自由研究のテーマえらび

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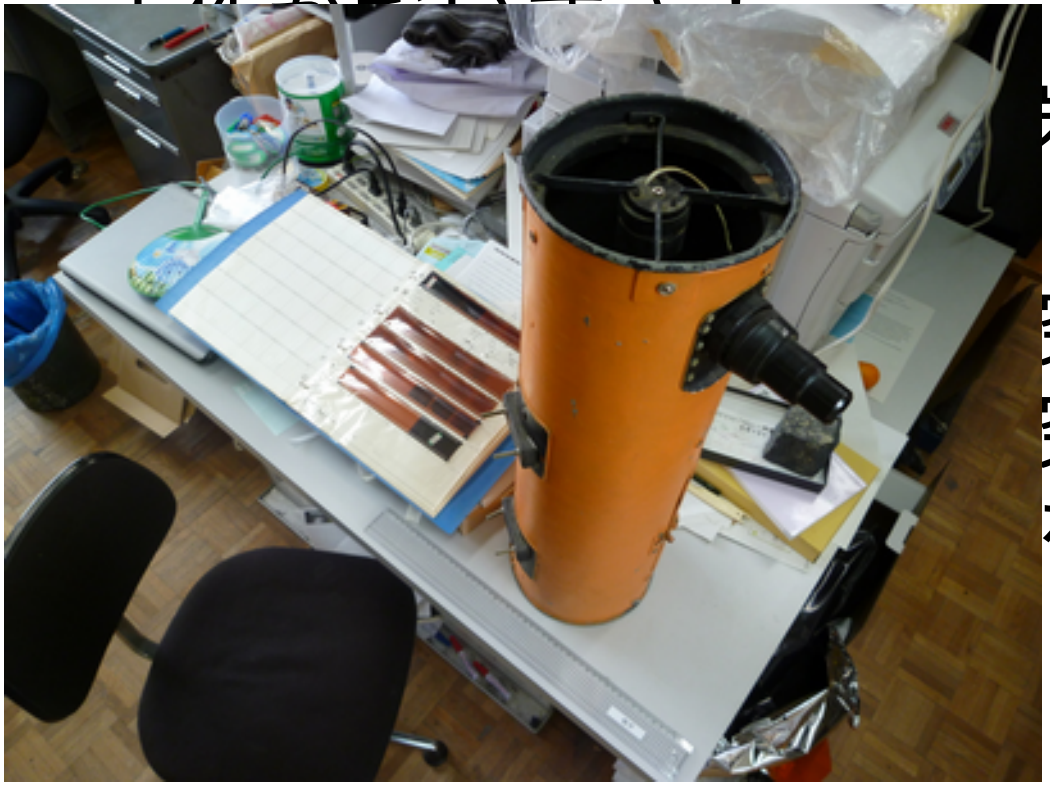
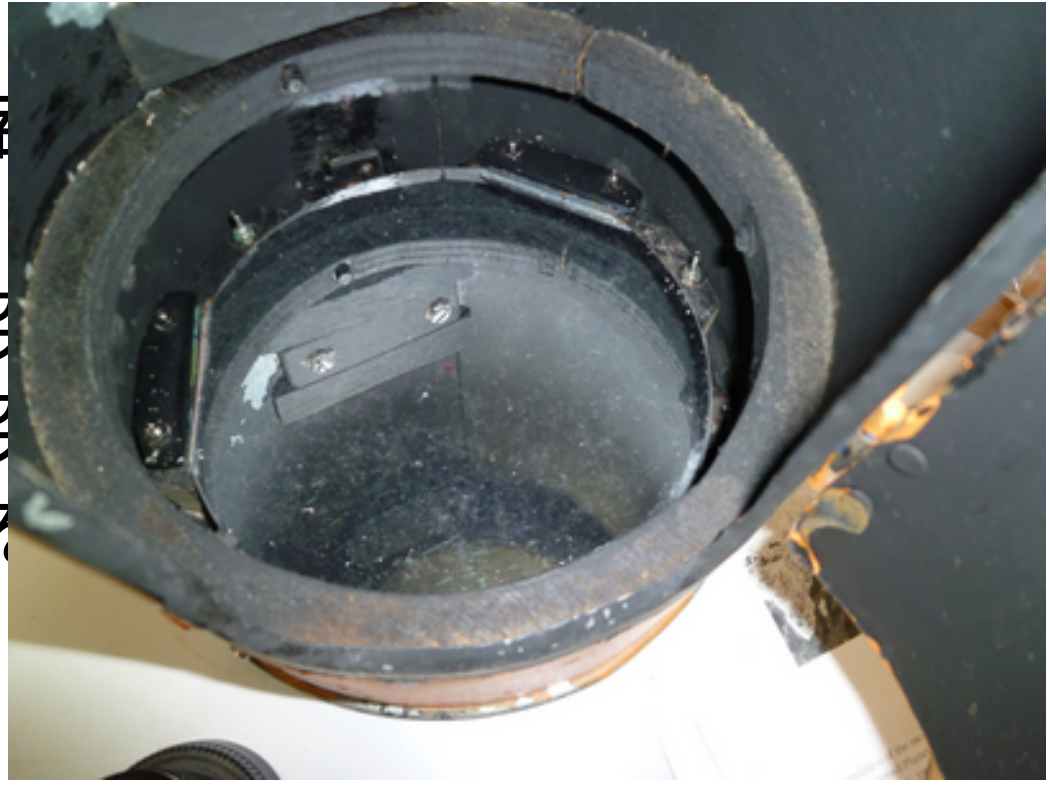
2026年5月23日堺教育センター

私の研究れき

- こどものころから　もけい飛行機，望遠鏡　など





教材 | 研究報告 | 巡検紀行(海外) | 巡検紀行(国内) | 雑文など

地学教材のサイト．授業などに活用ください．活用は自由ですが，著作権は保持します．商用利用は相談ください．

English Page

What's New(06 Feb 2026)<古いものは更新記録(高志分)へ>

2026-02-06 2025-2026年タイ科学高校訪問報告
2026-02-06 身近なデータからみる気候変動(2022年版)
2025-12-27 震源決定作図用の波形および地図作成
2025-12-25 Claudeを用いたN88Basicプログラム移植
2025-08-25 2025創路学会Poster磁気嵐
2025-08-25 2025創路学会タイ地震計と波形実習
2025-08-01 堺教育センター中学理科研修資料
2025-05-24 堺教育センター自由研究資料
2025-03-03 2025年初春タイ科学高校訪問報告
2024-12-06 大阪教育大学実験講座資料
2024-11-19 岩石薄片撮影システム
2024-10-15 Covid-19 感染Sim その4
2024-08-20 2024大分学会Poster+磁気嵐データ
2024-08-05 数年前の2022島根松江学会・巡検報告
2024-07-22 数年前の大学主催火山灰観察講座の動画を再アップ
2024-06-10 ESP32+DPS310微気圧計製作レシピ
2024-06-03 古いN88Basicプログラム博物館
2024-05-27 シリアル通信でタイムスタンプの付加
2024-05-16 QMC5883L/BM1422GMV地磁気計の試作
2024-02-25 ESP32地震計の試作(昨年)
2024-02-01 2024年小学校特別授業資料
2024-01-31 2024年能登地震関連教材
2024-01-28 2023Dec-2024Jan Thailand visit Whole_List
2024-01-24 MUGC2024 巡検記
2024-01-21 Satun Geo Park 巡検記
2023-12-07 私の地震計開発小史
2023-12-03 1997年神戸地震後の野島断層の写真を公開します．
2023-11-07 Webサーバーを切り替えました．
2023-11-03 GoPro動画手ブレ補正スクリプトを追加
2023-10-02 2023年Aug-Sep.タイ日記と資料
2023-09-21 2023年度地学教育学会「スケルトン地震計」製作レシピ．
2023-07-15 古い計測震度計のWebPageを復活させました．

Topics

- 大阪教育大学平川ゼミ資料
- 最近の講義・講演資料
- For Thailand
- 地震計関連資料
- 薄片作成関連資料
- 大阪市小学校自由研究資料
- 堺市学校理科研修資料

古いMisc資料

- 古いHPの記録
- 大学講義資料
- SSH生徒研究関係
- 教材の小ネタ(研修資料など)

Seagull Lab

- Seagull Labとは
- 作成教材一覧
- 走時曲線関連(2022-03-22 改訂)

プロフィール (April 2022)

岡本　義雄(OKAMOTO,Yoshio)

yossi.okamoto <atmark> gmail.com

at Cape Town (2016, South Africa Rep.)

現在高校教員リタイヤ後

タイ王国KVIS(Kamnoetvidya Science Academy)visiting teacher(2017年8月～)
タイ王国Princess Chulabhorn Science High School (PCSHS)Mukdahan visiting teacher and adviser(2019年9月)
2020-2021年度のタイの仕事はCOVID-19禍で中止．

大阪教育大学非常勤講師(2013年4月～2022年2月で定年のため終了)

＜社会的活動＞
日本地震学会学校教育担当理事(2012年4月～2014年3月,2002年4月～2007年3月)

＜所属学会＞
日本地震学会
日本地学教育学会
AGU(American Geophysical Union)
NAGT(National Asociation of Geoscience Teachers

＜受賞歴＞
1989年度東レ理科教育賞奨励作「高感度地震計システムの製作と活用」
日本地学教育学会 渡部景隆奨励賞

＜職歴＞
大阪産業大学環境理工学科非常勤講師(2019年10月～2020年3月)
大阪教育大学 非常勤講師(科研費研究員,2013年4月～2016年3月)
大阪教育大学 科学教育センター特任准教授(2012年4月～2013年3月)
大阪教育大学附属高等学校天王寺校舎地学科教諭(2000年4月より2012年3月まで,および2015年7月から2017年3月まで)
大阪府教育センター科学教育部地学研究室研究員兼指導主事(1996年4月から2000年3月まで)
大阪府立東百舌鳥高等学校地学科教諭(1992年4月から)
大阪府立横山高等学校地学科教諭(1978年4月から)

＜学歴＞
大阪市立大学大学院理学研究科後期博士課程中退(2012年4月～2016年3月)
岡山大学理学部地学科卒業(1976年3月)

もっと古いプロフィール紹介．

教室でできる地学実験 Publications

身近な素材で地震を体験？！岡本義雄氏による「なゐふる」の名物コーナー。

- フィルムケースで地震計を作ってみよう　第1回　第2回　第3回　第4回
- ココアと小麦粉で断層を作ろう！！！
- 「トランスフォーム断層ペーパーモデル」
- 「大陸移動ペーパーモデル」
- 「簡単に作れる『簡易磁力計』」
- ANB地震計を作ろう！　第1回　第2回　第3回

私のポリシー

- 勉強は何かを覚えることではない.
- 手元にある材料だけで, 一生懸命考える, ためしてみる.
- 失敗の数だけ, アイデアが湧いてくる

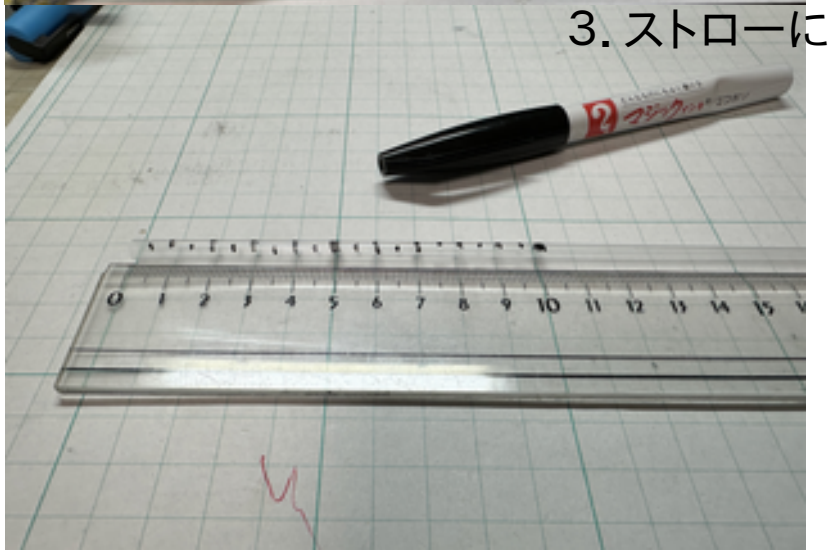
- ICT, デジタル, ハイテクではなく, アナログ, スーパーローテクが子どもたちを育てる.
- 非効率, 回り道こそ研究や勉強への近道. コスパなんてもってのほか!専門家はこれを負荷をかけた勉強というらしい.

今日の製作：気圧計を作る

- ビンに７分目ほど水を入れて，食紅で色をつける．
- ストローに目盛を描く（5mmおき）
- 粘土を細長くして，ストローに巻き，ビンの口を密封する．
- ストローから静かに息を少しだけ吹き込む．
- 水がストローの目盛の中間あたりに止まるように．

1. 水を7分目入れる

2. 食紅で色をつける

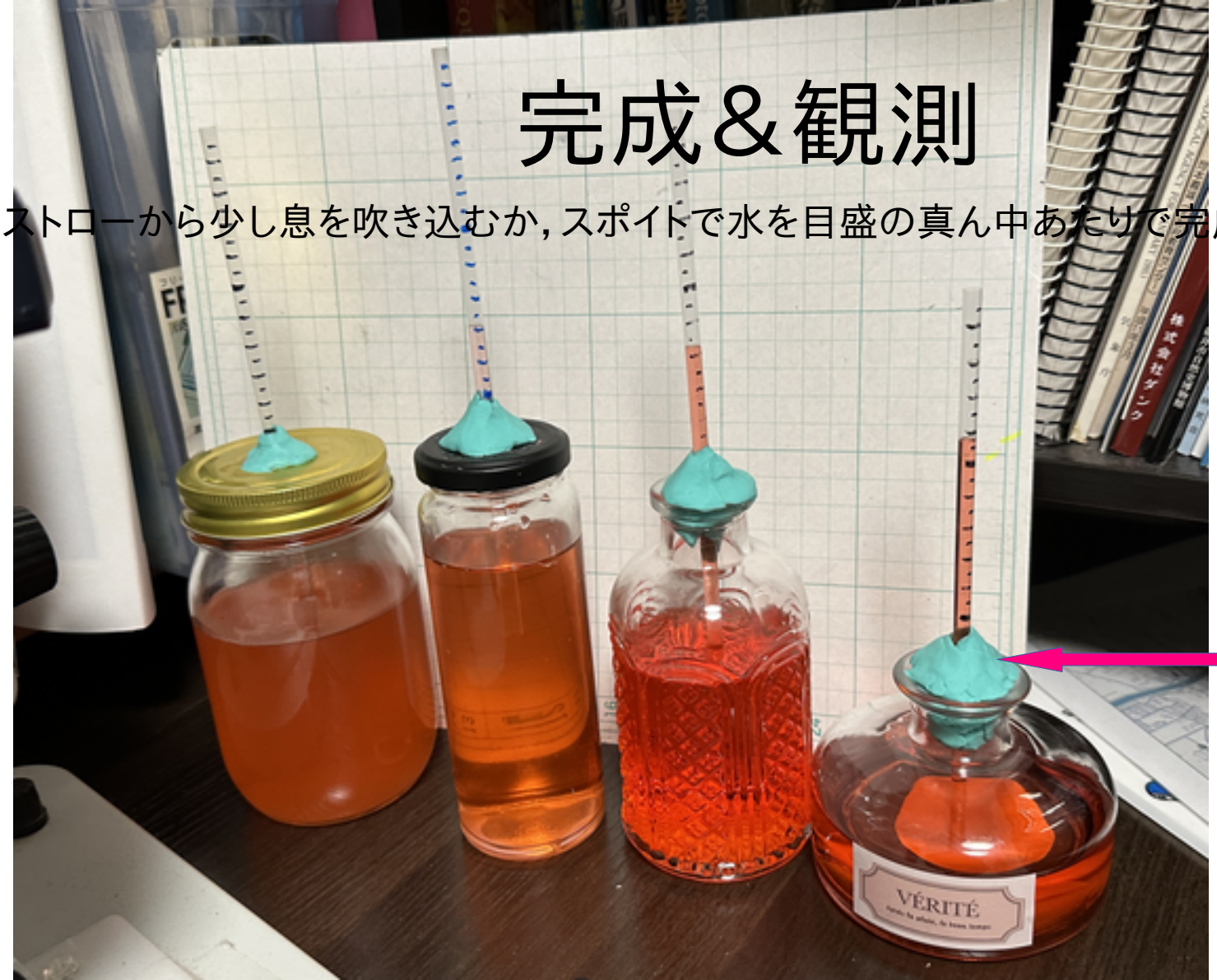


3. ストローに目盛

4. 粘土でフタをする

完成＆観測

5. ストローから少し息を吹き込むか，スポイトで水を目盛の真ん中あたりで完成

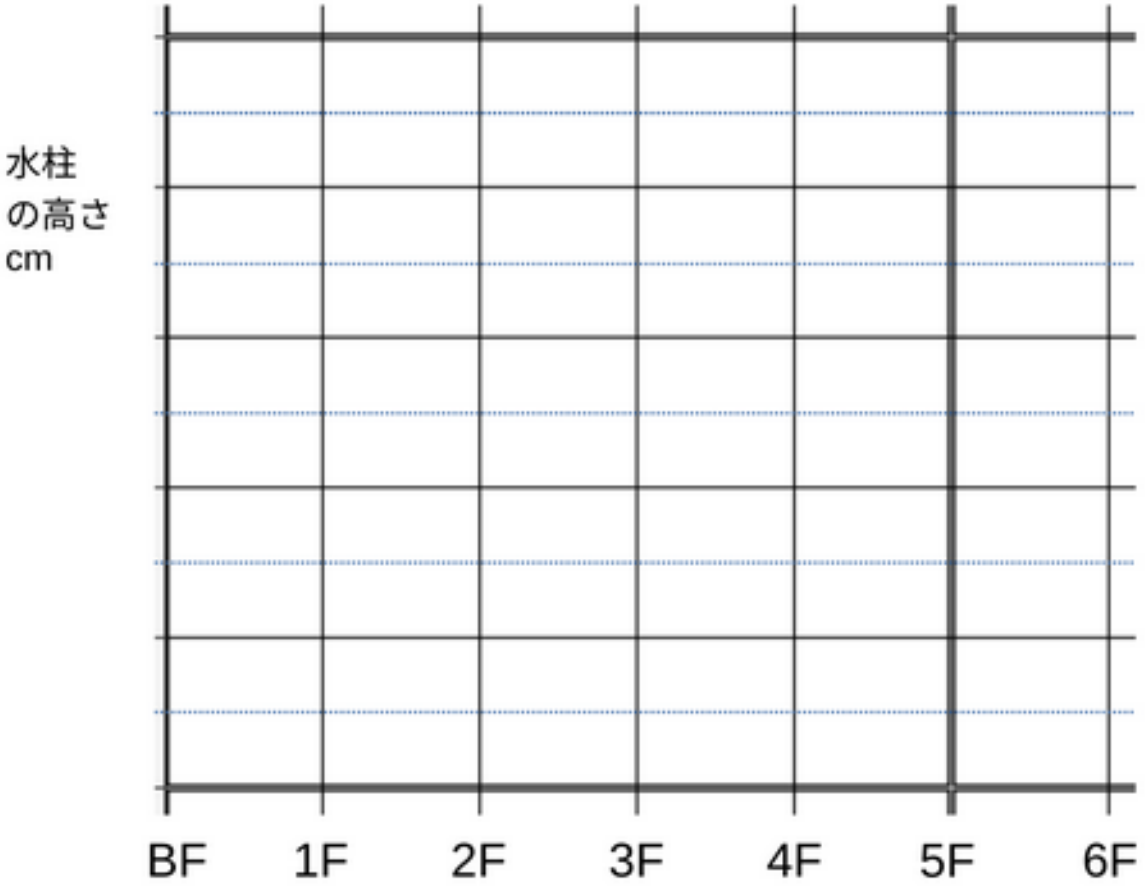


粘土の隙間から空気がもれないように！

今日の観測

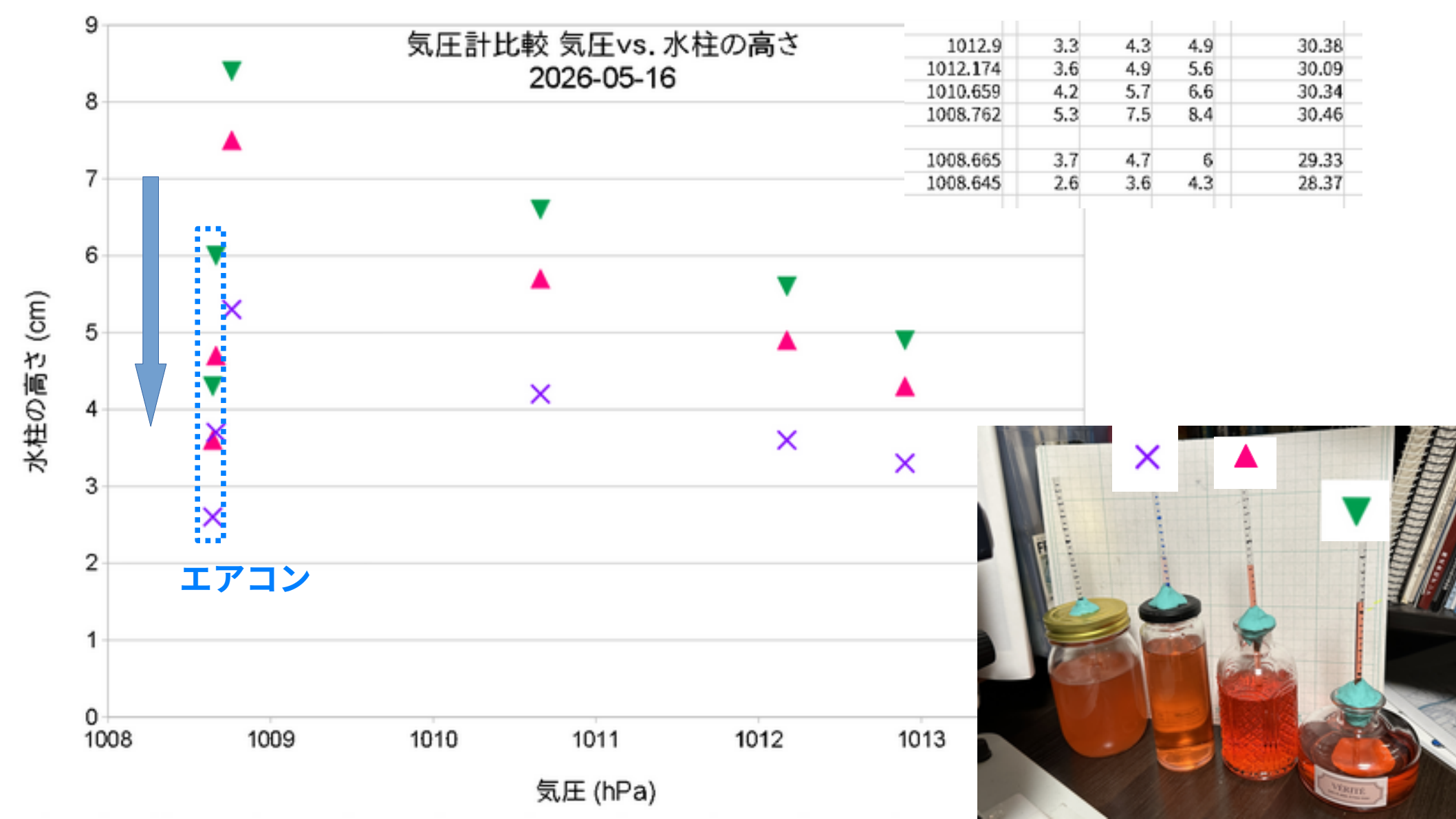
- この教育センターの階段を降りたり，登ったりして
- 赤い水の目盛の位置がどのように変化するかを単位はcmでメモに書く．
- ４Fから１Fそして地下まで降りて，１階分の目盛の変化がどれくらいかをメモする．目盛の何番目かに着目．
- ４Fに戻ったときに，目盛の最初の位置に戻るかも調べる．
- なぜ上のような変化が生じたかを考える．

気圧計グラフ用紙（堺教育センタービル）



日時

記録者



1012.9	3.3	4.3	4.9	30.38
1012.174	3.6	4.9	5.6	30.09
1010.659	4.2	5.7	6.6	30.34
1008.762	5.3	7.5	8.4	30.46
1008.665	3.7	4.7	6	29.33
1008.645	2.6	3.6	4.3	28.37

この実験のポイント

- ビンの形による変化の違い
- 気温による変化
- その他に何か影響を与えるものがあるか？
- 比較の気圧計はスマホのアプリを使おう！

さあいよいよ今日のおはなし！

- 研究テーマについて
- 自由研究のカン違い
- テーマの探し方
- みんなで実験してみよう！

ビー玉と２Ｂ弾を混ぜる

- れきと砂（すな）と泥（どろ）をまぜて，水の中に入れて，かきまわす
- れきが一番下に，砂がつぎ，さいごがどろになる．（私の実験ではガラスビーズを使っています）

- ところが，---------

- 研究には意外性（いがいせい）がだいじ！

ウィキペディア
フリー百科事典

メインページ
コミュニティ・ポータル
最近の出来事
新しいページ
最近の更新
おまかせ表示
練習用ページ
アップロード (ウィキメディア・コモンズ)

ヘルプ
ヘルプ
井戸端
お知らせ
バグの報告
寄付
ウィキペディアに関するお問い合わせ

印刷/書き出し
ブックの新規作成
PDF 形式でダウンロード

ブラジルナッツ効果

ブラジルナッツ効果（ブラジルナッツこうか）とは、異なる大きさからなる粉粒体を振ると、最も大きな粒子が表面に浮き上がってくる現象のことである。ミックスナッツでは最も大きな粒はブラジルナッツであることが多いことからこのように呼ばれる。この現象は、同じような密度で大きさの異なる粒からなる朝食のシリアルの箱の中でも見られることから、ミューズリー効果と呼ばれることもある。

最も大きくおそらく一番重い粒子が浮き上がってくるのは直感に反するようにも思われるが、これにはいくつかの説明が考えられている。

- 小さな粒は振られるごとに大きな粒の下の隙間に落ちることができる。それを繰り返すことで大きな粒が浮き上がる。ミックスナッツを含む系全体の任意の状態を考えると、その重心はブラジルナッツの周りに空間があるため最適とは限らない。ナッツが振られると、重力は系全体の重心を下方向に移動するように働き、それはブラジルナッツを上に動かすことのみ可能になる。重力は上にあがったものをその位置に保つようにも働く。

他のナッツの上に乗ったブラジルナッツ

みんなもミックスナッツでためしてみよう！

Street, Covent Garden, a great auk's egg in fine condition was sold for two hundred guineas… This is a considerable falling-off from the three hundred guineas obtained for the last specimen sold by Mr. Stevens, the reason being attributed to the fact that several other fine examples are in the market.
From *Nature* 26 May 1904.

MAXIMILIAN STOCK LTD/SPL

Figure 1 Nuts: why do brazils always rise to the top?

Granular materials

The brazil nut effect — in reverse

Troy Shinbrot

In a box of mixed nuts, the brazils rise to the top. In granular mixtures in general, depending on their size and density, the 'brazil nuts' may sink instead. This reverse effect has now been explored further.

Every farmer can attest to the curious fact that the largest crop each spring is the boulders that appear, untended, on open fields. Common wisdom holds that this crop is loosened from the soil by frost heave, and rises because small pebbles can slip beneath large boulders, but not vice versa[1]. This is the 'brazil nut effect' — named for the fact that, in a container of mixed nuts, the brazil nuts always seem to rise to the top (Fig. 1). Because similar processes and effects occur in pharmaceutical, chemical and food processing, the problem of granular segregation has earned serious attention[2] — and now, in *Physical Review Letters*, Huerta and Ruiz-Suárez[3] add the latest piece of the puzzle.

The first complication to the simple picture of pebbles slipping beneath boulders (termed 'percolation') was the demonstration that a tapped bed of grains 'convects' in a regular pattern: a wide swath of grains rises in the centre of a container, and thin margins correspondingly sink[4]. According to the convection picture, large 'intruder' particles rise with the surrounding bed, and then find themselves simply unable to fit into narrow downwelling margins. This mechanism was confirmed by a clever experiment in which the convection rolls were reversed and, as predicted, large particles migrated to the bottom of vibrated beds[4]. Later confirmations came from magnetic-resonance-imaging experiments that conclusively demonstrated the presence of segregating convection rolls[5], and from meticulous computational comparisons that revealed that convection dominates over percolation in producing segregation in deep beds[6].

Over the past decade, however, our understanding of the segregation of large particles in vibrated beds has been challenged by experiments revealing that although large heavy 'intruder' particles can indeed rise in vibrated beds of finer grains, equally large light intruders can sink, contrary to expectation and common experience. Now termed the 'reverse brazil nut effect', this observation[7], made by myself and Fernando Muzzio, is explained by neither the convection nor the percolation description. It is so counterintuitive that a reviewer of the original manuscript reporting the effect insisted that it could not be correct; and the

土石流（どせきりゅう）のたいせきぶつ
ノルウエイの島のちそう

自由研究のテーマ選び
みんながよくするまちがい（その１）

- 「研究」と「調べ（しらべ）学習」はちがう
- 研究とは，まだ誰も知らないことを調べる．

⇒「オリジナリティ」という

- そのためには，過去の研究をまず調べる．
- 今ではインターネットでかんたん！
- だれも発表していないことをさがす

⇒でもけっこうむずかしい！

よくあるまちがい（その２）

- じぶんの興味（きょうみ）でテーマを選んでしまう
- 宇宙に興味があるから「ブラックホール」を研究する！
  ⇒大人でもむずかしい研究テーマ
- 虫に興味があるから，「蜘蛛（くも）の研究」
  ⇒たくさんのひと（専門家やこどもたち）がすでにおこなってしまっている！
- 自分の興味からすこし注目点をずらす！

よくあるまちがい（その３）

- 「研究」というのは何かむずかしい装置でむずかしい実験をすることだと思っている．
- 専門家と同じような研究ができると思っている．
- 実は専門家でも「研究」はほんのささいなこと（おおきな研究のごく一部）を調べたもの
- 一人ですごい研究がすぐにできるわけではない！
- ほんのちょっとしたことをまず調べてみる．
- これはとても大事なこと．

じゃあどうするか？

- ほんのみじかにある，ふしぎに着目する
- とりあえず何か測定してみる！
- 台所などにもテーマはころがっている！
  「キッチン科学」⇒専門家も注目
  （あとでみんなに実験をしてもらう予定！）
- 自分で何か工作をする！
- 誰かの研究を“参考”にして条件や材料をかえてみる．

誰かの研究を参考に

- 誰かが蜘蛛（くも）の研究を
  のはり方を研究して賞を取っ
- 私の教えた高校生の例
- 同じ糸でも彼女は

- **綿菓子（わたがし）**の糸

⇒これで彼女は何と神戸大学のAO入試に合格した！

研究テーマを決めるのは難しい！

- 研究の９割は「研究テーマ」のよしあしできまる.
- 自分で面白そうなテーマを５個考えてくる.
- その中で研究して，うまくいきそうかどうかを学校の先生や専門家の先生に選んでもらう！
- そうするとテーマは自分で選んだことになる.
- テーマまで親や先生に決めてもらうのは反則！
- そして研究テーマを選んだら，かならず賞に応募したり，
- どこかで発表することを考える！
- ほかの人が興味を引く，研究名を考える！

考えてもなかなかいいテーマがみつからないときは-------

- とりあえず何か身近なものを測定してみよう！
- 私が数年前に，この講座の準備を考えていて
  10分ほどで発見した「研究」！-------
- 私の家の近所にある「狭山池」に何か研究テーマがないかさがしに行った.
- 池で水鳥が遊んでいた.
- それを見た私は-------

ここで動画をみてください

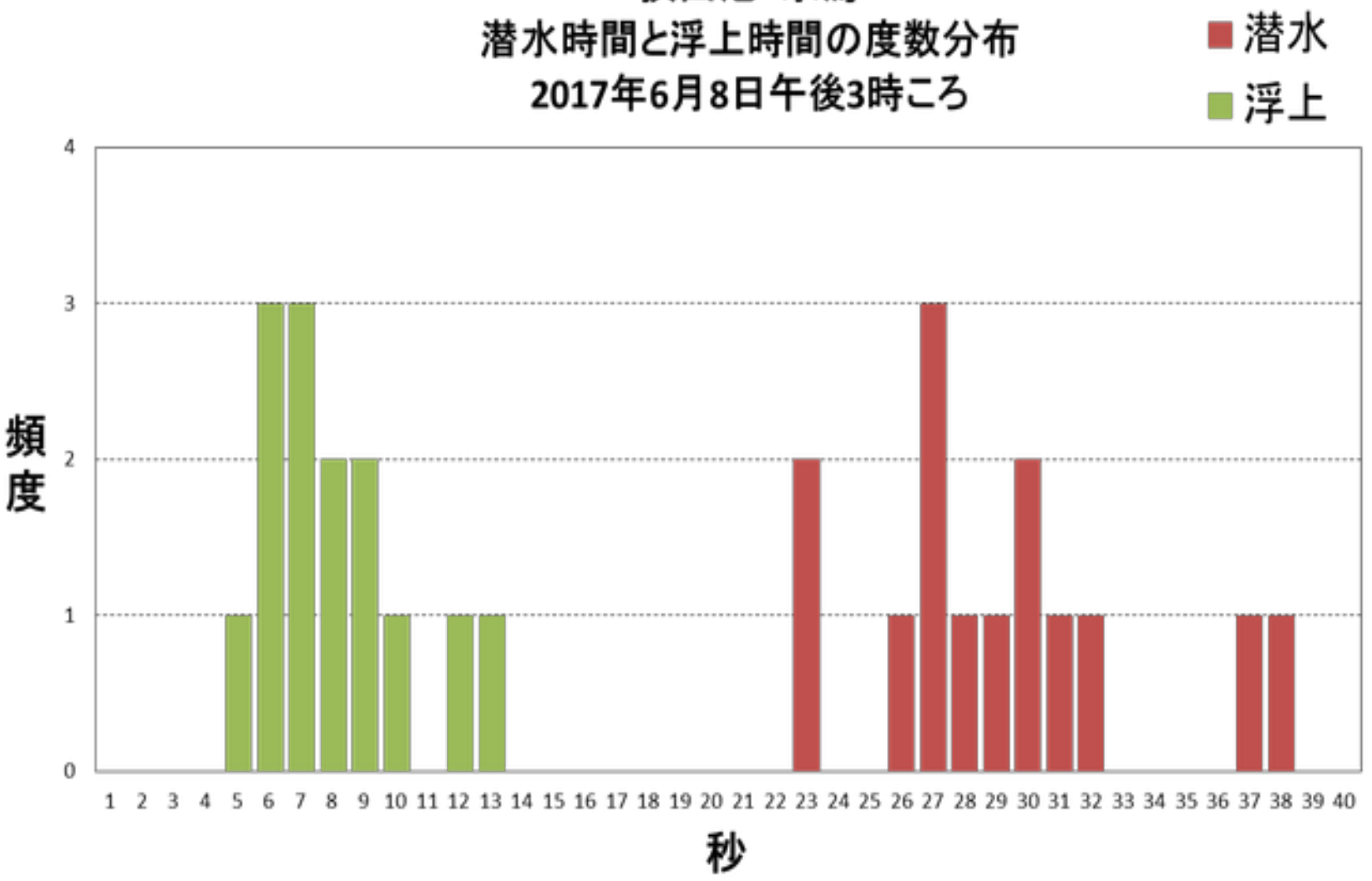

IMG_4656
02:55

Date 2017 6. 8

狭山池 カイツブリ?

潜水

	潜	浮
00:23		
00:30		7
1:00	30	
1:08		8
1:37	29	10
1:47		
2:14	27	13
2:27	30	
2:57		6
3:03	27	
3:40		12
3:52	23	
4:15		7
4:22	32	
4:54		6
5:00	31	
5:31		9
5:40	28	
6:08		7
6:15		
6:38	23	
6:44		6
7:16	27	5
7:42	26	
7:57		9
8:18	27	
8:26		8
9:04	38	


狭山池　水鳥
潜水時間と浮上時間の度数分布
2017年6月8日午後3時ころ
潜水
浮上
頻度
秒
0
1
2
3
4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

先行（せんこう）研究と比較する

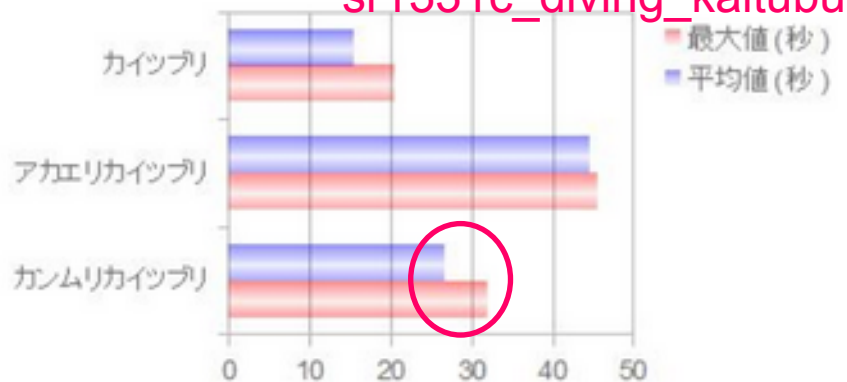
- もうすでに同じことを考えた人がいる！

【グラフで見る】鳥類の潜水時間 － カイツブリ類 －
カイツブリ アカエリカイツブリ カンムリカイツブリ

カイツブリ類の潜水時間を測定しました。カイツブリ、アカエリカイツブリ、カンムリカイツブリの潜水時間の最大値と平均値とをグラフに示します。

なお、カイツブリ、カンムリカイツブリは京都・洛西(らくさい)の桂川(かつらがわ)で、アカエリカイツブリは関東の海でそれぞれ観察しました。

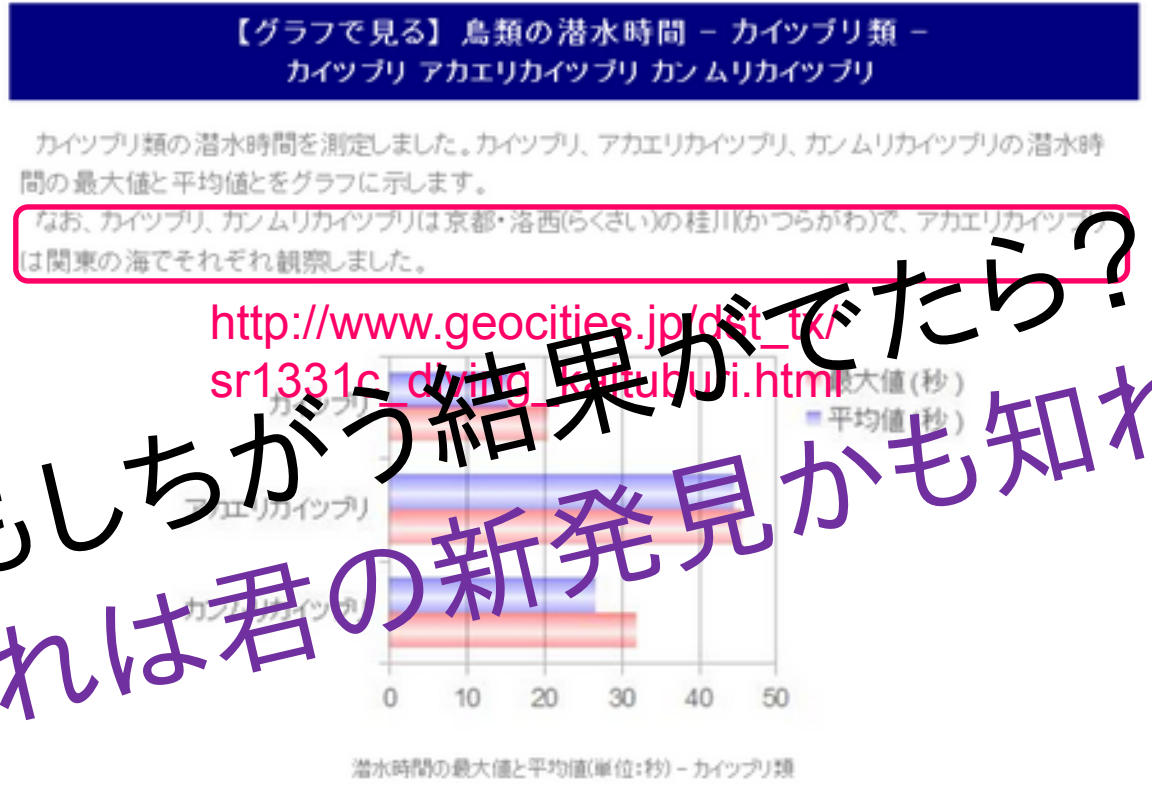
http://www.geocities.jp/dst_tx/sr1331c_diving_kaituburi.html



潜水時間の最大値と平均値(単位:秒) - カイツブリ類

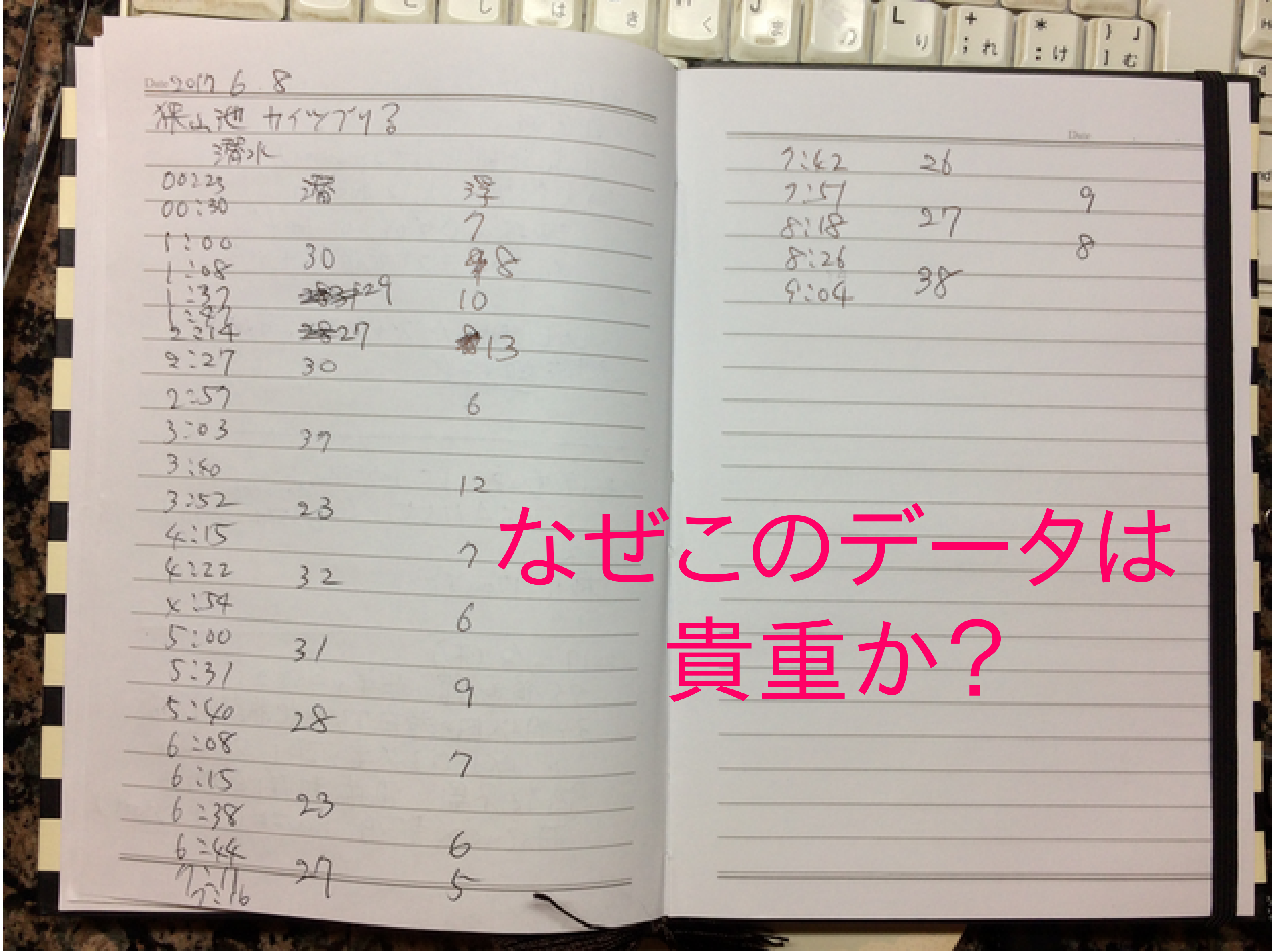
私の研究を発展させるには？

- 条件：場所や季節，時刻などを変えてみる！



もしちがう結果がでたら？

それは君の新発見かも知れない！


なぜこのデータは貴重か？

台所（キッチン）は研究の宝庫！

http://magazine.shokuikuclub.jp/wp/wp-content/uploads/2015/09/IMG_0009.jpg

Barham *Flavour* 2013, **2**:5
http://www.flavourjournal.com/content/2/1/5

OPINION Open Access

Physics in the kitchen

Peter Barham

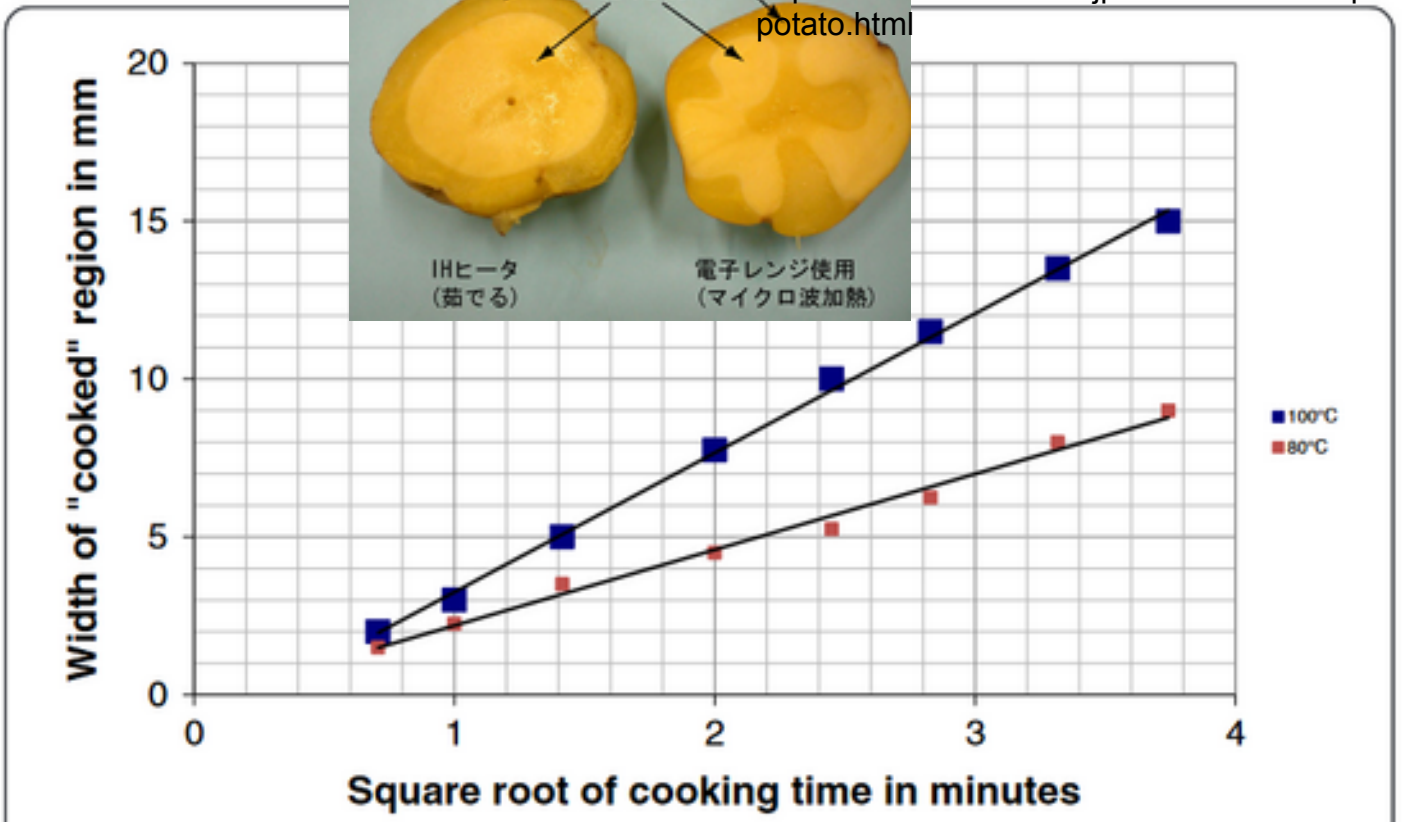
Abstract

The kitchen is a laboratory and cooking is an experimental science. When we cook we generally follow a recipe (either written or from memory); we select, quantify and process the ingredients and then serve the food to our friends, family or guests. A good cook (or scientist) will keep records in a notebook of exactly what they do so that they can repeat the experiment (recipe) as required.

During the meal, as we eat we note how good the food is, where there is room for improvement and what is particularly liked. In effect we analyse the results of the experiment – the good scientific cook will keep notes of these discussions and use them to draw preliminary conclusions about how to improve the recipe. After several more tests of the recipe, we may then begin to derive a model to explain our results and to understand how and why making small changes to the recipe produces different qualities in the final dish – we can then use that understanding and apply it to other recipes, so continually improving our cooking skills.

This is nothing more than the application of the scientific method to cookery – simple but highly effective. If taken seriously and applied properly there is no excuse for any scientifically trained person not to become a superb cook.

But is there more to physics in the kitchen than ensuring physicists are good cooks? Can physics help chefs with no scientific background improve their own cook- ensure some degree of consistency between cooks there is a need to have some assurance that the temperatures used in different kitchens are closely similar (if not the same). Without the use of expensive scientific equipment the only easy way is to use a phase transition that occurs at a fixed temperature – and the simplest and most accessible of these is to use boiling water. Common practice when cooking vegetables, for example, is therefore simply to put them in boiling water for a fixed time. This can provide a system which is sufficiently reproducible that the same recipes can be used by cooks around the world and ensure they get similar results. But is it? We teach our children that water boils at 100°C, but it is only much later when those who progress on to higher levels of education begin to learn that the boiling point of water is not fixed, but actually quite variable – for example, in Denver, Colorado, which is about 1.6 km above sea level and where the atmospheric pressure is around 85 kPa, water boils at around 94°C.



http://www.ei.u-tokai.ac.jp/student/kitchen/potato/potato.html

Figure 1 Cooking potatoes. Graph of the measured width of the cooked region of a potato as a function of the square root of the cooking time in minutes at two different temperatures.

そしてもしテーマが決まれば

- じぶんの研究にとても大事なタイトルを考えよう！

- その言葉でみんながふりむいてくれるようなタイトルを考えよう！

たとえば「くもの糸の研究」

- どこまで行っても　くものいと！
- スパイダーネットのひみつ！
- 糸をつむいで　“三代目！”
- くももん　がやってくれました！
- くも　がおしえてくれたこと！
- くも　はちいさな繊維工場（せんいこうじょう）
- くも　VS.　かいこ　強い　いと　はどっち？
- などなど.

研究発表の重要性（じゅうようせい）

- どんな研究をしても，それをどこかで発表しないと誰もふりむかない．
  →学生科学賞など．
- 有名な研究の例を紹介．

Novel prize 2012

- Shinya Yamanaka **山中伸弥**

Induction of Pluripotent Stem Cells from Mouse Embryonic and Adult Fibroblast Cultures by Defined Factors

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[1]Department of Stem Cell Biology, Institute for Frontier Medical Sciences, Kyoto University, Kyoto 606-8507, Japan
[2]CREST, Japan Science and Technology Agency, Kawaguchi 332-0012, Japan
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DOI 10.1016/j.cell.2006.07.024

SUMMARY

Differentiated cells can be reprogrammed to an embryonic-like state by transfer of nuclear contents into oocytes or by fusion with embryonic stem (ES) cells. Little is known about factors that induce this reprogramming. Here, we demonstrate induction of pluripotent stem cells from mouse embryonic or adult fibroblasts by introducing four factors, Oct3/4, Sox2, c-Myc, and Klf4, under ES cell culture conditions. Unexpectedly, Nanog was dispensable. These cells, which we designated iPS (induced pluripotent stem) cells, exhibit the morphology and growth properties of ES cells and express ES cell marker genes. Subcutaneous transplantation of iPS cells into nude mice resulted in tumors containing a variety of tissues from all three germ layers. Following injection into blastocysts, iPS cells contributed to mouse embryonic development. These data demonstrate that pluripotent stem cells can be directly generated from fibroblast cultures by the addition of only a few defined factors.

INTRODUCTION

Embryonic stem (ES) cells, which are derived from the inner cell mass of mammalian blastocysts, have the ability to grow indefinitely while maintaining pluripotency and the ability to differentiate into cells of all three germ layers (Evans and Kaufman, 1981; Martin, 1981). Human ES cells might be used to treat a host of diseases, such as Parkinson's disease, spinal cord injury, and diabetes (Thomson et al., 1998). However, there are ethical difficulties regarding the use of human embryos, as well as the problem of tissue rejection following transplantation in patients. One way to circumvent these issues is the generation of pluripotent cells directly from the patients' own cells.

Somatic cells can be reprogrammed by transferring their nuclear contents into oocytes (Wilmut et al., 1997) or by fusion with ES cells (Cowan et al., 2005; Tada et al., 2001), indicating that unfertilized eggs and ES cells contain factors that can confer totipotency or pluripotency to somatic cells. We hypothesized that the factors that play important roles in the maintenance of ES cell identity also play pivotal roles in the induction of pluripotency in somatic cells.

Several transcription factors, including Oct3/4 (Nichols et al., 1998; Niwa et al., 2000), Sox2 (Avilion et al., 2003), and Nanog (Chambers et al., 2003; Mitsui et al., 2003), function in the maintenance of pluripotency in both early embryos and ES cells. Several genes that are frequently upregulated in tumors, such as *Stat3* (Matsuda et al., 1999; Niwa et al., 1998), *E-Ras* (Takahashi et al., 2003), c-myc (Cartwright et al., 2005), *Klf4* (Li et al., 2005), and β-catenin (Kielman et al., 2002; Sato et al., 2004), have been shown to contribute to the long-term maintenance of the ES cell phenotype and the rapid proliferation of ES cells in culture. In addition, we have identified several other genes that are specifically expressed in ES cells (Maruyama et al., 2005; Mitsui et al., 2003).

In this study, we examined whether these factors could induce pluripotency in somatic cells. By combining four selected factors, we were able to generate pluripotent cells, which we call induced pluripotent stem (iPS) cells, directly from mouse embryonic or adult fibroblast cultures.

RESULTS

We selected 24 genes as candidates for factors that induce pluripotency in somatic cells, based on our hypothesis that such factors also play pivotal roles in the maintenance of ES cell identity (see Table S1 in the Supplemental Data available with this article online). For β-catenin, c-Myc, and Stat3, we used active forms, S33Y-β-catenin (Sadot et al., 2002), T58A-c-Myc (Chang et al., 2000), and Stat3-C (Bromberg et al., 1999), respectively. Because of the reported negative effect of Grb2 on pluripotency (Burdon et al., 1999; Cheng et al., 1998), we included its dominant-negative mutant Grb2Δ5H2 (Miyamoto et al., 2004) as 1 of the 24 candidates.

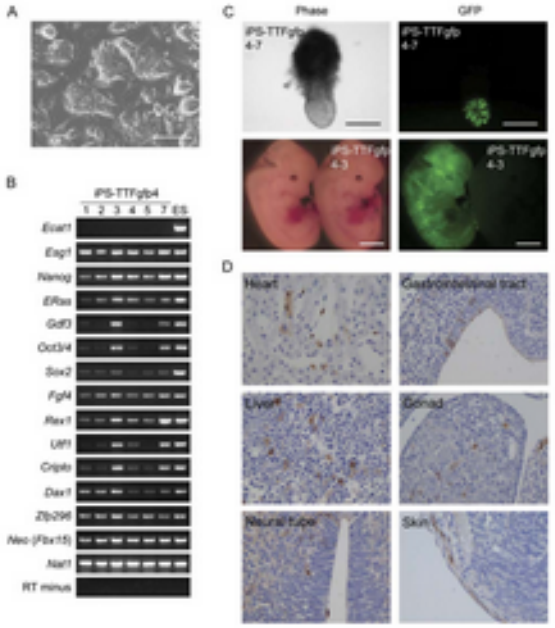


Figure 6. Characterization of iPS Cells Derived from Adult Mouse Tail-Tip Fibroblasts

(A) Morphology of iPS-TTFgfp4-3 on STO feeder cells.

(B) RT-PCR analysis of ES marker gene expression in iPS-TTFgfp4 cells (clones 1–5 and 7). We used primer sets that amplified endogenous but not transgenic transcripts.

(C) Contribution of iPS-TTFgfp4-7 and iPS-TTFgfp4-3 cells to mouse embryonic development. iPS cells were microinjected into C57/BL6 blastocysts. Embryos were analyzed with a fluorescence microscope at E7.5 (upper panels, iPS-TTFgfp4-7) or E13.5 (lower panels, iPS-TTFgfp4-3). Scale bars = 200 μm (upper panels) and 2 mm (lower panels).

(D) The E13.5 chimeric embryo was sectioned and stained with anti-GFP antibody (brown). Cells were counterstained with eosin (blue).

showed that iPS-TTFgfp4wt cells also expressed most of the ES cell marker genes (Figure S6).

We transplanted 2 iPS-TTF4 and 6 iPS-TTFgfp4 clones into nude mice, all of which produced tumors containing tissues of all three germ layers (Table S6 and Figure S3). We then introduced 2 clones of iPS-TTFgfp4 cells (clones 3 and 7) into C57/BL6 blastocysts by microinjection. With iPS-TTFgfp4-3, we obtained 18 embryos at E13.5, 2 of which showed contribution of GFP-positive iPS cells (Figure 6C). Histological analyses confirmed that iPS cells contributed to all three germ layers (Figure 6D). We observed GFP-positive cells in the gonad but could not determine whether they were germ cells or somatic cells. With iPS-TTFgfp4-7, we obtained 22 embryos at E7.5, 3 of which were positive for GFP. With the 2 clones, we had 27 pups born, but none of them were chimeric mice. In addition, iPS-TTFgfp4 cells could differentiate into all three germ layers in vitro (Figure S7). These data demonstrate that the four selected factors could induce pluripotent cells from adult mouse fibroblast cultures.

2002年ノーベル化学賞：田中耕

彼は受賞当時，博士号を持たない企業の研究者であった．ノーベル賞選考委員会が着目したのは，
正式な論文ではなく日本と中国の合同学会に提出した，たった4ページの簡単な報告であった．

DETECTION OF HIGH-MASS MOLECULES BY LASER DESORPTION TIME-OF-FLIGHT MASS SPECTROMETRY

Koichi Tanaka, Yutaka Ido, Satoshi Akita, Yoshikazu Yoshida and Tamio Yoshida

Central Research Laboratory, Shimadzu Corporation, 1 Nisinokyo-Kuwabaracho, Nakagyo-ku, Kyoto 604, Japan

[Introduction]

The laser desorption time-of-flight mass spectrometer has been developed in order to analyze non-volatile, thermally labile and high mass organic molecules. In this spectrometer we have made improvements on all stages of mass spectrometer (ion source, mass separation, detector, electronics).

[Equipment]

The construction of the laser desorption time-of-flight mass analyzer is shown in Fig.1. Figure 2 shows the block diagram of TOF spectrum measurement system.

-- Ion source --

N_2 laser (Wavelength:337nm, Pulse width:about 15nsec, Pulse energy:4mJ Max.) was used for ionization. "Rapid heating" [1] is achieved by irradiating pulsed laser on sample surface. As for sample preparation, "Ultra fine metal powder (UFP) and glycerol matrix method " was found to be very effective for increasing the yield of high mass molecular ions, and decreasing the yield of fragment ions[2].

In comparison with Bulk, UFP has the following features

- High photo-absorption
- Low heat capacity
- Extremely large surface area per unit volume

This UFP matrix method seemed to enhance the speed of heating even further.

-- Mass separation --

Generally, TOF-MS has the following characteristics

- Very high transmission
- Measurement time of less than a few hundreds μsec

- Low mass resolution

A new gradient-electric field ion reflecter for a time-of-flight mass spectrometer has been developed in order to improve mass spectral resolution by energy focusing [3]. In the TOF mass spectrometer consisting of a free ion drift region and a new ion reflector, the motion of the same M/z ions is quasi-single oscillation of the same period. Therefore, the flight-times of the same m/z ions are focused to a constant even if the initial kinetic energy of the emitted ions are scattered.

The TOF mass separation system was designed to permit easy switching between "Reflector type" ($V_r > V_0$) and "Linear type" ($V_r = 0$).

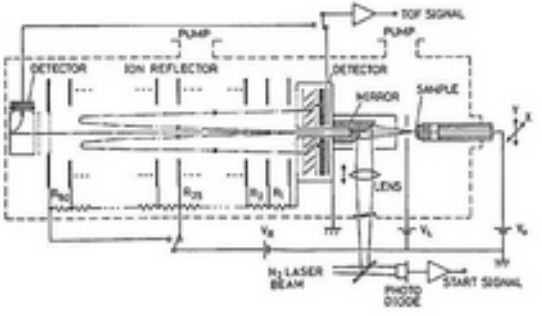


Fig. 1 Construction of the Laser Desorption TOF Mass Analyzer.

-- Detector --

Micro channel plate (MCP) or secondary electron multiplier (SEM) is usually used to detect ions, electrons or photons. Ions of larger m/z generally have low velocities in TOF-MS. So the detection sensitivity of MCP has a tendency to decrease in higher mass regions.

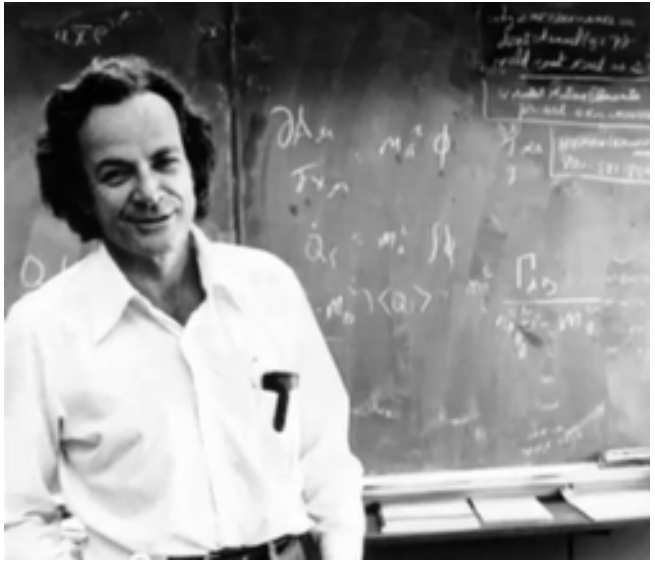
Higher detection sensitivity for high mass ions was

ここで休憩！

きょうの実験！
スパゲティを折るとどうなるか？

- 2006年のイグ・ノーベル賞！

有名な物理学者ファインマン先生のぎもん



折れた本数

折れた破片の長さを測定

Fragmentation of Rods by Cascading Cracks: Why Spaghetti Does Not Break in Half

Basile Audoly and Sébastien Neukirch

Laboratoire de Modélisation en Mécanique, CNRS/Université Paris VI, 4 place Jussieu, Paris, France

(Received 22 December 2004; published 25 August 2005)

When thin brittle rods such as dry spaghetti pasta are bent beyond their limit curvature, they often break into more than two pieces, typically three or four. With the aim of understanding these multiple breakings, we study the dynamics of a bent rod that is suddenly released at one end. We find that the sudden relaxation of the curvature at this end leads to a burst of flexural waves, whose dynamics are described by a self-similar solution with no adjustable parameters. These flexural waves locally *increase* the curvature in the rod, and we argue that this counterintuitive mechanism is responsible for the fragmentation of brittle rods under bending. A simple experiment supporting the claim is presented.

DOI: 10.1103/PhysRevLett.95.095505 PACS numbers: 62.20.Mk, 46.50.+a, 46.70.De

The physical process of fragmentation is relevant to several areas of science and technology. Because different physical phenomena are at work during the fragmentation of a solid body, it has mainly been studied from a statistical viewpoint [1–5]. Nevertheless, a growing amount of works have included physical considerations: surface energy contributions [6], nucleation and growth properties of the fracture process [7], elastic buckling [8,9], and stress wave propagation [10]. Usually, in dynamic fragmentation, the abrupt application of fracturing forces (e.g., by an impact) triggers numerous elementary breaking processes, making a statistical study of the fragment sizes possible. This is in contrast to quasistatic fragmentation where a advance. In the model problem, the rod is initially uniformly bent and at rest. This is achieved by clamping one end and applying a moment M_0 at the other end: M_0 plays the role of the internal moment transmitted across the section that is about to fail; see Fig. 1. At time $t = 0$, this end is suddenly released as the applied moment M_0 is removed instantaneously. The rod no longer is in equilibrium, and we study its subsequent dynamics.

The dynamics of thin rods are described by the celebrated Kirchhoff equations [13], which in the limit of small, planar deflections take the form

$$L^4 \kappa_{,s^4}(s,t) + T^2 \kappa_{,t^2}(s,t) = 0, \qquad (1)$$

スパゲティを折った結果を調べてみよう！

- 何本に折れたか
- 何cmに折れたか

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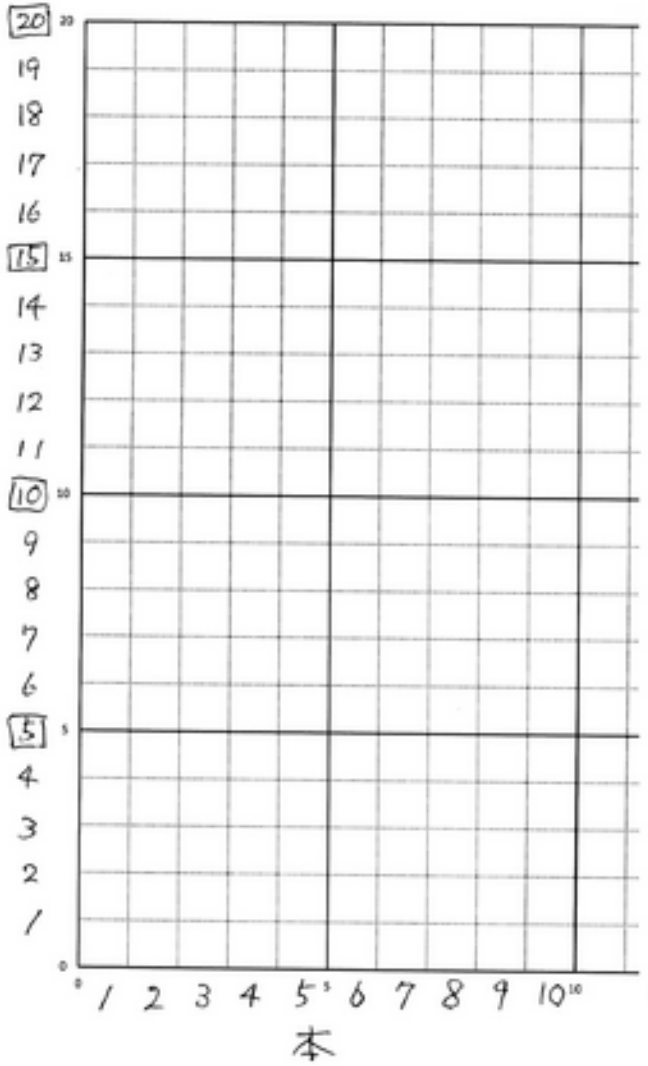
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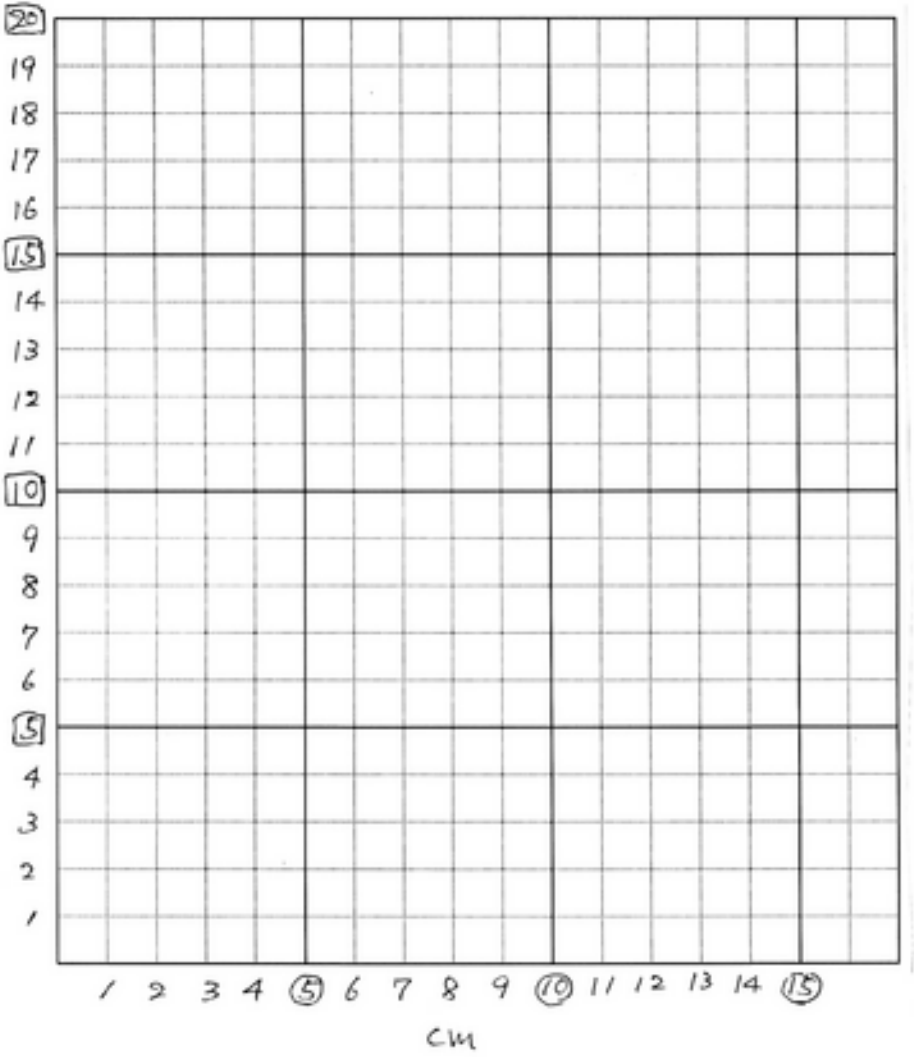
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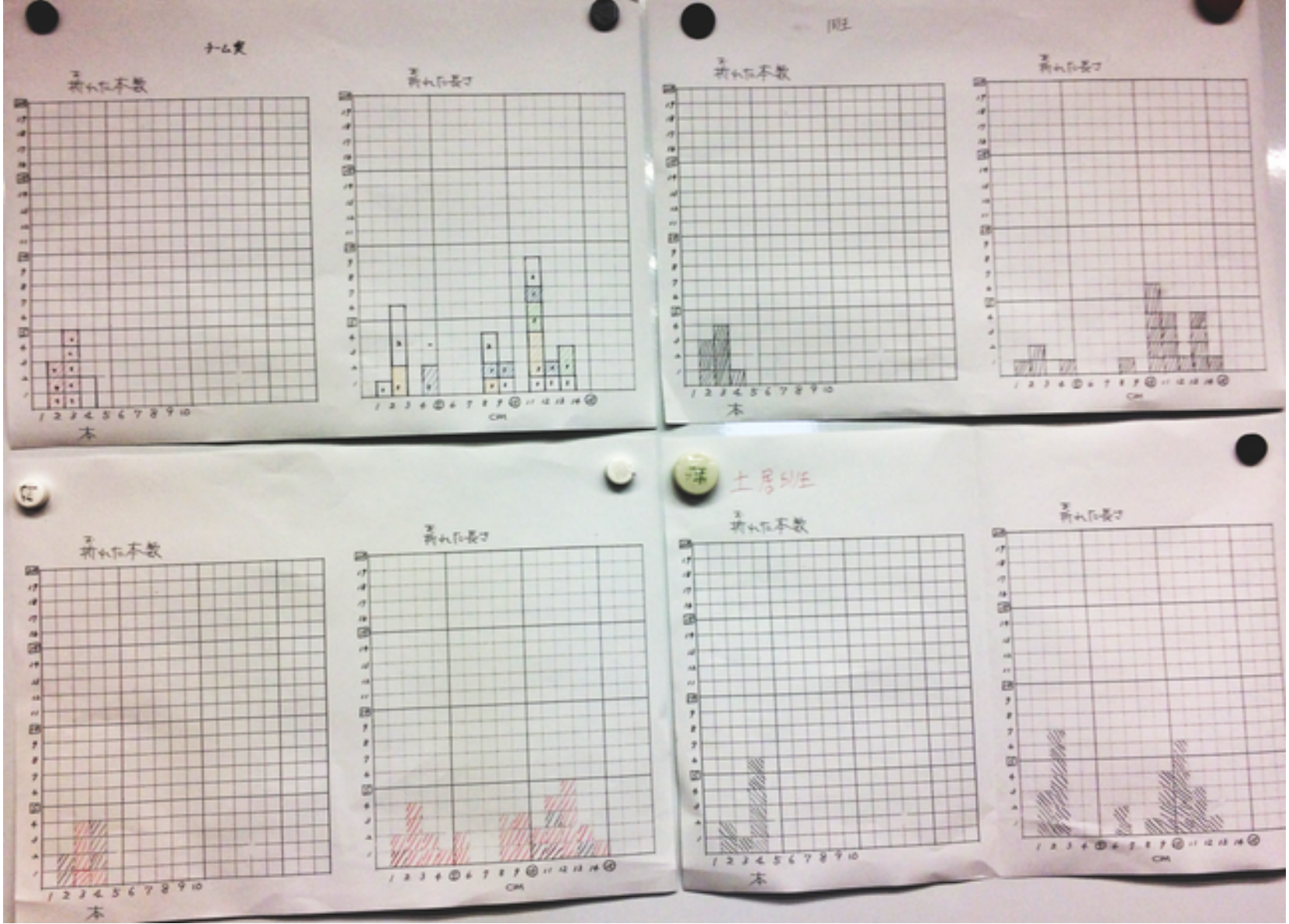
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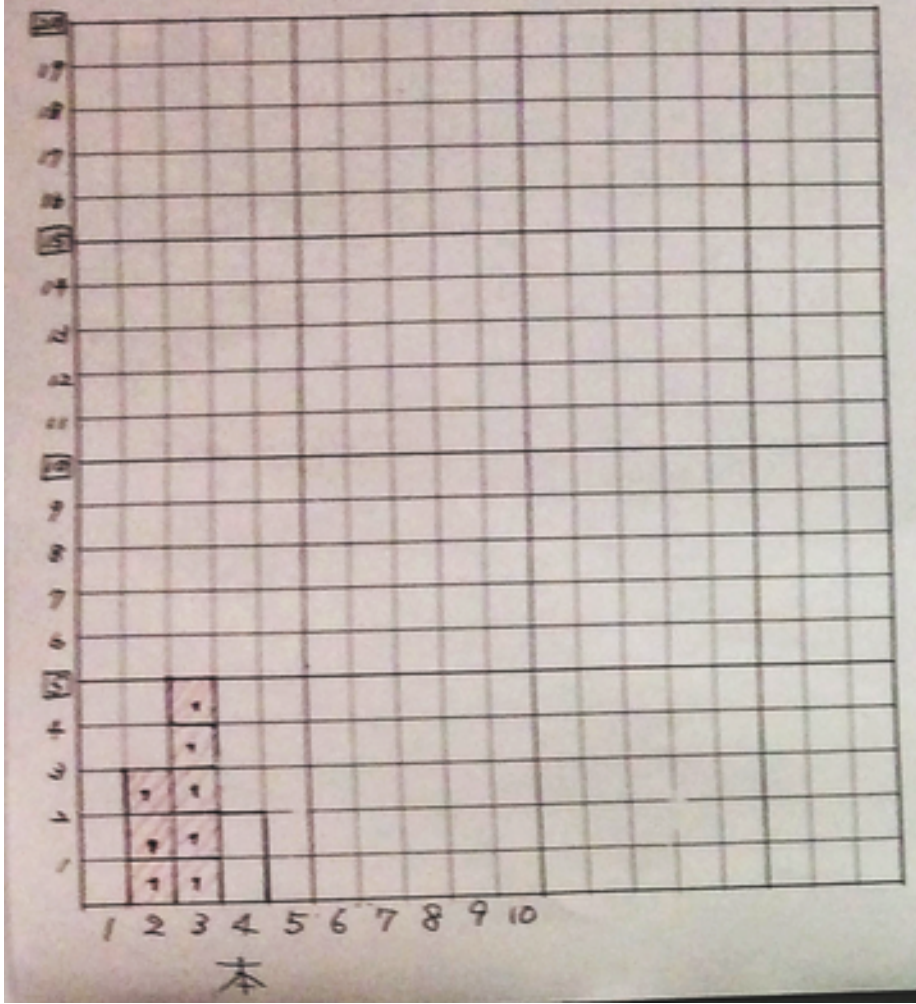

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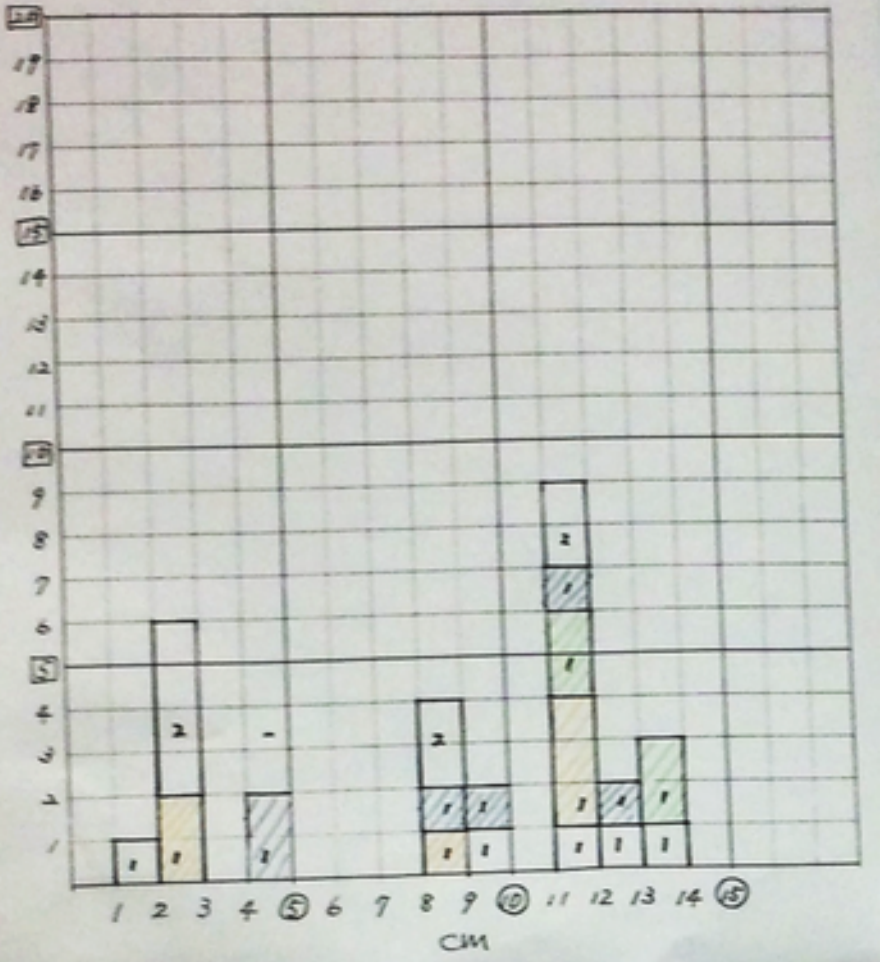


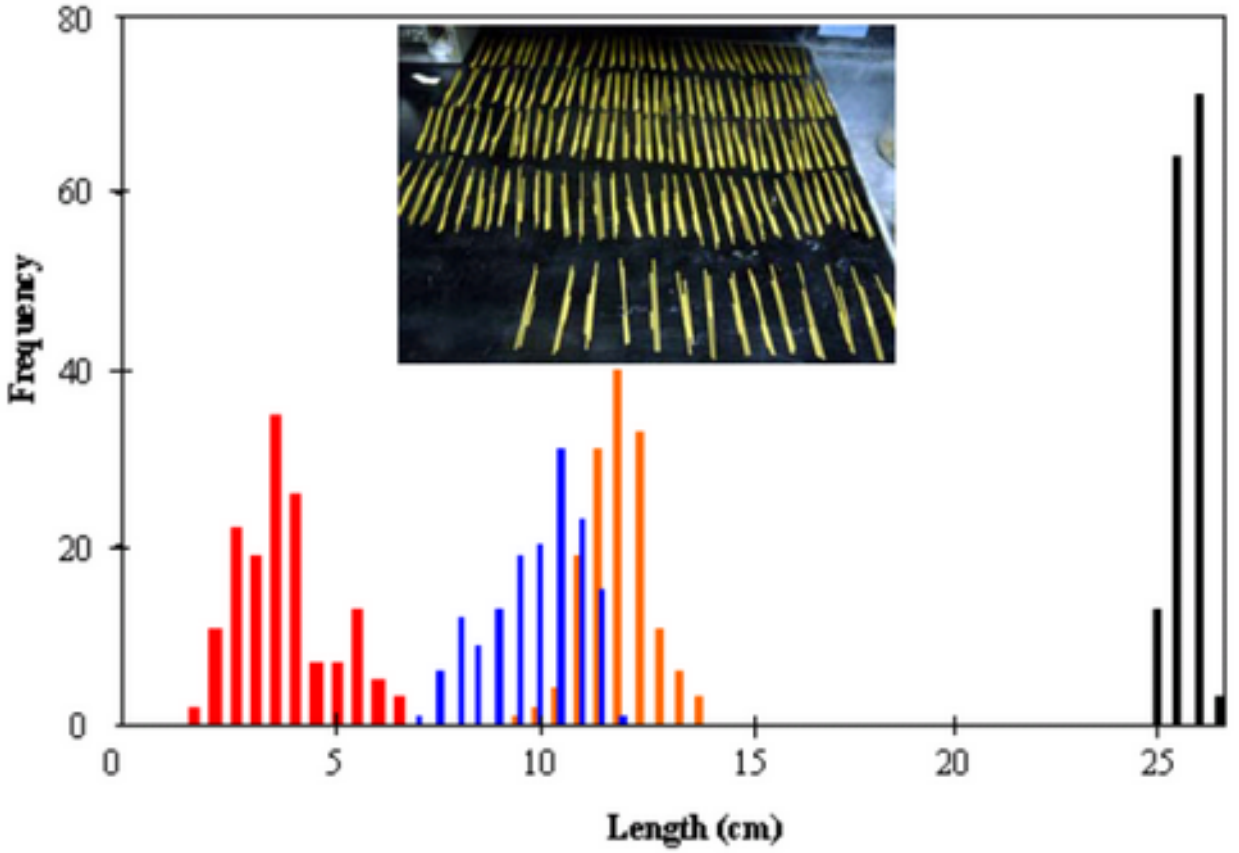


Figure 4.13 Length distribution of spaghetti noodles before (black) and after (red, blue and orange) fracture into three pieces.

[From Zaziski 2003; pages 83–84]

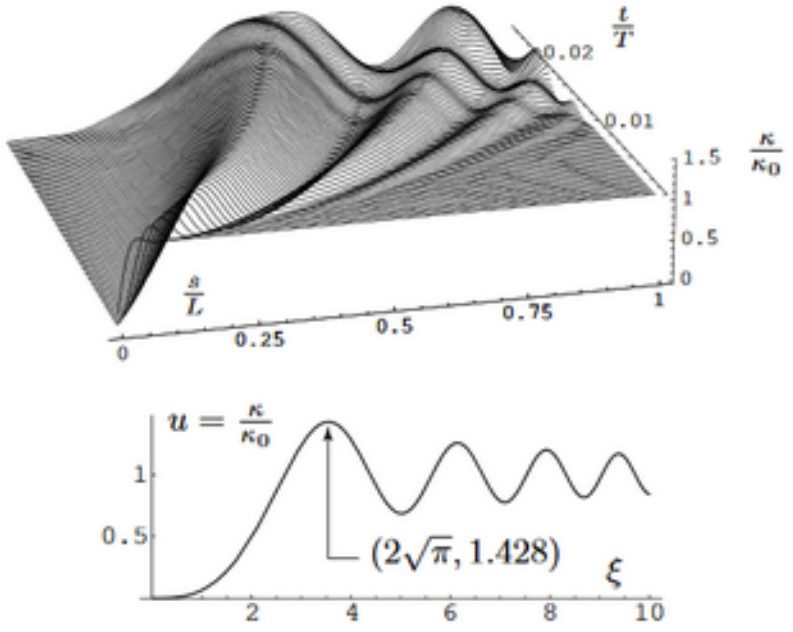


FIG. 2: *Top:* numerical solution of the nonlinear Kirchhoff equations for an initial half-circle configuration, $\kappa_0 = \pi/L$. The curvature at the free end $\kappa(0,t)$ relaxes to zero within the first few time steps (inner solution of the boundary layer problem) while it is given in the intermediate regime (2) by the universal self-similar solution (4) (outer solution). At later times, for $t \sim T$, reflections take place on the clamped end $s = L$. *Bottom:* self-similar solution describing the intermediate regime with $\xi = s/\sqrt{\gamma\, t}$.

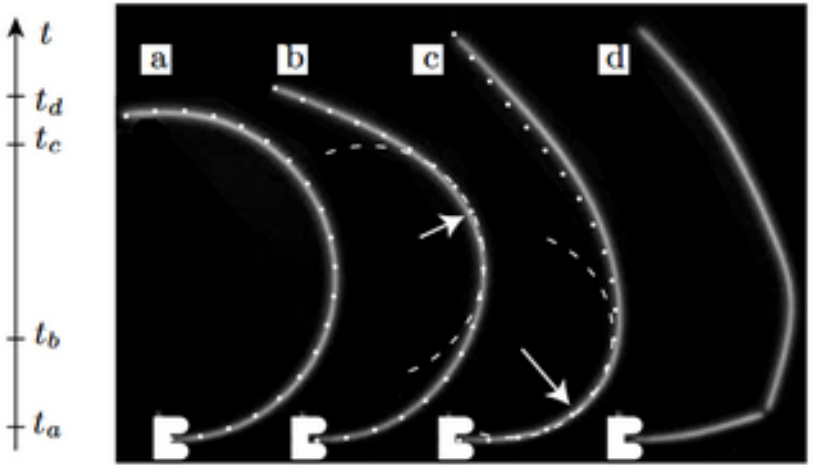
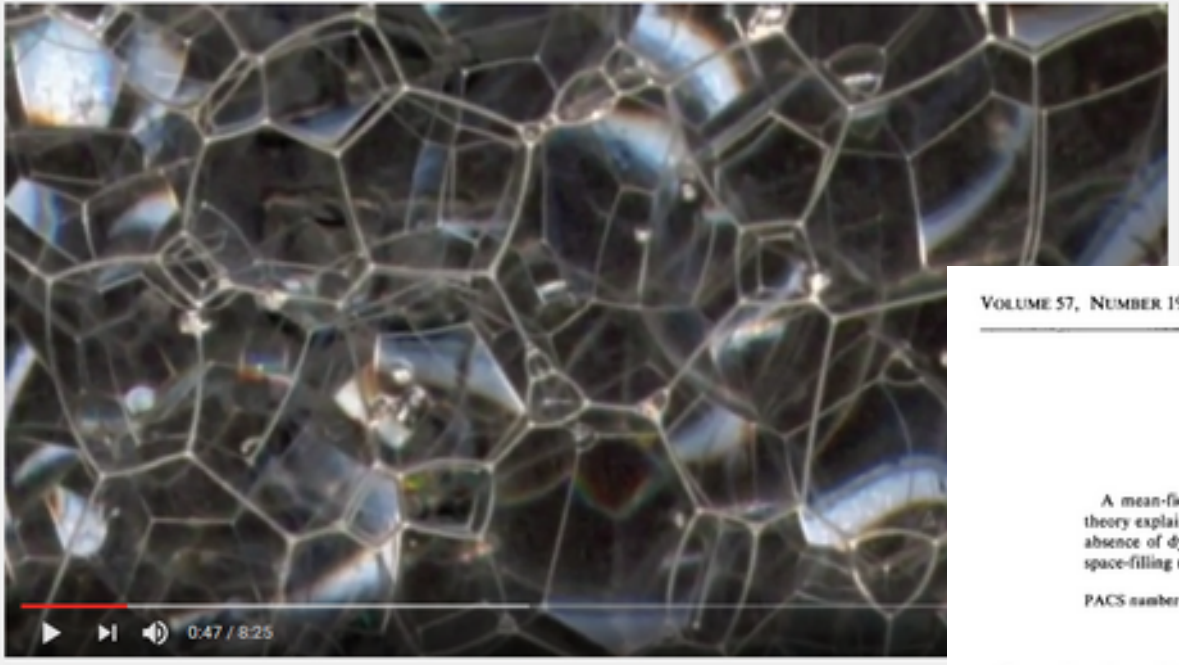


FIG. 3: A dry spaghetti can be broken by releasing one of its ends. The pasta is first bent into an arc of circle with a curvature slightly below its limit curvature. The lower end is clamped. The upper one is suddenly set free at time $t_a = 0$. Selected frames shot with a fast camera at 1000 Hz: (a) release $t_a = 0$, (b) intermediate frame $t_b = 0.0159\,T$, (c) frame just before rupture $t_c = 0.0509\,T$, and (d) after rupture $t_d = 0.0596\,T$. Numerical simulations based on the nonlinear Kirchhoff equations are superimposed, without any adjustable parameters: rod profile (dotted line) and osculating circle (dashed lines) at the point of largest curvature (arrow). Note that the rod breaks at the point of maximal curvature.

面白い例

YouTube

sixty Symbols foam



Foam Physics - Sixty Symbols

Sixty Symbols

チャンネル登録 64,575

追加 共有 その他

VOLUME 57, NUMBER 19 PHYSICAL REVIEW LETTERS 10 NOVEMBER 1986

Evolution of Two-Dimensional Soap-Film Networks

C. W. J. Beenakker
Philips Research Laboratories, 5600 JA Eindhoven, The Netherlands
(Received 14 July 1986)

A mean-field theory is presented for the coarsening of a two-dimensional soap-film network. This theory explains (1) the correlation between area and number of sides of the cells, and (2) the anomalous absence of dynamical scaling laws, which is shown to have its origin in the topological constraint of a space-filling network.

PACS numbers: 82.70.Rr, 68.90.+g

Coarsening of soap froths is an interesting and familiar process in which soap cells lower their surface free energy by increasing their average size. Traditionally, metallurgists have studied this process as a model for grain growth in polycrystalline solids.[1] Recently, cellular soap-film networks have appeared in the literature on condensed matter as prototypical systems with topological disorder.[2] It is, in fact, the topological aspect that distinguishes this process from what is known as Ostwald ripening, which is the coarsening of precipitated grains in a solution. Whereas there one has well-separated, approximately spherical grains, here the cell shapes are constrained by the network topology: Spherical cells cannot fill space. For Ostwald ripening, a very successful mean-field theory was developed around 1960 by Lifshitz, Slyosov, and Wagner[3,4] (LSW). To my knowledge, there is no comparable theory that incorporates the topological constraints of a network. It is the purpose of this paper to present such a mean-field theory

of an n-sided cell, one then easily derives von Neumann's law,[5,9]

$$dA/dt = k(n-6), \tag{1}$$

with $k = (\pi/3)\sigma\mu$. The total area of the system remains constant in time, as it should, by virtue of Euler's theorem that the cells have six sides on average. The description of the network dynamics consists of two problems, which can be dealt with separately as a result of the separation of time scales mentioned above: (1) What is the relation between the area and number of sides of the cells; and (2) how does the distribution of areas evolve in time? I first turn to problem (1).

It is observed experimentally that large cells tend to have many sides. I attribute this correlation to the relatively low surface energy of a many-sided cell.[10] Consider an n-sided cell bounded by a *regular* polygon constructed by circular arcs meeting at 120° angles. For a given length S of the cell perimeter, its area A is given by

泡の形や大きさに注目

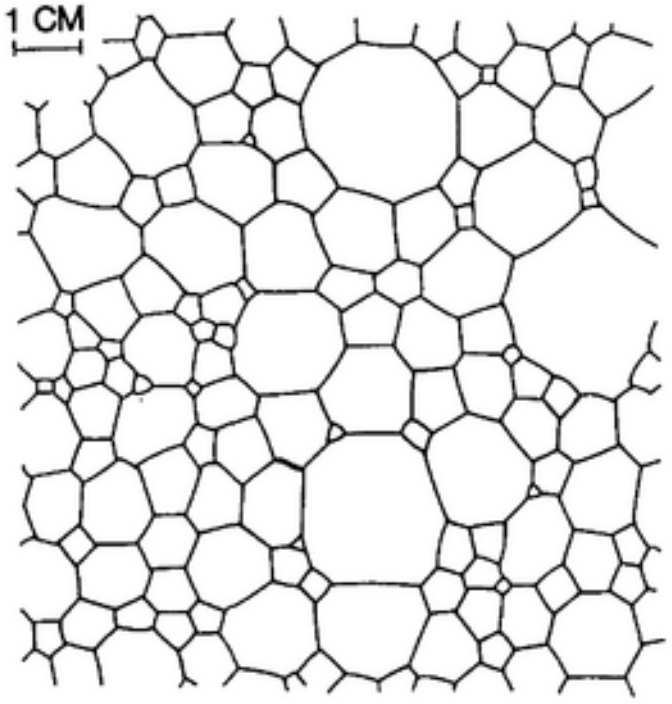


FIG. 1. Two-dimensional soap-film network, traced from an experimental photograph made by Smith (Ref. 5). The froth lies between parallel glass plates, spaced about 4 mm apart.

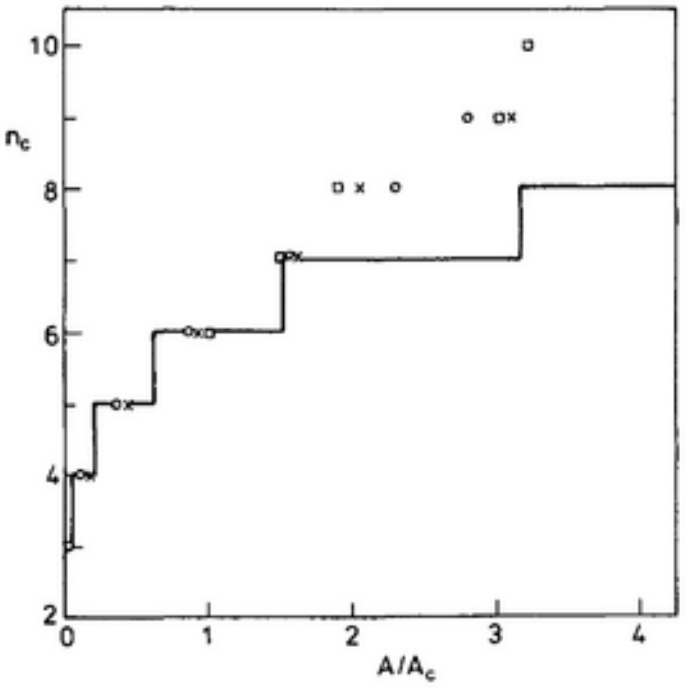


FIG. 2. Plot of the relation between cell area and number of sides, from the minimizing of expression (6). For comparison, markers show $\overline{A}(n)/\overline{A}$ as obtained in the simulation of Ref. 12. (The different markers correspond to three different networks; for $n \leq 5$, squares and circles coincide.)

ようがんのふしぎな形

- 柱状節理（ちゅうじょうせつり）

東尊坊
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ドイツ中部
Rhon山系

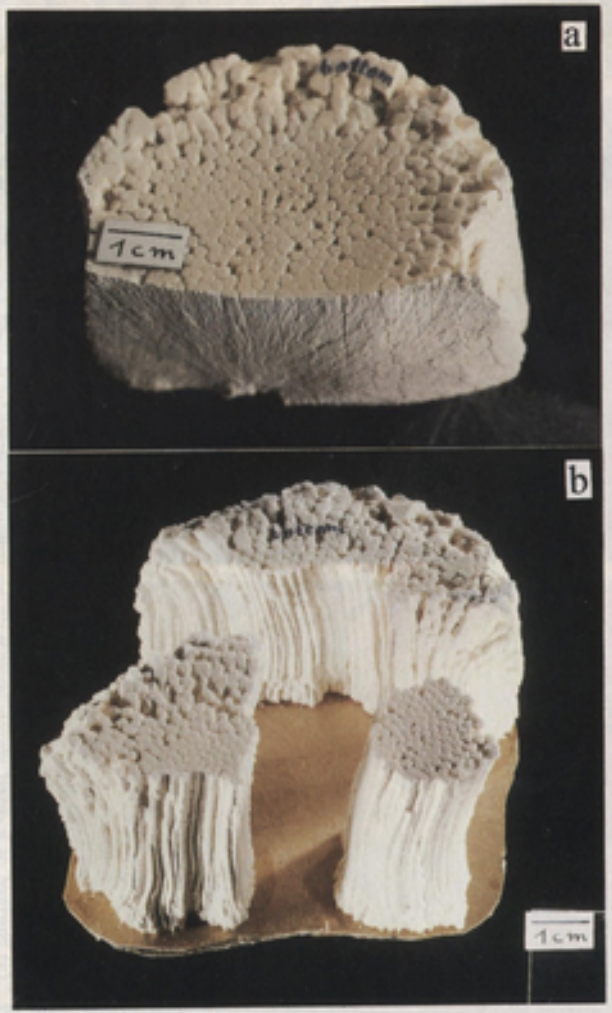

Plate 3. Thick dried starch layers with columns. View is on the bottomside of the specimens; lamp drying was performed from the other side. (a) Large first-generation crack visible in front, showing characteristic plumose rupture structures, radiating from the crack hypocenter at the (original) top of the specimen. (b) Specimen broken into pieces. The columns develop regularity within about 5-10 mm from the (original) top. Several cases of joining columns can be seen.

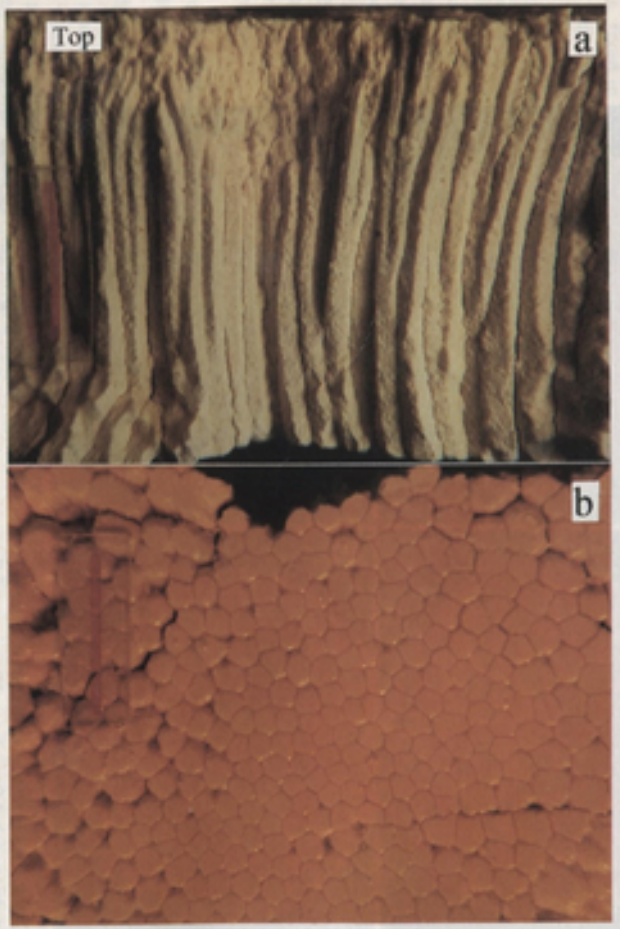

Plate 4. (a) Detailed side view and (b) bottom view of the starch columns of the same specimen (red bar is 1 cm long). The top row of columns in Plate 4b agrees with the columns in Plate 4a.

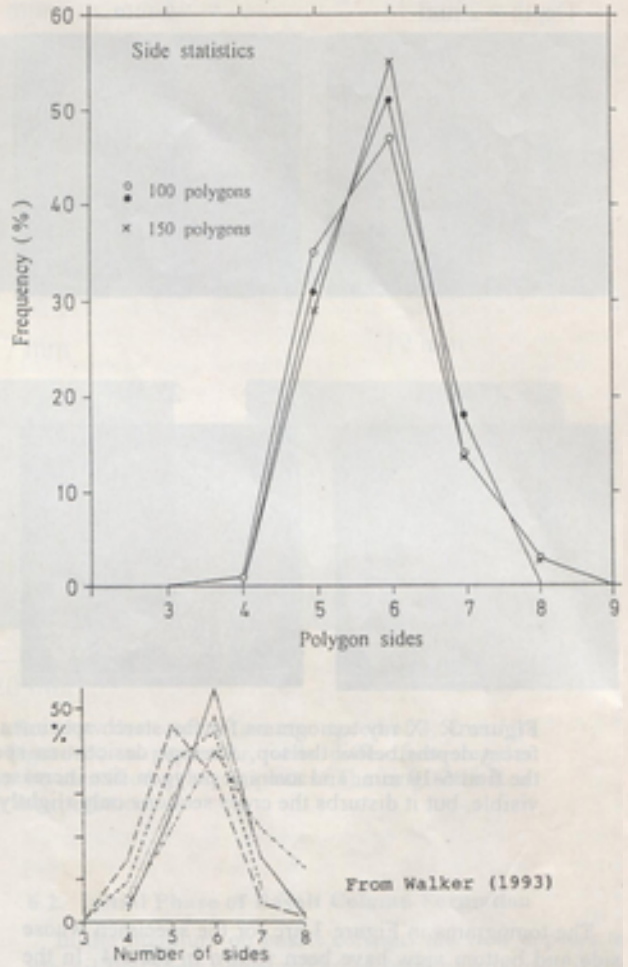

Figure 2. (top) Side statistics of the polygons in three starch specimens. (bottom) Side statistics in different basalt column locations (modified from *Walker* [1993]; reprinted with permission of Geological Society Publishing House).

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ırch columns: Analog model for basalt columns

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ıtract. Desiccation of starch-water mixtures produces tensile-crack patterns which ear to be interesting, but largely unknown study objects for fracture mechanics, struc- l geology, and volcanology. This paper concentrates on columnar jointing and on ımns in starch. Starch columns have polygonal cross sections and are very similar to alt columns. They are produced by lamp drying starch specimens with dimensions of eral centimeters and have diameters in the millimeter range. The columns develop be- l a crack front which propagates from the surface into the interior. The experiments, ported by X ray tomograms, show that polygonal regularity of the crack pattern is not

is that the ratio $\Delta D / \Delta F = (\sigma(t)/G)/(L/A)$ increases with time approaching unity, or that $\sigma(t)/G$ increases with time and approaches the ratio L/A of total crack length L and total area A. Equivalently, L/A can be taken as the ratio of crack length and area per cell of the crack system. Then, if there is a crack system whose L/A per cell is lower than the actual L/A, there will be a trend toward such a system because less energy is required to realize it. This trend implies straightening of cracks from rugged to smooth and linear segments and a preference for polygonal cells. A crack system without preferential directions then consists necessarily of area-filling equilateral polygons, and among them equilateral hexagons have the lowest L/A ratio. This ideal configuration is, however, not reached in nature, but only a close configuration, consisting of general hexagons and the neighboring polygons, pentagons and heptagons.

6.4. Colonnade-Entablature Problem

Starch experiments so far contribute little to the solution of the colonnade-entablature problem in multitiered basalt flows, where abrupt changes from thin, irregular, non vertical columns (entablature) to thick, regular, vertical columns (colonnade) are observed, often at horizontal planes and corresponding to one (downward) cooling direction [*Spry*, 1962; *DeGraff and Aydin*, 1987]. At least some of these cases apparently can be explained by water, flowing through the newly created joints, vaporizing and efficiently cooling the basalt, thereby producing the entablature character, whereas the colonnades correspond to cooling periods without water access. An interesting question, however, is whether such changes can also occur without pronounced environmental variations and reflect transitions between two basic states of a cooling and frac-

Figure 5. Side view of a 5 m thick Icelandic lava flow which has cooled from above and below (from *Walker* [1993]; reprinted with permission of Geological Society Publishing House). Walker's sketch to the right illustrates the increase in column thickness and decrease in complexity into the interior of the flow from both sides.

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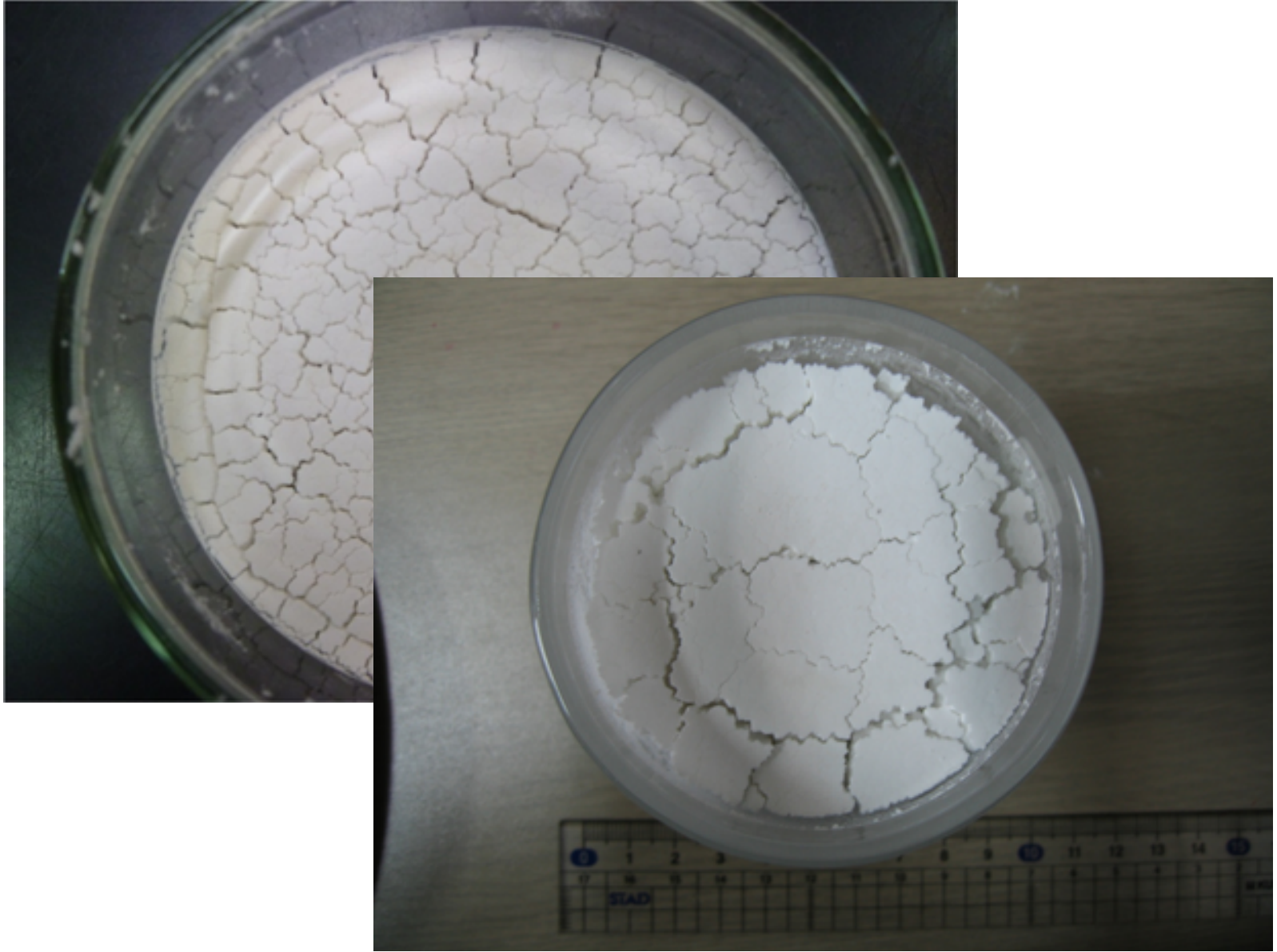

今日の講座を終えるにあたって
保護者の皆様へ

- 心理学者　岸田秀の一言
- あるお母さんから質問された.----
- どうすれば子供を「花を愛するやさしい子供」
- に育てることができますか？

- それはとても簡単です.「お母さん!あなたが花を愛する人になれば良いのです!」