

How the Planets Affect Our Daily Lives ...

... A Brief History of Uncertainty



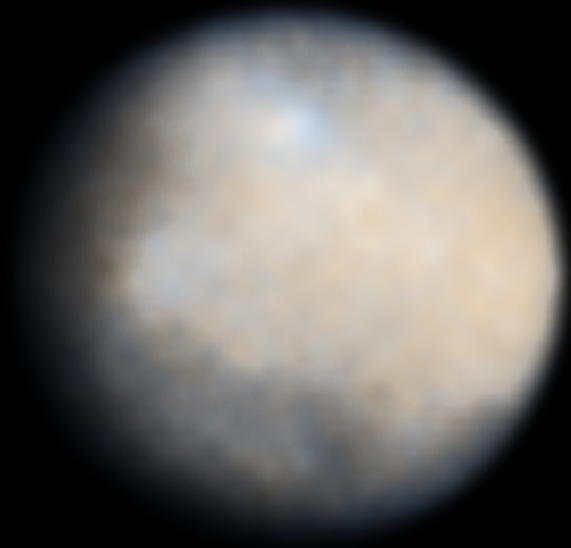


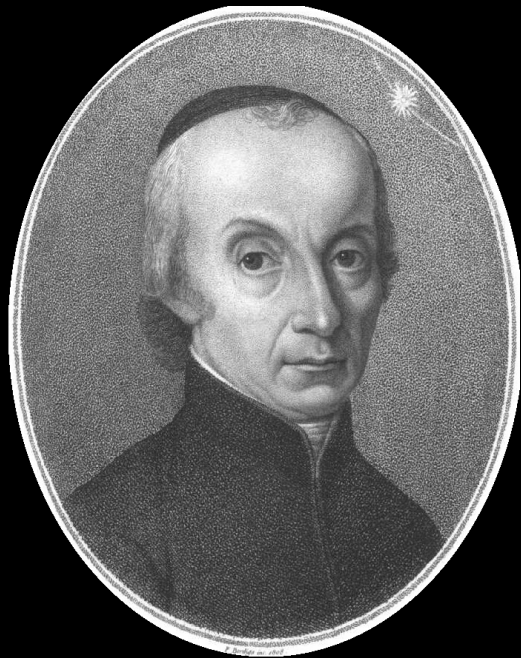






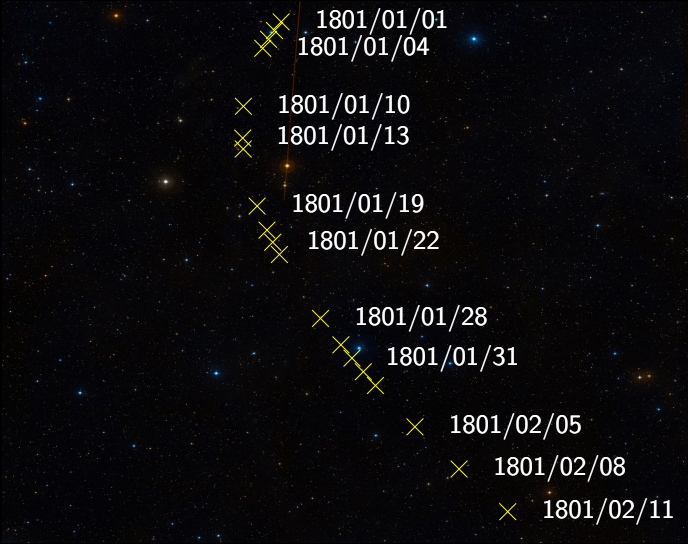






Beobachtungen des zu Palermo d. 1. Jan. 1801 von Prof. Piazzi neu entdeckten Gestirns.

| 1801  | Mittlere<br>Sonnen-<br>Zeit | Gerade<br>Aufstieg in<br>Zeit | Gerade Auf-<br>steigung in<br>Graden | Nördl.<br>Abweich. | Geocentri-<br>sche Länge | Geocentri-<br>Breite | Ort der Sonne<br>+ 20"<br>Aberration | Logar.<br>d. Distanz<br>☉ 3 |
|-------|-----------------------------|-------------------------------|--------------------------------------|--------------------|--------------------------|----------------------|--------------------------------------|-----------------------------|
|       | St                          | St                            |                                      |                    | Z                        |                      | Z                                    |                             |
| Jan.  | 1 8 43 37,8                 | 3 27 11,25                    | 51 47 48,8                           | 15 37 43,5         | 1 23 22 58,3             | 3 6 42,1             | 9 11 1 30,9                          | 9,9926156                   |
|       | 2 8 39 4,6                  | 3 26 53,85                    | 51 43 27,8                           | 15 41 5,5          | 1 23 19 44,3             | 3 2 24,9             | 9 12 2 38,6                          | 9,9926317                   |
|       | 3 8 34 53,3                 | 3 26 38,4                     | 51 39 36,0                           | 15 44 31,6         | 1 23 16 58,6             | 2 58 9,9             | 9 13 3 26,6                          | 9,9926324                   |
|       | 4 8 30 42,1                 | 3 26 23,15                    | 51 35 47,3                           | 15 47 57,6         | 1 23 14 15,5             | 2 53 55,6            | 9 14 4 14,9                          | 9,9926418                   |
|       | 10 8 6 15,8                 | 3 25 32,1                     | 51 23 1,5                            | 16 10 32,0         | 1 23 7 59,1              | 2 29 0,6             | 9 20 10 17,5                         | 9,9927641                   |
|       | 11 8 2 17,5                 | 3 25 29,73                    | 51 22 26,6                           | 16 10 32,0         | 1 23 7 59,1              | 2 29 0,6             | 9 20 10 17,5                         | 9,9927641                   |
|       | 13 7 54 26,2                | 3 25 30,30                    | 51 22 34,5                           | 16 22 49,5         | 1 23 10 37,6             | 2 16 59,7            | 9 23 12 13,8                         | 9,9928490                   |
|       | 14 7 50 31,7                | 3 25 31,72                    | 51 22 55,8                           | 16 27 5,7          | 1 23 12 1,2              | 2 12 56,7            | 9 24 14 13,5                         | 9,9928809                   |
|       | 17 7 35 11,3                | 3 25 55,1                     | 51 28 45,0                           | 16 40 13,0         | 1 23 25 59,2             | 1 53 38,2            | 9 29 19 53,8                         | 9,9930607                   |
|       | 19 7 31 28,5                | 3 26 8,15                     | 51 32 27,3                           | 16 49 16,1         | 1 23 34 21,3             | 1 46 6,0             | 10 1 20 40,3                         | 9,9931434                   |
|       | 21 7 24 2,7                 | 3 26 34,27                    | 51 38 34,1                           | 16 58 35,9         | 1 23 39 1,8              | 1 42 28,1            | 10 2 21 32,0                         | 9,9931886                   |
|       | 22 7 20 31,7                | 3 26 49,42                    | 51 42 21,2                           | 17 3 18,5          | 1 23 44 15,7             | 1 38 52,1            | 10 3 22 22,7                         | 9,9932348                   |
|       | 23 7 16 45,5                | 3 27 6,90                     | 51 46 43,5                           | 17 8 5,5           | 1 24 15 15,7             | 1 21 6,9             | 10 8 26 20,1                         | 9,9935062                   |
|       | 28 6 58 51,3                | 3 28 54,53                    | 52 13 38,3                           | 17 32 54,1         | 1 24 30 9,0              | 1 14 16,0            | 10 10 27 46,2                        | 9,9936332                   |
|       | 30 6 51 52,9                | 3 29 48,14                    | 52 27 2,1                            | 17 43 11,0         | 1 24 38 7,3              | 1 10 54,6            | 10 11 28 28,5                        | 9,9937007                   |
| Febr. | 1 6 44 59,9                 | 3 30 47,2                     | 52 41 48,0                           | 17 53 36,3         | 1 24 46 19,3             | 1 7 30,9             | 10 12 29 9,6                         | 9,9937703                   |
|       | 2 6 41 35,8                 | 3 31 19,06                    | 52 49 45,9                           | 17 58 57,5         | 1 24 54 57,9             | 1 4 1,5              | 10 13 29 49,9                        | 9,9938423                   |
|       | 5 6 31 31,5                 | 3 33 2,70                     | 53 15 40,5                           | 18 15 1,0          | 1 25 22 43,4             | 0 54 23,9            | 10 16 31 45,5                        | 9,9940751                   |
|       | 8 6 21 39,2                 | 3 34 58,50                    | 53 44 37,5                           | 18 31 23,2         | 1 25 53 29,5             | 0 45 5,0             | 10 19 33 33,3                        | 9,9943276                   |
|       | 11 6 11 58,2                | 3 37 6,54                     | 54 16 38,2                           | 18 47 58,8         | 1 26 26 40,0             | 0 36 2,9             | 10 22 35 11,4                        | 9,9945823                   |



1801/01/01  
1801/01/04

× 1801/01/10

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× 1801/01/19

× 1801/01/22

× 1801/01/28

× 1801/01/31

× 1801/02/05

× 1801/02/08

× 1801/02/11





hier in der Nähe der Quadratur der Einflufs der Sonnen-Länge geringer ist, als in andern Lagen. Dr. Gauss glaubt daher, dafs es nicht undenklich wäre, wenn man die Fehler der Sonnentafeln aus sehr genauen Beobachtungen für diese Zeiten bestimmte, und die Örter der Sonne hiernach verbesserte. Diese verbesserten Elemente sind nun folgende:

|                    |              |                        |            |
|--------------------|--------------|------------------------|------------|
| Sonnenferne . . .  | 326° 27' 38" | Hieraus:               |            |
| Ö . . . . .        | 81 0 44      | größte Mittelp. Glef.  |            |
| Neigung . . .      | 10 36 57     | chung . . . . .        | 9° 27' 41" |
| Log. halb. gr. Axe | 0.4420527    | logl. mittlere helioc. |            |
| Excentricität . .  | 0.0825017    | tropische Beweg.       | 770.914    |
| Epoch 1800 31 Dec. | 77° 36' 34"  |                        |            |

Aus diesen Elementen hat Dr. Gauss folgende Örter der Ceres Ferdinandea im voraus berechnet. Die Zeit ist mittlere für Mitternacht in Palermo.

| 1801    | Gröczen-<br>trische<br>Länge | Gröczen-<br>trische<br>Breite<br>nordl. | Logarith.<br>des Ab-<br>standes<br>von der S | Logarith.<br>des Ab-<br>standes<br>von der C | Verhält-<br>niss<br>der ge-<br>hehenen<br>Helligk. |
|---------|------------------------------|-----------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------------|
|         | Z                            |                                         |                                              |                                              |                                                    |
| Nov. 25 | 5 20 16                      | 9 25                                    | 0.42181                                      | 0.40468                                      | 0.6102                                             |
| Dec. 1  | 5 22 15                      | 9 48                                    | 0.40940                                      | 0.40472                                      | 0.6459                                             |
|         | 5 24 7                       | 10 12                                   | 0.39643                                      | 0.40479                                      | 0.6855                                             |
|         | 13 5 25 11                   | 10 37                                   | 0.38296                                      | 0.40488                                      | 0.7290                                             |
|         | 19 5 27 27                   | 11 4                                    | 0.36902                                      | 0.40499                                      | 0.7770                                             |
|         | 25 5 28 53                   | 11 32                                   | 0.35468                                      | 0.40512                                      | 0.8295                                             |
|         | 31 6 0 10                    | 12 1                                    | 0.34000                                      | 0.40528                                      | 0.8869                                             |

Sollte man den Ort des Planeten nach diesen Elementen genauer, oder auf eine längere Zeit berechnen wollen: so setzen wir zu diesem Behufe noch folgende Formeln hierher:

1) Zur

Excentricität  $e = 0,081307$  | Aphelische Beweg. 770,914  
 Epoche 1800 31 Dec.  $77^{\circ} 36' 34''$

Aus diesen Elementen hat Dr. *Gauß* folgende  
 Örter der *Ceres Ferdinandea* im voraus berechnet.  
 Die Zeit ist mittlere für Mitternacht in *Palermo*.

| 1801    | Geocen-<br>trische<br>Länge | Geocen-<br>trische<br>Breite<br>nördl. | Logarith.<br>des Ab-<br>standes<br>von der ☿ | Logarith.<br>des Ab-<br>standes<br>von der ☾ | Verhält-<br>niß<br>der ge-<br>sehenen<br>Helligk. |
|---------|-----------------------------|----------------------------------------|----------------------------------------------|----------------------------------------------|---------------------------------------------------|
|         | Z                           |                                        |                                              |                                              |                                                   |
| Nov. 25 | 5 20 16                     | 9 25                                   | 0,42181                                      | 0,40468                                      | 0,6102                                            |
| Dec. 1  | 5 22 15                     | 9 48                                   | 0,40940                                      | 0,40472                                      | 0,6459                                            |
|         | 7 5 24 7                    | 10 12                                  | 0,39643                                      | 0,40479                                      | 0,6855                                            |
|         | 13 5 25 51                  | 10 37                                  | 0,38296                                      | 0,40488                                      | 0,7290                                            |
|         | 19 5 27 27                  | 11 4                                   | 0,36902                                      | 0,40499                                      | 0,7770                                            |
|         | 25 5 28 53                  | 11 32                                  | 0,35468                                      | 0,40512                                      | 0,8295                                            |
|         | 31 6 0 10                   | 12 1                                   | 0,34000                                      | 0,40528                                      | 0,8869                                            |

Sollte man den Ort des Planeten nach diesen Ele-  
 menten genauer, oder auf eine längere Zeit berech-  
 nen wollen: so setzen wir zu diesem Behufe noch  
 folgende Formeln hierher:



DELLA SCOPERTA  
DEL NUOVO PIANETA  
CERERE FERDINANDEA

OTTAVO TRA I PRIMAII DEL NOSTRO SISTEMA  
SOLARE.



PALERMO  
1802

NELLA STAMPERIA REALE.





Mercury  
Venus

Earth

Mars

Jupiter

Saturn

Uranus

Neptune

— “Planets”

Ceres

— “Dwarf  
Planets”

Pluto

Haumea

Makemake

Eris









other, we say that its choice is an effect without a cause. It is then, says Leibnitz, the blind chance of the Epicureans. The contrary opinion is an illusion of the mind, which, losing sight of the evasive reasons of the choice of the will in indifferent things, believes that choice is determined of itself and without motives.

We ought then to regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow. Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently vast to submit these data to analysis—it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes. The human mind offers, in the perfection which it has been able to give to astronomy, a feeble idea of this intelligence. Its discoveries in mechanics and geometry, added to that of universal gravity, have enabled it to comprehend in the same analytical expressions the past and future states of the system of the world. Applying the same method to some other objects of its knowledge, it has succeeded in referring to general laws observed phenomena and in foreseeing those which given circumstances ought to produce. All these efforts in the search for truth tend to lead it back continually to the vast intelligence which we have just mentioned, but from which it will always remain infinitely removed. This tendency, peculiar to the human race, is that which renders it superior to animals; and their progress

choice is determined of itself and without motives.

We ought then to regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow. Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently vast to submit these data to analysis—it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes. The human mind differs in the perfection which it has

height: "The day will come when, by study pursued through several ages, the things now concealed will appear with evidence; and posterity will be astonished that truths so clear had escaped us." Clairaut then undertook to submit to analysis the perturbations which the comet had experienced by the action of the two great planets, Jupiter and Saturn; after immense calculations he fixed its next passage at the perihelion toward the beginning of April, 1759, which was actually verified by observation. The regularity which astronomy shows us in the movements of the comets doubtless exists also in all phenomena. .

The curve described by a simple molecule of air or vapor is regulated in a manner just as certain as the planetary orbits; the only difference between them is that which comes from our ignorance.

Probability is relative, in part to this ignorance, in part to our knowledge. We know that of three or a greater number of events a single one ought to occur; but nothing induces us to believe that one of them will occur rather than the others. In this state of indecision it is impossible for us to announce their occurrence with certainty. It is, however, probable that one of these events, chosen at will, will not occur because we see several cases equally possible which exclude its occurrence, while only a single one favors it.

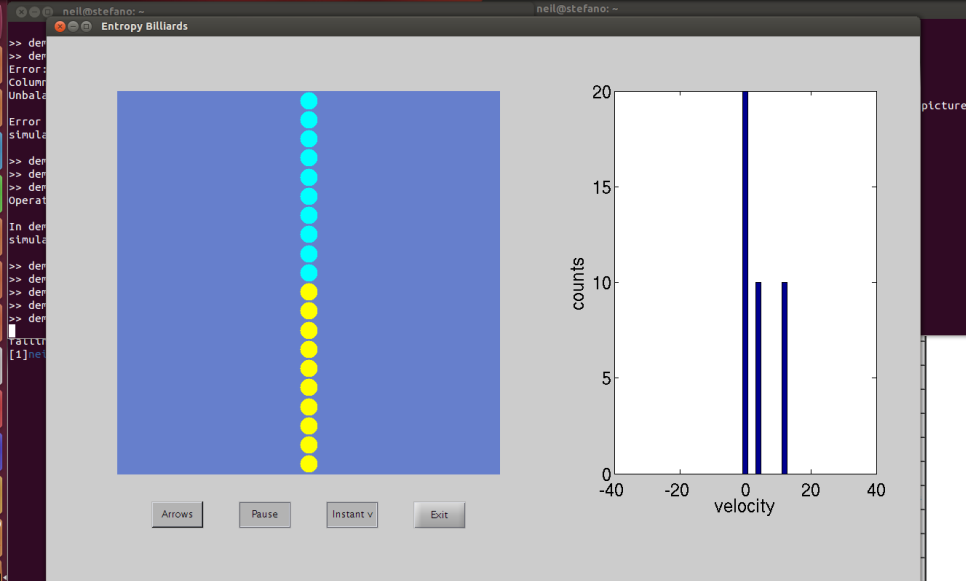
The theory of chance consists in reducing all the events of the same kind to a certain number of cases equally possible, that is to say, to such as we may be equally undecided about in regard to their existence, and in determining the number of cases favorable to the event whose probability is sought. The ratio of

shows us in the movements of the comets doubtless exists also in all phenomena. -

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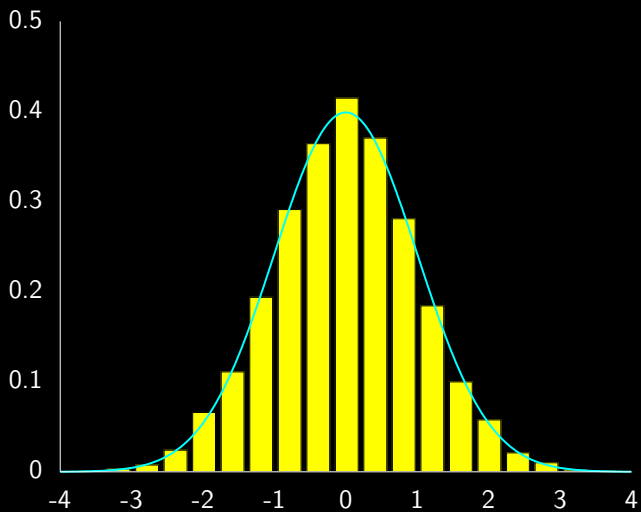


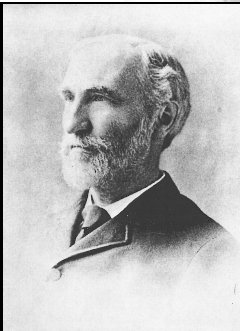
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UIContextMenu

Uicontextmenu object associated with the uicontrol









# THE NATURE OF THE PHYSICAL WORLD

by  
A. S. EDDINGTON  
M.A., LL.D., B.Sc., F.R.S.  
*Pembroke Professor of Astronomy  
in the  
University of Cambridge*

THE  
GIFFORD LECTURES  
1927

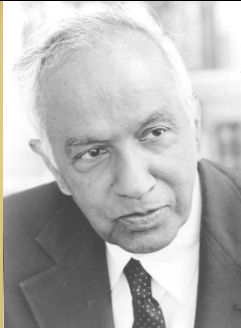
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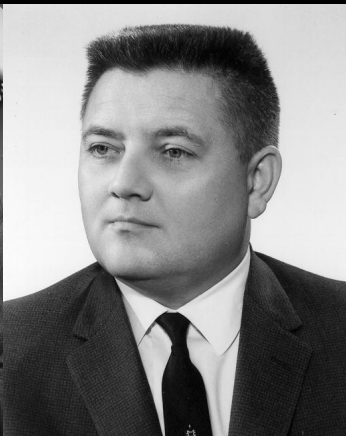
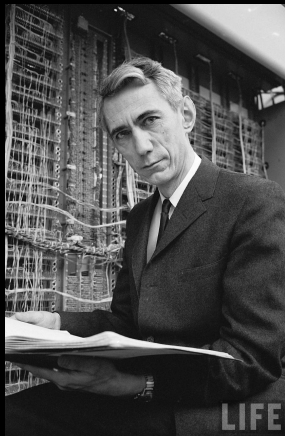
## 74 THE RUNNING-DOWN OF THE UNIVERSE

The uniform march of a regiment is not the only form of organised motion; the organised evolutions of a stage chorus have their natural analogue in sound waves. A common measure can now be applied to all forms of organisation. Any loss of organisation is equitably measured by the chance against its recovery by an accidental coincidence. The chance is always regarded as a contingency, but it is precise as a measure.

The practical measure of the random element which can increase in the universe but can never decrease is called entropy. Measuring by entropy is the same as measuring by the chance equated in the last paragraph, only the unmanageably large numbers are transformed (by a simple formula) into a more convenient scale of reckoning. Entropy continually increases. We can, by isolating parts of the world and postulating rather idealised conditions in our problems, arrest the increase, but we cannot turn it into a decrease. That would involve something much worse than a violation of an ordinary law of Nature, namely, as improbable coincidence. The law that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much the worse for Maxwell's equations. If it is found to be contradicted by observation—well, these experimentalists do hump things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no larger; there is nothing for it but to collapse in deepest humiliation. This exaltation of the second law is not unreasonable. There are other laws which we have strong reason to believe in, and we feel that a hypothesis which violates them is highly



ordinary law of Nature, namely, an improbable coincidence. The law that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much the worse for Maxwell's equations. If it is found to be contradicted by observation—well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation. This exaltation





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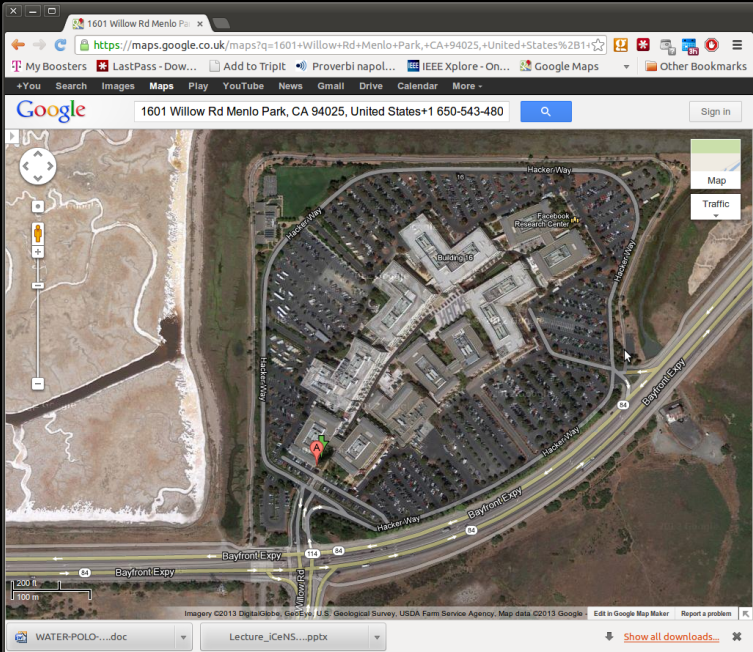
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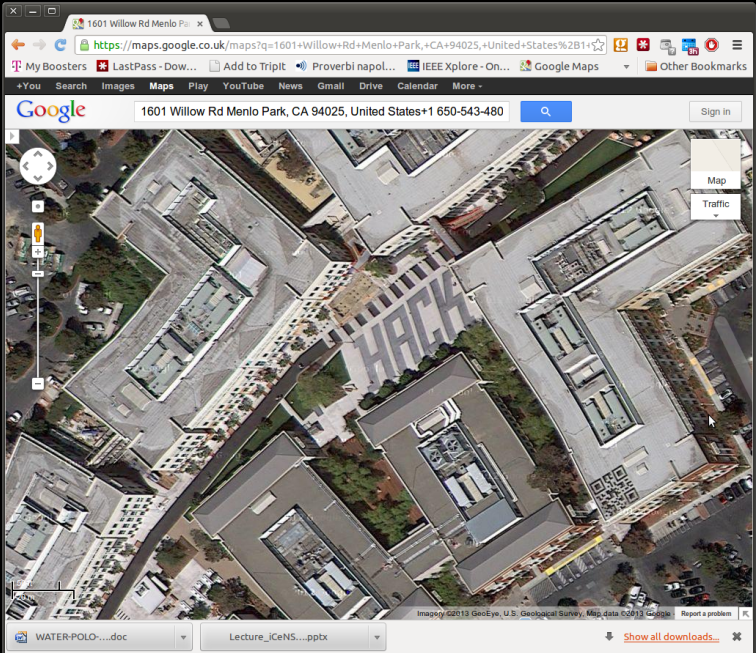
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A satellite map view of the Facebook Menlo Park campus. The map shows several large, interconnected office buildings with flat roofs and parking lots. To the left of the campus is a large, dry, brownish area, likely a former lake or reservoir. To the right, a multi-lane highway (Bayfront Expressway) runs parallel to the campus. A red pin with a green 'A' marker is placed on one of the buildings. The map interface includes a search bar at the top with the address '1601 Willow Rd Menlo Park, CA 94025, United States+1 650-543-480'. Below the search bar are navigation controls like a compass and a scale bar. At the bottom, there are tabs for 'WATER-POLO....doc' and 'Lecture\_iCeNS....pptx', and a 'Show all downloads' link.









Joaquin Quiñonero Candela

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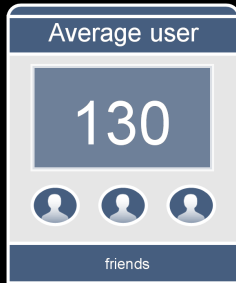


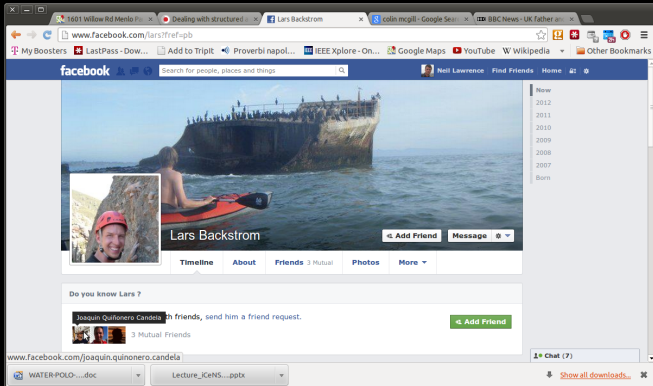
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