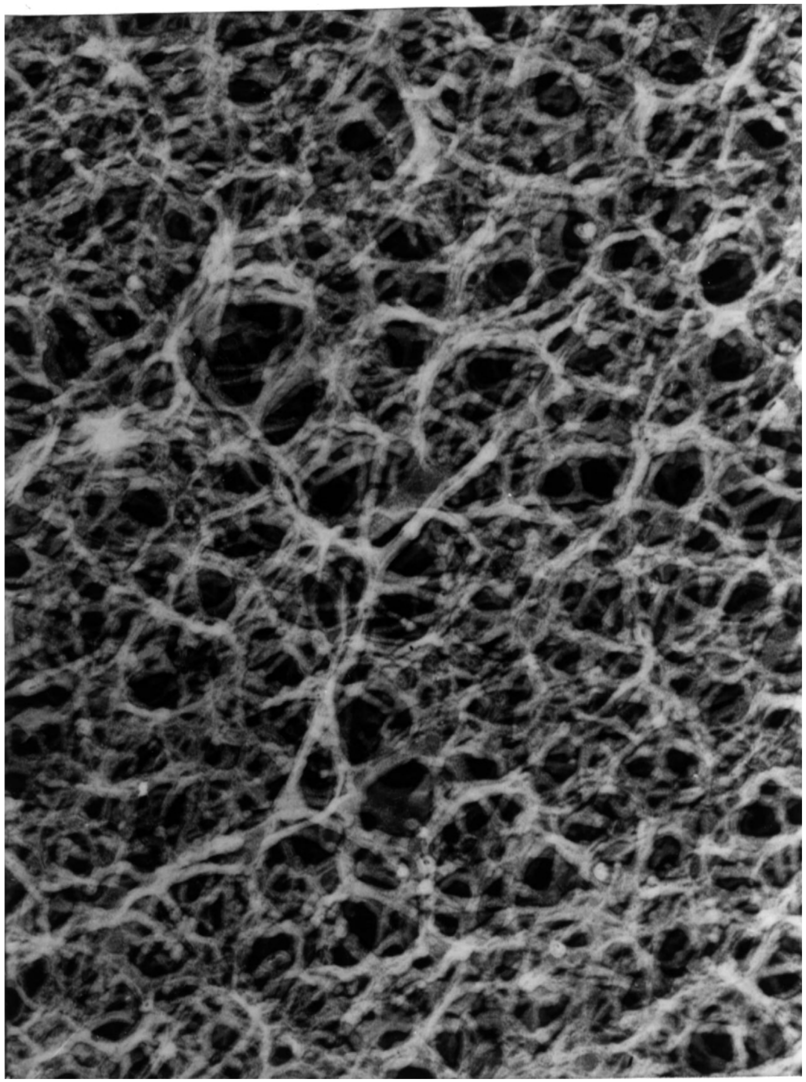
D3(S)xD3(W)

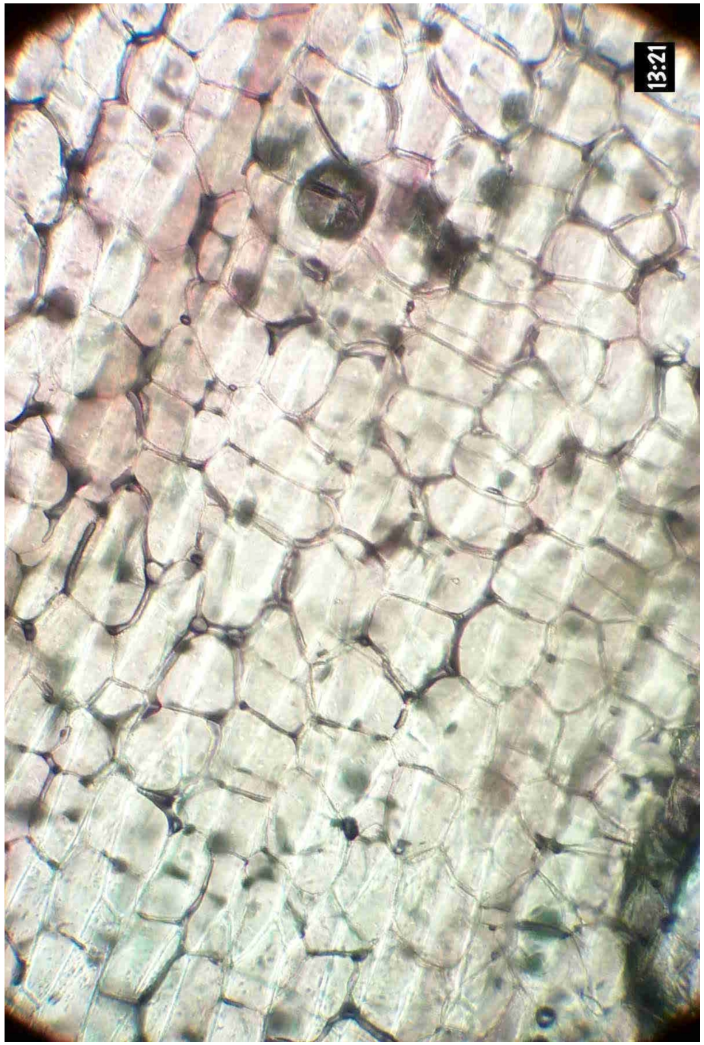


Complex gels are an invitation to do more: [D0(W)+D1(W)]/D3(S)



On distingue enfin les gels





Pour identifier tous les gels de classe 1

```
phase := [W, O, S];
dimension := [D0, D1, D2, D3];
operateur := ["X", "/", "@", "&sigma;"];
formule := ""; graine := "";
for dim1 to 4 do
for phas1 to 3 do
for ope to 4 do
for dim2 to 4 do
for phas2 to 3 do
if phas1 <> phas2 then formule := cat(graine, dimension[dim1], "(", phase[phas1], ")", operateur[ope], dimension[dim2], "(",
   phase[phas2], ")")
end if
end do
end do
end do
 end do
 end do;
```

Les voici

D2(W)/D3(S)
D2(O)xD3(S)
D2(O)/D3(S)
D3(W)xD3(S)
D3(W)/D3(S)
D3(O)xD3(S)
D3(O)/D3(S)
D0(W)/D3(S)
D0(O)/D3(S)
D1(W)xD3(S)
D1(W)/D3(S)
D1(O)xD3(S)
D1(O)/D3(S)
D2(W)xD3(S)

Classe 2.1 :
399 systèmes !

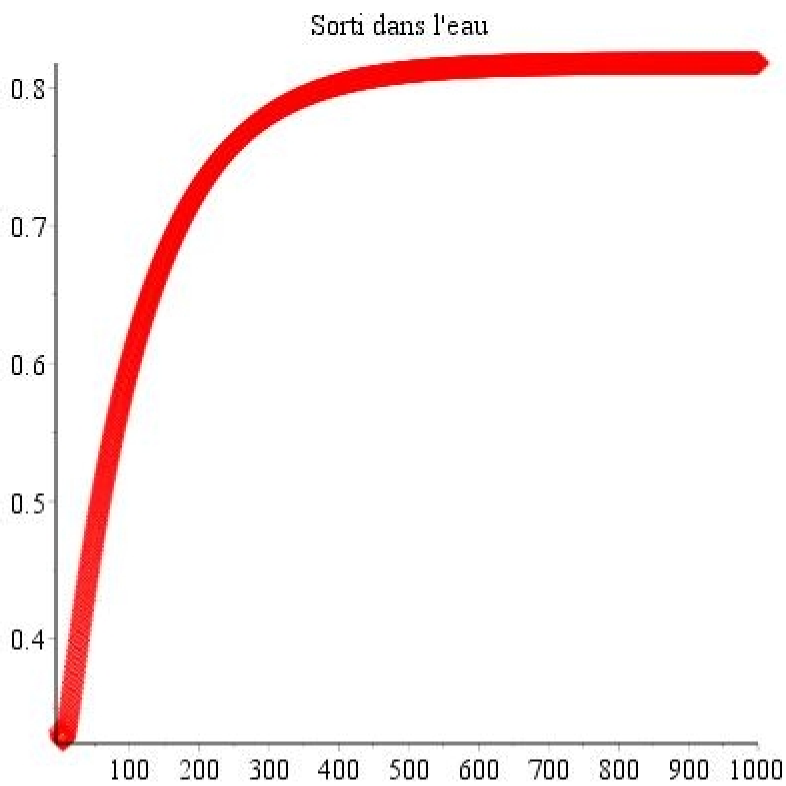
1. [D0(W)xD0(W)]/D3(S)
2. [D0(W)xD1(W)]xD3(S) :
3. [D0(W)xD1(W)]/D3(S)
4. [D0(W)xD1(O)]xD3(S)
5. [D0(W)xD1(O)]/D3(S)
6. [D0(W)xD2(W)]xD3(S)
7. [D0(W)xD2(W)]/D3(S)
8. [D0(W)xD2(O)]xD3(S)
9. [D0(W)xD2(O)]/D3(S)
10. [D0(W)/D0(W)]/D3(S)
11. [D0(W)/D0(O)]/D3(S)
12. [D0(W)/D1(W)]xD3(S)
13. [D0(W)/D1(W)]/D3(S)
14. [D0(W)/D1(O)]xD3(S)
15. [D0(W)/D1(O)]/D3(S)
16. [D0(W)/D2(W)]xD3(S)
17. [D0(W)/D2(W)]/D3(S)
18. [D0(W)/D2(O)]xD3(S)
19. [D0(W)/D2(O)]/D3(S)
20. [D0(W)/D3(W)]xD3(S)
21. [D0(W)/D3(W)]/D3(S)
22. [D0(W)/D3(O)]xD3(S)
23. [D0(W)/D3(O)]/D3(S)
24.[D0(W)@D0(W)]/D3(S)
25. [D0(W)@D1(W)]xD3(S)
26. [D0(W)@D1(W)]/D3(S)
27. [D0(W)@D1(O)]xD3(S)
28. [D0(W)@D1(O)]/D3(S)
29. [D0(W)@D2(W)]xD3(S)
30. [D0(W)@D2(W)]/D3(S)
31. [D0(W)@D2(O)]xD3(S)
32. [D0(W)@D2(O)]/D3(S)
33. [D0(W)@D3(W)]xD3(S)
34. [D0(W)@D3(W)]/D3(S)
35. [D0(W)@D3(O)]/D3(S)
36. [D0(W)σD0(W)]/D3(S)
37. [D0(W)σD0(O)]/D3(S)
38. [D0(W)σD1(W)]xD3(S)
39. [D0(W)σD1(W)]/D3(S)
40. [D0(W)σD1(O)]xD3(S)
41. [D0(W)σD1(O)]/D3(S)
42. [D0(W)σD2(W)]xD3(S)
43. [D0(W)σD2(W)]/D3(S)
44. [D0(W)σD2(O)]xD3(S)
45. [D0(W)σD2(O)]/D3(S)
46. [D0(W)σD3(W)]xD3(S)
47. [D0(W)σD3(W)]/D3(S)
48. [D0(W)σD3(O)]xD3(S)
49. [D0(W)σD3(O)]/D3(S)
50. [D0(W)+D0(W)]/D3(S)
51. [D0(W)+D0(O)]/D3(S)
52. [D0(W)+D1(W)]xD3(S)
53. [D0(W)+D1(W)]/D3(S)
54. [D0(W)+D1(O)]xD3(S)
55. [D0(W)+D1(O)]/D3(S)
56. [D0(W)+D2(W)]xD3(S)
57. [D0(W)+D2(W)]/D3(S)
58. [D0(W)+D2(O)]xD3(S)
59. [D0(W)+D2(O)]/D3(S)
60. [D0(W)+D3(W)]xD3(S)
61. [D0(W)+D3(W)]/D3(S)
62. [D0(W)+D3(O)]xD3(S)
63. [D0(W)+D3(O)]/D3(S)
64. [D0(O)xD0(W)]/D3(S)
65. [D0(O)xD0(O)]/D3(S)
66. [D0(O)xD1(W)]xD3(S)
67. [D0(O)xD1(W)]/D3(S)
68. [D0(O)xD1(O)]xD3(S)
69. [D0(O)xD1(O)]/D3(S)
70. [D0(O)xD2(W)]xD3(S)
71. [D0(O)xD2(W)]/D3(S)
72. [D0(O)xD2(O)]xD3(S)
73. [D0(O)xD2(O)]/D3(S)
74. [D0(O)xD3(W)]xD3(S)
75. [D0(O)xD3(W)]/D3(S)
76. [D0(O)xD3(O)]xD3(S)
77. [D0(O)xD3(O)]/D3(S)
78. [D0(O)/D0(W)]/D3(S)
79. [D0(O)/D0(O)]/D3(S)
80. [D0(O)/D1(W)]xD3(S)
81. [D0(O)/D1(W)]/D3(S)
82. [D0(O)/D1(O)]xD3(S)
83. [D0(O)/D1(O)]/D3(S)
84. [D0(O)/D2(W)]xD3(S)
85. [D0(O)/D2(W)]/D3(S)
86. [D0(O)/D2(O)]xD3(S)
87.[D0(O)/D2(O)]/D3(S)
88. [D0(O)/D3(W)]xD3(S)
89. [D0(O)/D3(W)]/D3(S)
90. [D0(O)/D3(O)]xD3(S)
91. [D0(O)/D3(O)]/D3(S)
92. [D0(O)@D0(W)]/D3(S)
93. [D0(O)@D0(O)]xD3(S)
94. [D0(O)@D0(O)]/D3(S)
95. [D0(O)@D1(W)]xD3(S)
96. [D0(O)@D1(W)]/D3(S)
97. [D0(O)@D1(O)]xD3(S)
98. [D0(O)@D1(O)]/D3(S)
99. [D0(O)@D2(W)]xD3(S)
100. [D0(O)@D2(W)]/D3(S)
101. [D0(O)@D2(O)]xD3(S)
102. [D0(O)@D2(O)]/D3(S)
103. [D0(O)@D3(W)]xD3(S)
104. [D0(O)@D3(W)]/D3(S)
105. [D0(O)@D3(O)]/D3(S)
106. [D0(O)σD0(O)]/D3(S)
107. [D0(O)σD1(W)]xD3(S)
108. [D0(O)σD1(W)]/D3(S)
109. [D0(O)σD1(O)]xD3(S)
110. [D0(O)σD1(O)]/D3(S)
111. [D0(O)σD2(W)]xD3(S)
112. [D0(O)σD2(W)]/D3(S)
113. [D0(O)σD2(O)]xD3(S)
114. [D0(O)σD2(O)]/D3(S)
115. [D0(O)σD3(W)]xD3(S)
116. [D0(O)σD3(W)]/D3(S)
117. [D0(O)σD3(O)]xD3(S)
118. [D0(O)σD3(O)]/D3(S)
119. [D0(O)+D0(O)]/D3(S)
120. [D0(O)+D1(W)]xD3(S)
121. [D0(O)+D1(W)]/D3(S)
122. [D0(O)+D1(O)]xD3(S)
123. [D0(O)+D1(O)]/D3(S)
124. [D0(O)+D2(W)]xD3(S)
125. [D0(O)+D2(W)]/D3(S)
126. [D0(O)+D2(O)]xD3(S)
127. [D0(O)+D2(O)]/D3(S)
128. [D0(O)+D3(W)]xD3(S)
129. [D0(O)+D3(W)]/D3(S)
130. [D0(O)+D3(O)]xD3(S)
131. [D0(O)+D3(O)]/D3(S)
132. [D1(W)xD1(W)]xD3(S)
133. [D1(W)xD1(W)]/D3(S)
134. [D1(W)xD1(O)]xD3(S)
135. [D1(W)xD1(O)]/D3(S)
136. [D1(W)xD2(W)]xD3(S)
137. [D1(W)xD2(W)]/D3(S)
138. [D1(W)xD2(O)]xD3(S)
139. [D1(W)xD2(O)]/D3(S)
140. [D1(W)xD3(W)]xD3(S)
141. [D1(W)xD3(W)]/D3(S)
142. [D1(W)xD3(O)]xD3(S)
143. [D1(W)xD3(O)]/D3(S)
144. [D1(W)/D0(W)]xD3(S)
145. [D1(W)/D0(W)]/D3(S)
146. [D1(W)/D0(O)]/D3(S)
147. [D1(W)/D1(W)]xD3(S)
148. [D1(W)/D1(W)]/D3(S)
149. [D1(W)/D1(O)]xD3(S)
150. [D1(W)/D1(O)]/D3(S)
151. [D1(W)/D2(W)]xD3(S)
152. [D1(W)/D2(W)]/D3(S)
153. [D1(W)/D2(O)]xD3(S)
154. [D1(W)/D2(O)]/D3(S)
155. [D1(W)/D3(W)]xD3(S)
156. [D1(W)/D3(W)]/D3(S)
157. [D1(W)/D3(O)]/D3(S)
158. [D1(W)@D0(W)]/D3(S)
159. [D1(W)@D0(O)]/D3(S)
160. [D1(W)@D1(W)]xD3(S)
161. [D1(W)@D1(W)]/D3(S)
162. [D1(W)@D1(O)]xD3(S)
163. [D1(W)@D1(O)]/D3(S)
164. [D1(W)@D2(W)]xD3(S)
165. [D1(W)@D2(W)]/D3(S)
166. [D1(W)@D2(O)]xD3(S)
167. [D1(W)@D2(O)]/D3(S)
168. [D1(W)@D3(W)]xD3(S)
169. [D1(W)@D3(W)]/D3(S)
170. [D1(W)@D3(O)]xD3(S)
171. [D1(W)@D3(O)]/D3(S)
172. D1(W)σD1(W)]xD3(S)
173. [D1(W)σD1(W)]/D3(S)
174. [D1(W)σD1(O)]xD3(S)
175. [D1(W)σD1(O)]/D3(S)
176. [D1(W)σD2(W)]xD3(S)
177. [D1(W)σD2(W)]/D3(S)
178. [D1(W)σD2(O)]xD3(S)
179. [D1(W)σD2(O)]/D3(S)
180. [D1(W)σD3(W)]xD3(S)
181. [D1(W)σD3(W)]/D3(S)
182. [D1(W)σD3(O)]xD3(S)
183. [D1(W)σD3(O)]/D3(S)
184. [D1(W)+D1(W)]xD3(S)
185. [D1(W)+D1(W)]/D3(S)
186. [D1(W)+D1(O)]xD3(S)
187. [D1(W)+D1(O)]/D3(S)
188. [D1(W)+D2(W)]xD3(S)
189. [D1(W)+D2(W)]/D3(S)
190. [D1(W)+D2(O)]xD3(S)
191. [D1(W)+D2(O)]/D3(S)
192. [D1(W)+D3(W)]xD3(S)
193. [D1(W)+D3(W)]/D3(S)
194. [D1(W)+D3(O)]xD3(S)
195. [D1(W)+D3(O)]/D3(S)
196. [D1(O)xD1(O)]xD3(S)
197. [D1(O)xD1(O)]/D3(S)
198. [D1(O)xD2(W)]xD3(S)
199. [D1(O)xD2(W)]/D3(S)
200. [D1(O)xD2(O)]xD3(S)

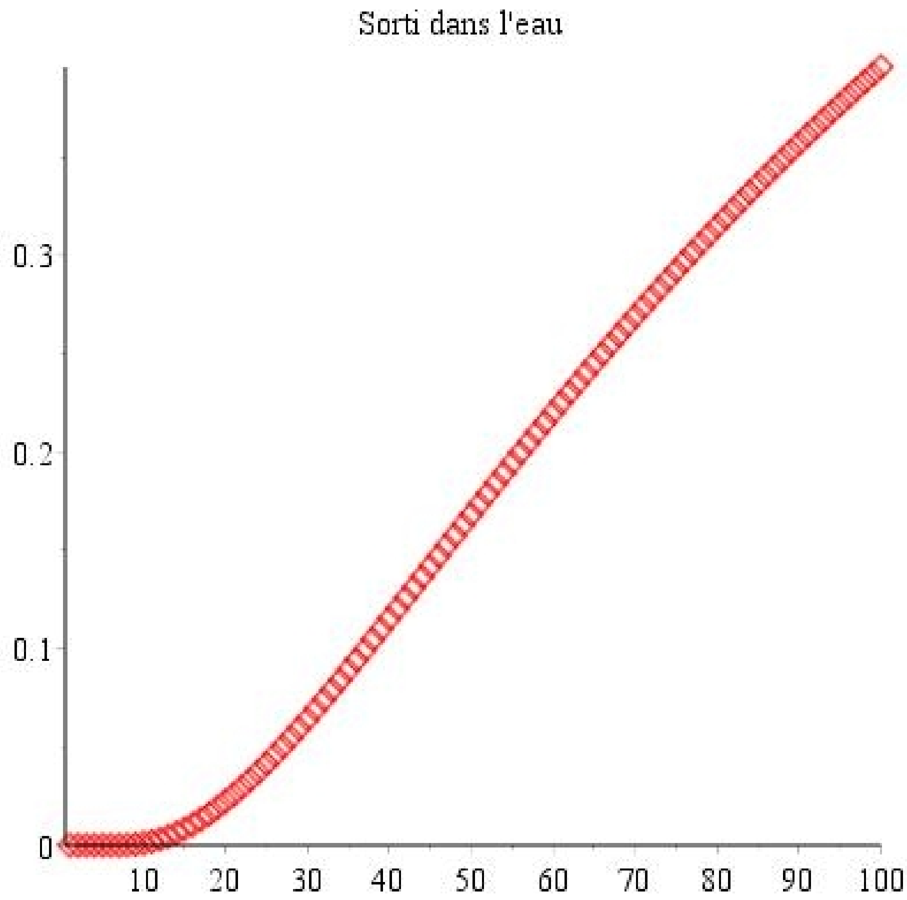
Classe 2.1 : ici aussi

201. [D1(O)xD2(O)]/D3(S)
202. [D1(O)xD3(W)]xD3(S)
203. [D1(O)xD3(W)]/D3(S)
204. [D1(O)xD3(O)]xD3(S)
205. [D1(O)xD3(O)]/D3(S)
206. [D1(O)/D0(W)]xD3(S)
207. [D1(O)/D0(W)]/D3(S)
208. [D1(O)/D0(O)]/D3(S)
209. [D1(O)/D1(W)]xD3(S)
210. [D1(O)/D1(W)]/D3(S)
211. [D1(O)/D1(O)]xD3(S)
212. [D1(O)/D1(O)]/D3(S)
213. [D1(O)/D2(W)]xD3(S)
214. [D1(O)/D2(W)]/D3(S)
215. [D1(O)/D2(O)]xD3(S)
216. [D1(O)/D2(O)]/D3(S)
217. [D1(O)/D3(W)]xD3(S)
218. [D1(O)/D3(W)]/D3(S)
219. [D1(O)/D3(O)]xD3(S)
220. [D1(O)/D3(O)]/D3(S)
221. [D1(O)@D0(W)]/D3(S)
222. [D1(O)@D0(O)]/D3(S)
223. [D1(O)@D1(W)]xD3(S)
224. [D1(O)@D1(W)]/D3(S)
225. [D1(O)@D1(O)]xD3(S)
226. [D1(O)@D1(O)]/D3(S)
227. [D1(O)@D2(W)]xD3(S)
228. [D1(O)@D2(W)]/D3(S)
229. [D1(O)@D2(O)]xD3(S)
230. [D1(O)@D2(O)]/D3(S)
231. [D1(O)@D3(W)]xD3(S)
232. [D1(O)@D3(W)]/D3(S)
233. [D1(O)@D3(O)]xD3(S)
234. [D1(O)@D3(O)]/D3(S)
235. [D1(O)σD1(O)]xD3(S)
236. [D1(O)σD1(O)]/D3(S)
237. [D1(O)σD2(W)]xD3(S)
238. [D1(O)σD2(W)]/D3(S)
239. [D1(O)σD2(O)]xD3(S)
240. [D1(O)σD2(O)]/D3(S)
241. [D1(O)σD3(W)]xD3(S)
242. [D1(O)σD3(W)]/D3(S)
243. [D1(O)σD3(O)]xD3(S)
244. [D1(O)σD3(O)]/D3(S)
245. [D1(O)+D2(W)]xD3(S)
246. [D1(O)+D2(W)]/D3(S)
247. [D1(O)+D2(O)]xD3(S)
248. [D1(O)+D2(O)]/D3(S)
249. [D1(O)+D3(W)]xD3(S)
250. [D1(O)+D3(W)]/D3(S)
251. [D1(O)+D3(O)]xD3(S)
252. [D1(O)+D3(O)]/D3(S)
253. [D2(W)xD2(W)]xD3(S)
254. [D2(W)xD2(W)]/D3(S)
255. [D2(W)xD2(O)]xD3(S)
256. [D2(W)xD2(O)]/D3(S)
257. [D2(W)xD3(W)]xD3(S)
258. [D2(W)xD3(W)]/D3(S)
259. [D2(W)xD3(O)]xD3(S)
260. [D2(W)xD3(O)]/D3(S)
261. [D2(W)/D0(W)]xD3(S)
262. [D2(W)/D0(W)]/D3(S)
263. [D2(W)/D0(O)]/D3(S)
264. [D2(W)/D1(W)]xD3(S)
265. [D2(W)/D1(W)]/D3(S)
266. [D2(W)/D1(O)]xD3(S)
267. [D2(W)/D1(O)]/D3(S)
268. [D2(W)/D2(W)]xD3(S)
269. [D2(W)/D2(W)]/D3(S)
270. [D2(W)/D2(O)]xD3(S)
271. [D2(W)/D2(O)]/D3(S)
272. [D2(W)/D3(W)]xD3(S)
273. [D2(W)/D3(W)]/D3(S)
274. [D2(W)/D3(O)]xD3(S)
275. [D2(W)/D3(O)]/D3(S)
276. [D2(W)@D0(W)]/D3(S)
277. [D2(W)@D0(O)]/D3(S)
278. [D2(W)@D1(W)]xD3(S)
279. [D2(W)@D1(W)]/D3(S)
280. [D2(W)@D1(O)]xD3(S)
281. [D2(W)@D1(O)]/D3(S)
282. [D2(W)@D2(W)]xD3(S)
283. [D2(W)@D2(W)]/D3(S)
284. [D2(W)@D2(O)]xD3(S)
285. [D2(W)@D2(O)]/D3(S)
286. [D2(W)@D3(W)]xD3(S)
287. [D2(W)@D3(W)]/D3(S)
288. [D2(W)@D3(O)]xD3(S)
289. [D2(W)@D3(O)]/D3(S)
290. [D2(W)σD2(O)]xD3(S)
291. [D2(W)σD2(O)]/D3(S)
292. [D2(W)σD3(W)]xD3(S)
293. [D2(W)σD3(W)]/D3(S)
294. [D2(W)σD3(O)]xD3(S)
295. [D2(W)σD3(O)]/D3(S)
296. [D2(W)+D2(W)]xD3(S)
297. [D2(W)+D2(W)]/D3(S)
298. [D2(W)+D2(O)]xD3(S)
299. [D2(W)+D2(O)]/D3(S)
300. [D2(W)+D3(W)]xD3(S)
301. [D2(W)+D3(W)]/D3(S)
302. [D2(W)+D3(O)]xD3(S)
303. [D2(W)+D3(O)]/D3(S)
304. [D2(O)xD2(O)]xD3(S)
305. [D2(O)xD2(O)]/D3(S)
306. [D2(O)xD3(W)]xD3(S)
307. [D2(O)xD3(W)]/D3(S)
308. [D2(O)xD3(O)]xD3(S)
309. [D2(O)xD3(O)]/D3(S)
310. [D2(O)/D0(W)]/D3(S)
311. [D2(O)/D0(O)]/D3(S)
312. [D2(O)/D1(W)]xD3(S)
313. [D2(O)/D1(W)]/D3(S)
314. [D2(O)/D1(O)]xD3(S)
315. [D2(O)/D1(O)]/D3(S)
316. [D2(O)/D2(W)]xD3(S)
317. [D2(O)/D2(W)]/D3(S)
318. [D2(O)/D2(O)]xD3(S)
319. [D2(O)/D2(O)]/D3(S)
320. [D2(O)/D3(W)]xD3(S)
321. [D2(O)/D3(W)]/D3(S)
322. [D2(O)/D3(O)]xD3(S)
323. [D2(O)/D3(O)]/D3(S)
324. [D2(O)@D0(W)]/D3(S)
325. [D2(O)@D0(O)]/D3(S)
326. [D2(O)@D1(W)]xD3(S)
327. [D2(O)@D1(W)]/D3(S)
328. [D2(O)@D1(O)]xD3(S)
329. [D2(O)@D1(O)]/D3(S)
330. [D2(O)@D2(W)]xD3(S)
331. [D2(O)@D2(W)]/D3(S)
332. [D2(O)@D2(O)]xD3(S)
333. [D2(O)@D2(O)]/D3(S)
334. [D2(O)@D3(W)]xD3(S)
335. [D2(O)@D3(W)]/D3(S)
336. [D2(O)@D3(O)]xD3(S)
337. [D2(O)@D3(O)]/D3(S)
338. [D2(O)σD2(O)]xD3(S)
339. [D2(O)σD2(O)]/D3(S)
340. [D2(O)σD3(W)]xD3(S)
341. [D2(O)σD3(W)]/D3(S)
342. [D2(O)σD3(O)]xD3(S)
343. [D2(O)σD3(O)]/D3(S)
344. [D2(O)+D2(O)]xD3(S)
345. [D2(O)+D2(O)]/D3(S)
346. [D2(O)+D3(W)]xD3(S)
347. [D2(O)+D3(W)]/D3(S)
348. [D2(O)+D3(O)]xD3(S)
349. [D2(O)+D3(O)]/D3(S)
350. [D3(W)xD3(W)]xD3(S)
351. [D3(W)xD3(W)]/D3(S)
352. [D3(W)xD3(O)]xD3(S)
353. [D3(W)xD3(O)]/D3(S)
354. [D3(W)/D2(W)]xD3(S)
355. [D3(W)/D2(W)]/D3(S)
356. [D3(W)/D2(O)]xD3(S)
357. [D3(W)/D2(O)]/D3(S)
358. [D3(W)/D3(W)]xD3(S)
359. [D3(W)/D3(W)]/D3(S)
360. [D3(W)/D3(O)]xD3(S)
361. [D3(W)/D3(O)]/D3(S)
362. [D3(W)@D2(W)]xD3(S)
363. [D3(W)@D2(W)]/D3(S)
364. [D3(W)@D2(O)]xD3(S)
365. [D3(W)@D2(O)]/D3(S)
366. [D3(W)@D3(W)]xD3(S)
367. [D3(W)@D3(W)]/D3(S)
368. [D3(W)@D3(O)]xD3(S)
369. [D3(W)@D3(O)]/D3(S)
370. [D3(W)σD3(W)]xD3(S)
371. [D3(W)σD3(W)]/D3(S)
372. [D3(W)σD3(O)]xD3(S)
373. [D3(W)σD3(O)]/D3(S)
374. [D3(W)+D3(W)]xD3(S)
375. [D3(W)+D3(W)]/D3(S)
376. [D3(W)+D3(O)]xD3(S)
377. [D3(W)+D3(O)]/D3(S)
378. [D3(O)xD3(O)]xD3(S)
379. [D3(O)xD3(O)]/D3(S)
380. [D3(O)/D2(W)]xD3(S)
381. [D3(O)/D2(W)]/D3(S)
382. [D3(O)/D2(O)]xD3(S)
383. [D3(O)/D2(O)]/D3(S)
384. [D3(O)/D3(W)]xD3(S)
385. [D3(O)/D3(W)]/D3(S)
386. [D3(O)/D3(O)]xD3(S)
387. [D3(O)/D3(O)]/D3(S)
388. [D3(O)@D2(W)]xD3(S)
389. [D3(O)@D2(W)]/D3(S)
390. [D3(O)@D2(O)]xD3(S)
391. [D3(O)@D2(O)]/D3(S)
392. [D3(O)@D3(W)]xD3(S)
393. [D3(O)@D3(W)]/D3(S)
394. [D3(O)@D3(O)]xD3(S)
395. [D3(O)@D3(O)]/D3(S)
396. [D3(O)σD3(O)]xD3(S)
397. [D3(O)σD3(O)]/D3(S)
398. [D3(O)+D3(O)]xD3(S)
399. [D3(O)+D3(O)]/D3(S)

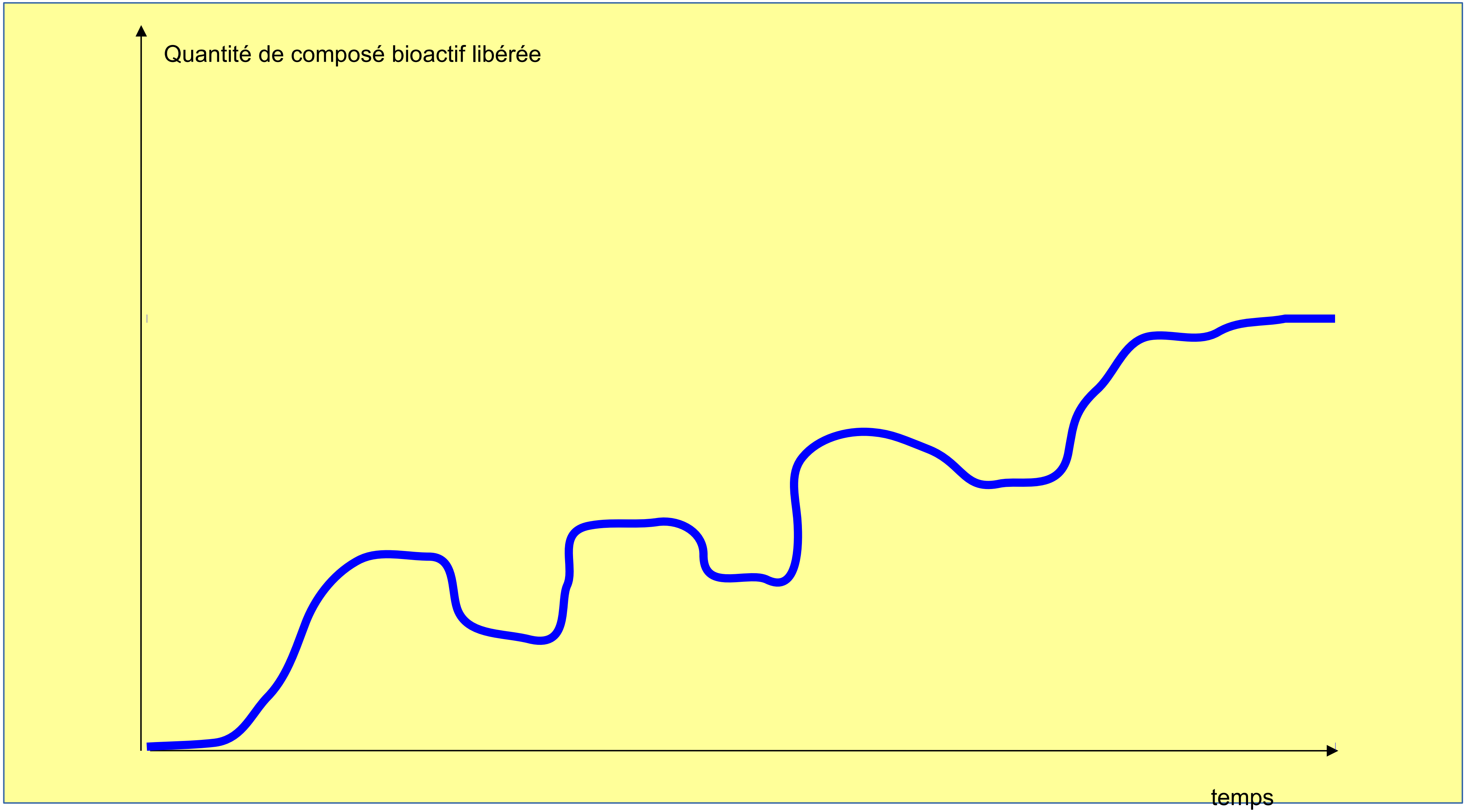
Mais aussi des gels de classe 2.2 : un liquide and un non liquide dans le solide

Des « bioactivités » différentes





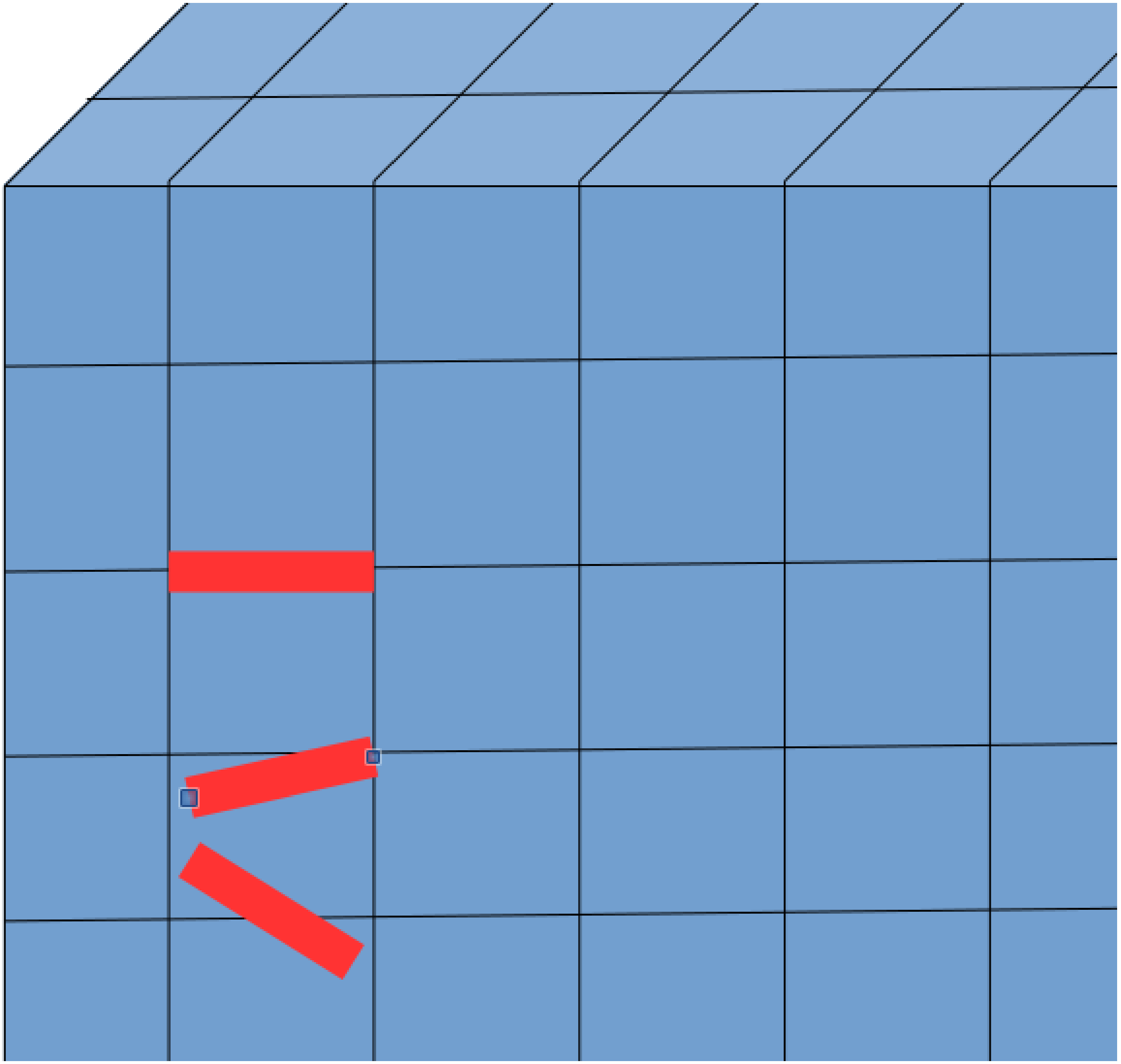
Peut-on faire ceci ?



Oui

Plus des « dynagels »

If E is the binding energy,
The proportion of linked ends at one end at a temperature T is :
$K \exp(-E/k_B T)$



De même pour les suspensions

https://doi.org/10.1351/goldbook.C01177

Suspension : A liquid in which solid particles are dispersed.

Colloidal suspension: A suspension in which the size of the particles lies in the colloidal range.

Source:

PAC, 1972, 31, 577. (Manual of Symbols and Terminology for Physicochemical Quantities and Units, Appendix II: Definitions, Terminology and Symbols in Colloid and Surface Chemistry) on page 606

Cite as: IUPAC. Compendium of Chemical Terminology, 2nd ed. (the "Gold Book"). Compiled by A. D. McNaught and A. Wilkinson. Blackwell Scientific Publications, Oxford (1997). Online version (2019-) created by S. J. Chalk. ISBN 0-9678550-9-8. https://doi.org/10.1351/goldbook.

Suspensions Classe 1

```
A := [];
phase := [W, O, S];
dimension := [D0, D1, D2, D3];
operateur := ["X", "/", "@", "&sigma;"];
formule := "";
graine := "";
for dim1 to 4 do
for phas1 to 3 do
for ope to 2 do
formule := cat(graine, dimension[dim1], "(", phase[phas1], ")", operateur[ope], dimension[4], "(", phase[1],
   ")"); A := [op(A), formule];
end do;
end do;
end do;
formule;
writedata("suspensions_classe_1_ds_W_brut", A, string);
```

24 systèmes

D0(S)/D3(W) : simple classic dispersion
D1(S)/D3(W) : dispersion of filaments
D2(S)/D3(W) : dispersion of feuillets
D0(S)/D3(O) : dispersion in oil
D1(S)/D3(O) : dispersion of filaments in oil
D2(S)/D3(O) : dispersion of sheets in oil

Suspensions de classe 2

```
A := [];
dimension := [D0, D1, D2, D3];
phase := [W, O, S];
operateur := ["X", "/", "@", "&sigma;", "+"];
formule := "";
graine := "";
for dim1 to 4 do
for phas1 to 3 do
for ope1 to 5 do
for dim2 to 4 do
for phas2 to 3 do
for ope2 to 2 do
if ope1 <> operateur[2] then formule := cat(graine, "[", dimension[dim1], "(", phase[phas1], ")", operateur[ope1], dimension[dim2], "(", phase[phas2], ")", "]", operateur[ope2],
  "D3(S)"); A := [op(A), formule];
end if;
end do;
end do;
end do;
end do;
end do;
end do;
writedata("liste deux phases trois objets", A, string);
```

362 systèmes

```
[D0(G)+D1(S)]/D3(O)
[D0(G)+D1(S)]/D3(O)
[D0(G)+D1(S)]/D3(O)
[D0(G)+D1(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD1(S)]/D3(O)
[D0(O)XD1(S)]/D3(O)
[D0(O)XD1(S)]/D3(O)
```

```
[D0(G)&sigma;D0(S)]/D3(O)
[D0(G)&sigma;D0(S)]/D3(O)
[D0(G)&sigma;D0(S)]/D3(O)
[D0(G)&sigma;D0(S)]/D3(O)
[D0(G)&sigma;D1(S)]/D3(O)
[D0(G)&sigma;D1(S)]/D3(O)
[D0(G)&sigma;D1(S)]/D3(O)
[D0(G)&sigma;D1(S)]/D3(O)
[D0(G)&sigma;D2(S)]/D3(O)
[D0(G)&sigma;D2(S)]/D3(O)
[D0(G)&sigma;D2(S)]/D3(O)
[D0(G)&sigma;D2(S)]/D3(O)
[D0(G)+D0(S)]/D3(O)
[D0(G)+D0(S)]/D3(O)
[D0(G)+D0(S)]/D3(O)
[D0(G)+D0(S)]/D3(O)
```

```
[D0(G)+D1(S)]/D3(O)
[D0(G)+D1(S)]/D3(O)
[D0(G)+D1(S)]/D3(O)
[D0(G)+D1(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(G)+D2(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD0(S)]/D3(O)
[D0(O)XD1(S)]/D3(O)
[D0(O)XD1(S)]/D3(O)
[D0(O)XD1(S)]/D3(O)
```

Et d'autres possibilités

Classes of higher orders

Suspensions in foams

Suspensions in emulsions

Suspensions in gels

With the same code

La grande question

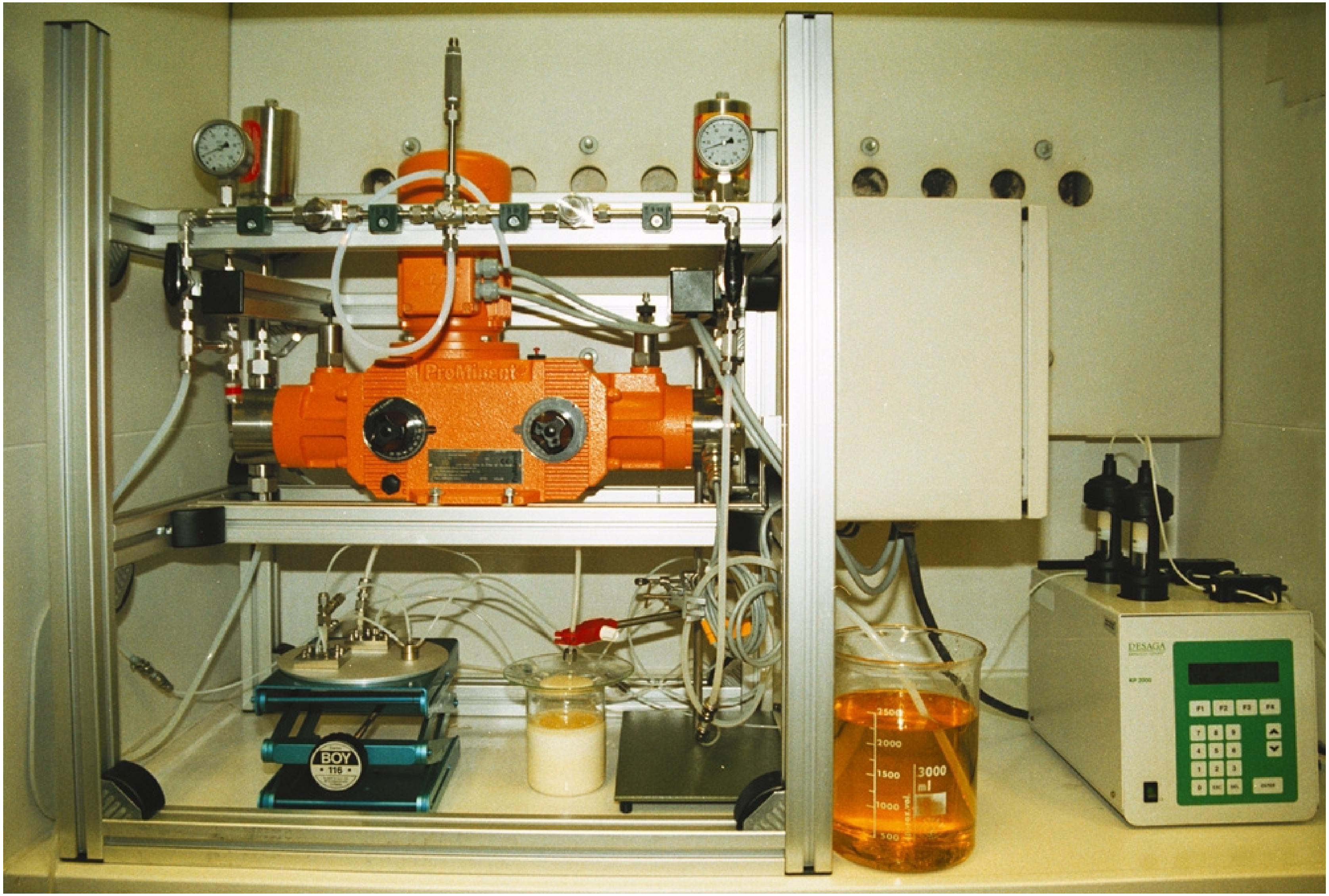
{formula}

↓

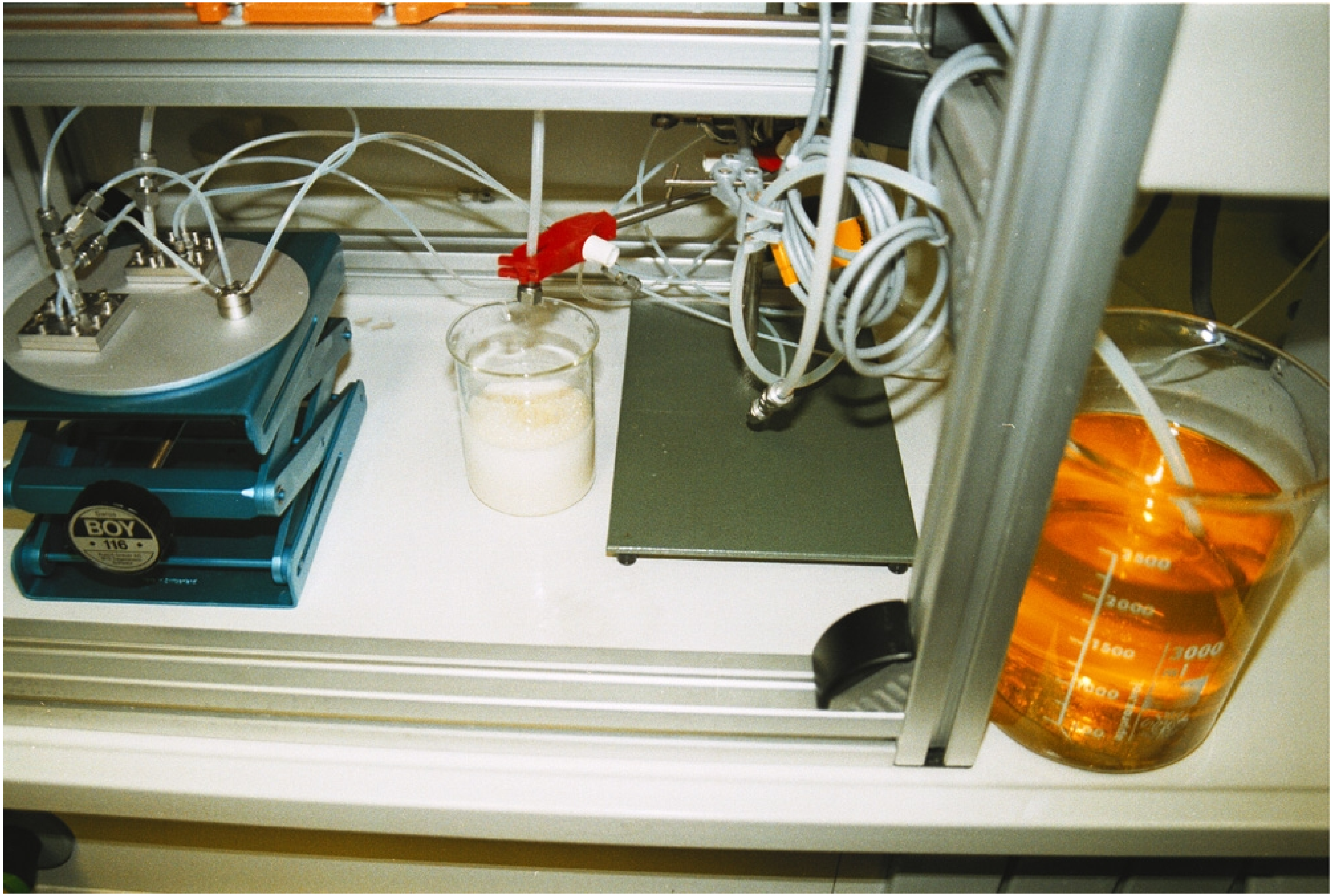
{Physical systems}

↓

{Chemical and physical properties:
odorant release, taste molecule release,
optical properties...}


ProMinent
BOY
116
DESAGA
3000
ml
2500
2000
1500
1000
500

(G + O + S) / W

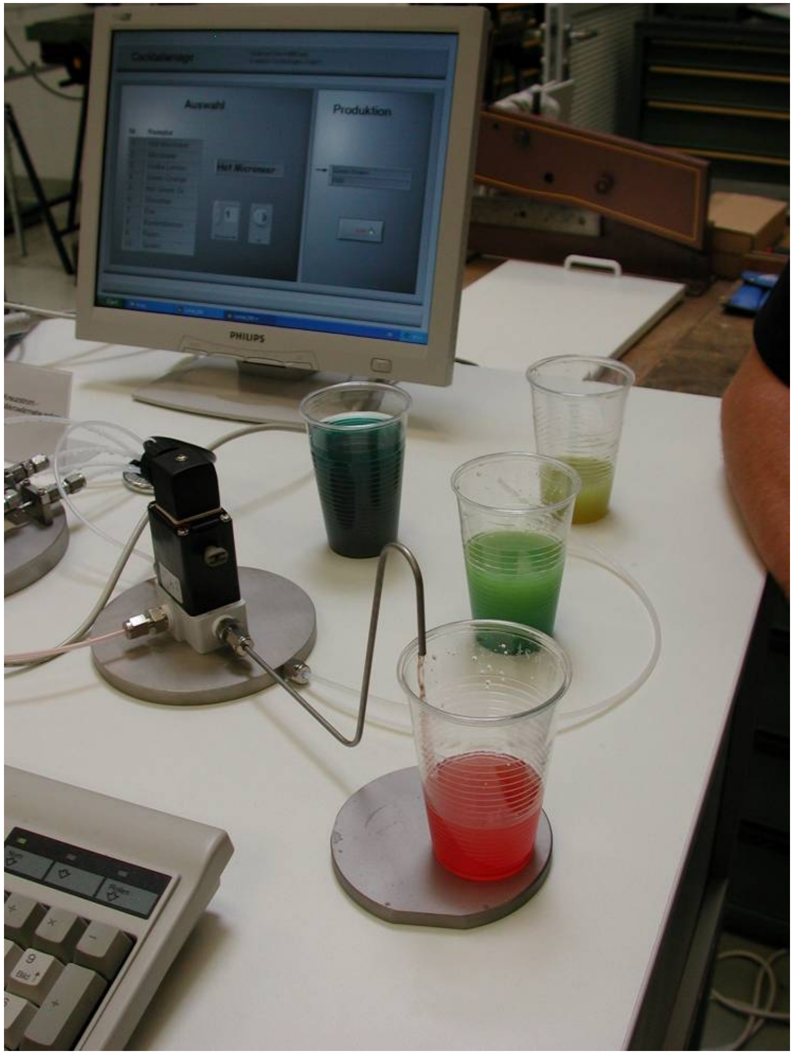


HTvK

INRAE-AgroParisTech International Centre for Molecular and Physical Gastronomy

Pilotage par un ordinateur

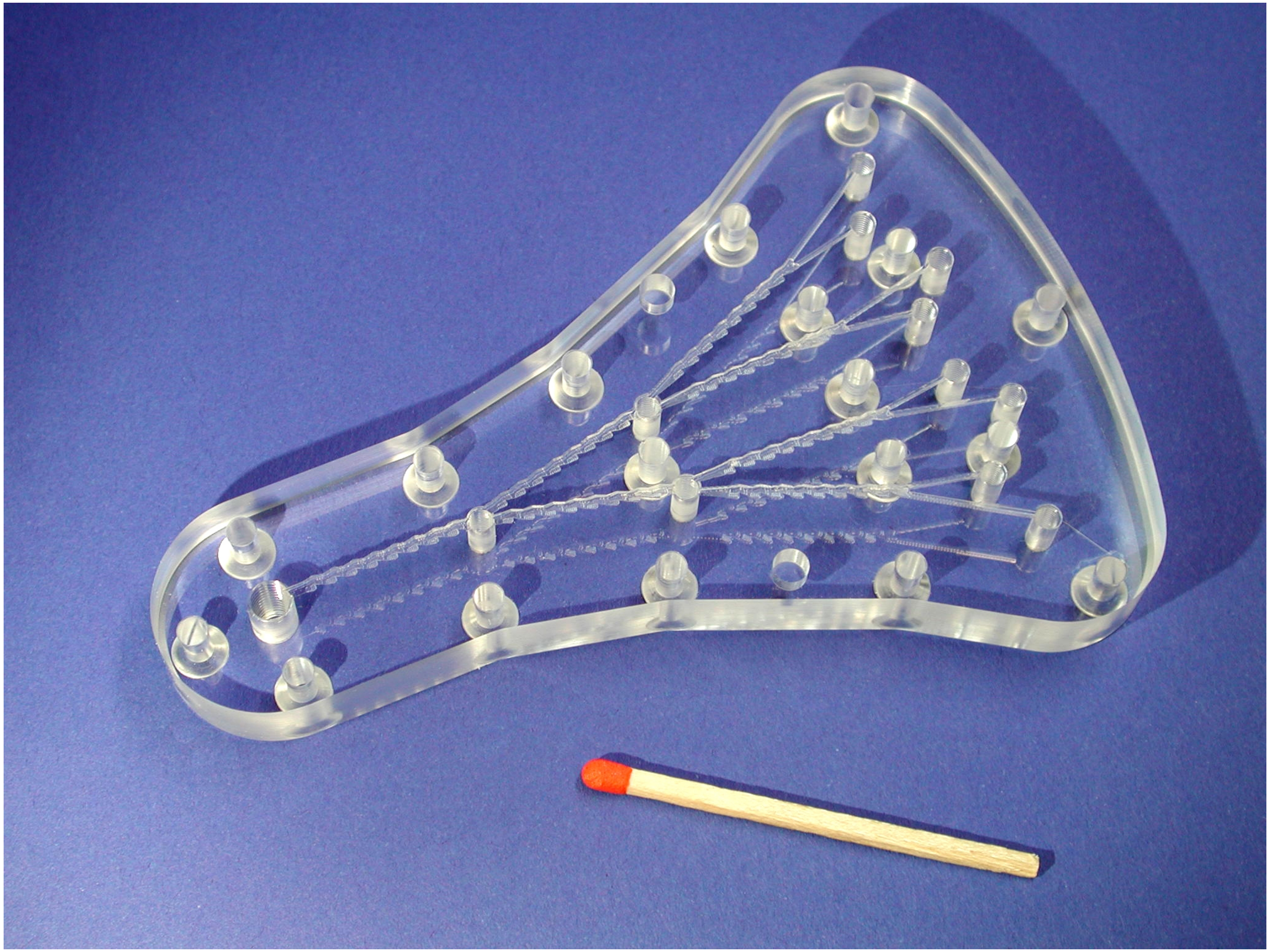
Des cocktails sur mesure

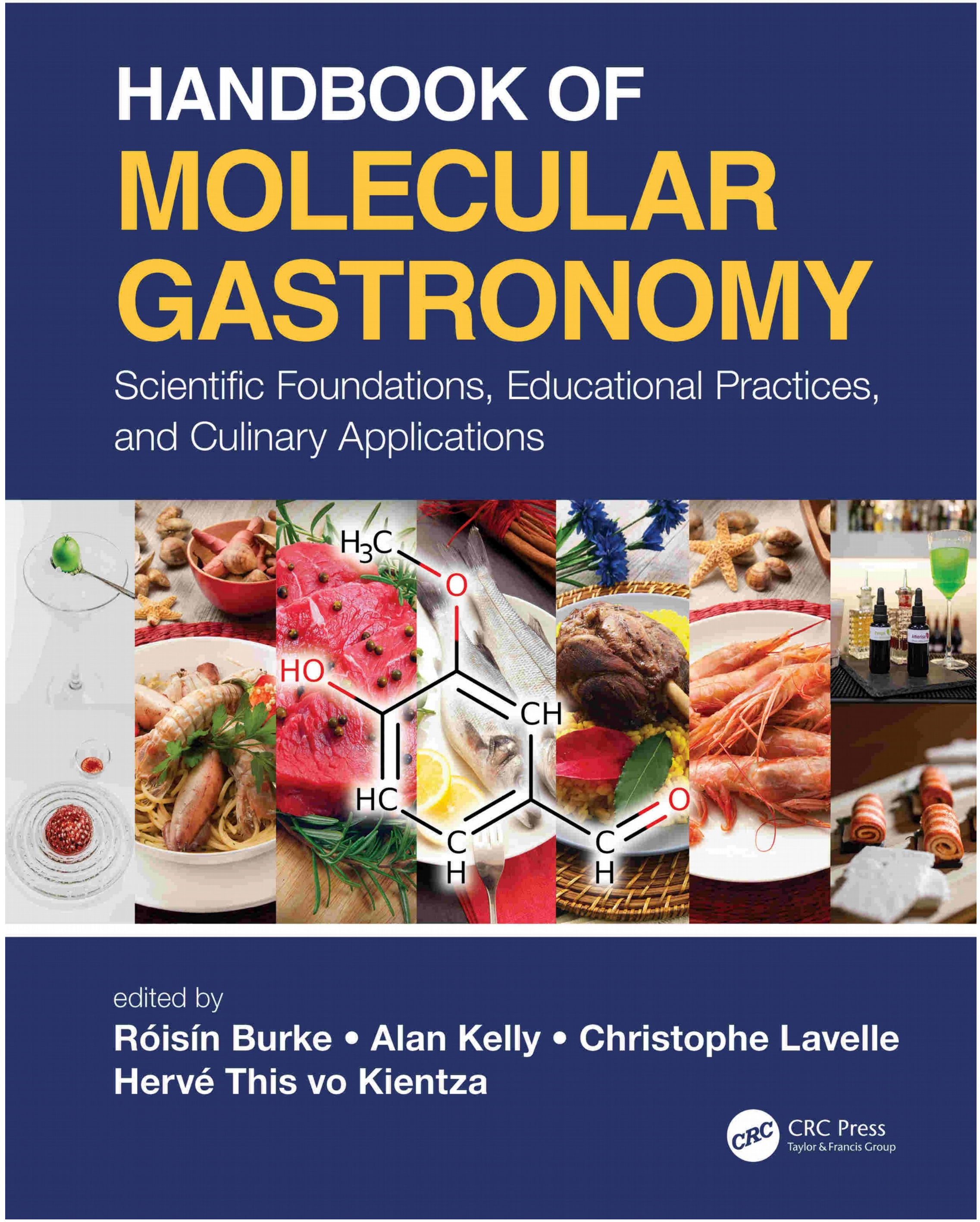


Le « pianocktail »

HTvK

500 milliards de combinaisons possibles




HANDBOOK OF
MOLECULAR GASTRONOMY
Scientific Foundations, Educational Practices, and Culinary Applications
edited by
Róisín Burke • Alan Kelly • Christophe Lavelle
Hervé This vo Kientza
CRC Press
Taylor & Francis Group

Pourquoi se lève-t-on le matin ?

BOUILLON D'ARTICHAUT TRUFFE, PÉTALES DE CABILLAUD

TYPE : Poisson

4

LE MARCHÉ

- 3 gros artichauts
- 50 à 80g de truffe fraîche
- 25cl d'huile d'olive vierge suave
- 5cl de Calvados
- 1 pomme reinette
- 2 litre d'eau de source
- 200 à 250g de cabillaud extra frais

MÉTHODE

1 Dans un bocal hermétique mélanger huile, calvados, truffes hachées, pomme coupée en quatre. Garder au frais 24 heures en agitant régulièrement le bocal.

2 Effeuiller l'artichaut pour ne garder que le cœur avec le foin.Mettre à cuire le tout (cœur & feuilles) dans une casserole haute et épaisse dans laquelle il y aura l'eau froide légèrement salée.Porter à ébullition pendant 30 minutes pour le cœur et poursuivre encore un 1/2 heures pour les feuilles.Arrêter le feu en fin de cuisson et remettre les cœurs dans le bouillon et laisser refroidir.Enlever alors le foin puis filtrer ce bouillon. Reporter ce bouillon à ébullition, éteindre le feu et verser les éléments du bocal dans ce bouillon chaud.Laisser infuser 10 minutes.

3 Déposer le cabillaud assaisonné de sel fin dans un plat épais beurré.Le cuire 20 minutes à four doux (80°) le retirer du plat et l'effeuiller délicatement dans les 4 assiettes.

4 Pendant ce temps, tailler le cœur d'artichaut en petits dés et le déposer dans 4 assiettes creuses.

LE DRESSAGE

Rectifier l'assaisonnement du bouillon, le poivrer et le verser brûlant dans chaque assiette devant les convives

Celebrate Chemistry !

herve.this@agroparistech.fr