CENTRO STUDI ETOLOGICI
C. S. E.

impronte

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Here is the second issue of your newsletter!

This is a collection of information about our activities and curiosities of nature, which we hope, may some day become useful to you.
The "perché,perché, perché" (why, why, why) section will always welcome your most outlandish questions. Don't forget to address them to:

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or email us at
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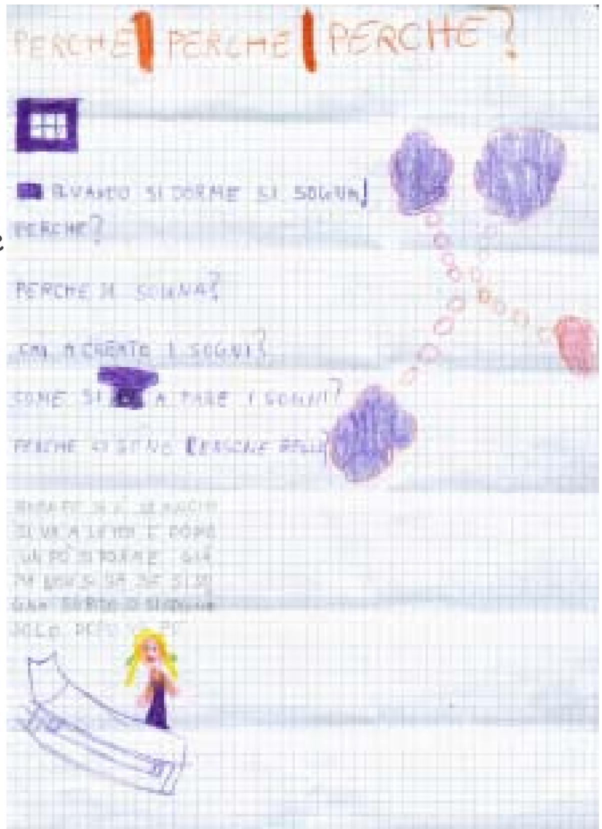
Please, let us know your name, your age and the country in which you live

In this issue "The woodsman" - will talk to us about the age of trees.
We also have a brand new section, "Know-all corner" which will guide you through the number crunching maze. On this occasion the know-all will talk to us about the meaning of probability.
As you will have gathered, the contents of this newsletter have an element of surprise; it all depends on how the contributors feel on the day. Sometimes they feel lazy, but at times they will be only too keen to share their experience with us.

A warm greeting from the editorial board

perché, perché, perché?

readers ask the questions



Why and how do we dream?

Livia Nanni (aged 8, Radicondoli)

Nice one Livia! Now…, sleep is one of the most researched areas of study in humans and animals. It has been possible to establish when someone is dreaming, by using an instrument capable of measuring the electrical activity of the brain (electroencelography) and a technique to gauge muscular toning (electromyography). Dreaming is also referred to as the Rapid Eye Movement (REM) stage of sleep. In this stage the eyes of someone asleep, start moving round at great speed. The interesting thing is that this phenomenon has been observed not just in humans but also in all other mammals (apart from echidna, that is the spiny anteater) and even birds. Reptiles sleep but we do not know whether they dream. We know even less about fish and amphibians. It may be that some future scholar will be able to find the answers to our questions, but as yet the way in which these animals set about their task of resting is a complete mystery. However if dreaming is a sufficiently common event with mammals and birds, we may at least conjecture that this activity serves some useful function. A word of warning, though, it does not necessarily follow that everything in life must have a useful purpose. With this proviso, it is fairly reasonable to attempt a few working hypotheses. Have you noticed how newly born puppies sleep all day long? Well, according to some researchers, sleeping and especially the REM stage, are crucial in order to promote all the sensory and motor connections inside the brain. Put another way, they are fundamental in the development of the nervous system. Other scholars have shown the interconnection between dreaming and the process of storage of memories. During the REM stage of sleep, actual events that have taken place and those that we hear about, are properly catalogued and committed to memory in our brain's filing system. Others still have come up with the interesting idea, that dreaming, in general, is like a programme whose function is to organise all instinctive activity. According to these scholars, during the dreaming phase, sensory perception and movement get to synchronize with each other and in relation to all the outside environmental stimuli, which can vary from season to season. Once the connections needed for a given behaviour (e.g. lethargy, coupling, migration and so on) is established, the REM stage of sleep makes sure that the connections needed for these patterns of behaviour are kept in ship shape condition for the time when they may be called upon to actually operate.

Dreaming is like packing for a holiday. We pack all that we might possibly need. Mask, flippers, bathing suit, T-shirts, trousers, skirts, shirts; but which one shall we pack, the blue one that matches the jeans or the green one that goes with the shorts? Well, let's pack the sneakers as well as the sandals, etc etc. Very likely, by the end of the holiday we will not have worn all that we have packed, but if it had been needed we had all the necessary stuff and would not have been caught unprepared. The more complex brains require a larger dose of REM sleep, like the longer holiday requires a larger suitcase.

How long do we dream for however? An adult human dreams for about two hours a night, which amounts to about four or five dreams, interspersed with dreamless spells of sleep. Newly born babies are able to dream for as long as eight hours in each sleeping cycle. In the animal world, amongst the most tireless dreamers, we find the armadillo (6 hours), the cat (3.6 hours), the hamster (3.4) and the fox (2.4 hours).

What is a dream anyway? At the same time that the brain is busy networking and verifying its connections, in the dream we also live an imaginary story, as a form of pastime. It is like watching a film for which, unconsciously, we have written the plot. You can dream about actual known experiences, but also about completely new experiences, such as dreaming of flying. We do not always remember what we have dreamt about, especially if it is about a fanciful event as it is then more difficult to recall. We remember nightmares more vividly because they probably cause us to pay more attention when they cause us to become startled and half-awake at the time we think about them.

According to Pedro Calderon de la Barca, a seventeenth century Spanish poet, everyone dreams about his or her subconscious passions. According to a friend of mine, to have nightmares you only need to sleep with one blanket too many…

What is the rainbow and how does it happen?

Andrea Garaffi (7 years of age, Radicondoli)

Before we can answer this question we must first of all understand what light is. Light is one of the many forms of radiating energy. Radiating energy is propagated from its source (for example the sun) through waves. These can be long or short waves, they repeat themselves in rapid or slow succession (frequency). According to their characteristics we can have radio waves, x rays, and, as in our own chosen example, light. Light behaves in a kind of strange fashion, while it travels along we don't see it, but as soon as it finds an obstacle on its way then we do see it. Sun light is not in reality white; in reality it is the sum total of several kinds of light waves which manifest themselves in different colours. Many years ago, Isaac Newton made an experiment with a piece of glass that had been cut in the shape of a prism. He exposed it to a source of light and noticed that, on the opposite side of the glass prism, a bundle of seven distinct colours came out. These are the same colours that we observe when we see a rainbow, that is, red, orange, yellow, green , blue, indigo and violet. The rays associated with each of these colours have a different wavelength and when they move from one type of matter to another of different density (e.g., from air to glass, from air to water) their trajectory is deviated (refracted) at a different angle according to their wavelength. It is therefore possible to distinguish one colour from another when the bundle of light of which they are made are refracted and dispersed (decomposition of light) when they go through a glass prism, or when they are reflected and dispersed by the drops of water which find themselves suspended in the air during a rainfall. In this latter case it gives rise to the rainbow phenomenon. To be able to see the rainbow you must have the sun behind you. It consists of seven arches of different colour.
The drops break up the sun-light into its seven separate constituents. However from a given view point the observer will only be able to see one colour on a number of drops, a different dominant colour on yet another group of drops and so on. It will depend entirely on the positioning of the viewer in relation to the location where it is raining and the source of light. The reason why the rainbow takes on a rounded look is due primarily to the spherical shape of the raindrops.

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So as to test that the sum total of all the rainbow colours give a white light, try and build yourselves a wooden top. All you need is balsa wood, cut a disc shaped piece of wood of 7 cm diameter and make a hole in the centre of 0.5 cm. Then cut an 11 cm long piece off a dowel of 0.5 cm in diameter and sharpen it at one end with a pencil sharpener until it has a nice point. Introduce this piece into the centre of the disc until the point is about 4 cm from the disc. Cut a piece of paper in the same shape as the wooden disc. Divide this circular piece of paper into seven equal segments and colour each segment in the seven colours of the rainbow following the same order as the one listed above. Make a hole of 0.5 cm in the centre of the paper and insert the paper on the upper part of the top you have just made. If you spin the top fast you will be able to see for yourself that when spinning the seven colours will produce a uniform white colour (almost), and so demonstrate that all seven colours together constitute the colour of white light.

Roberto Cozzolino has answered the questions put by Livia and Andrea
Drawings are by Annette Tillmann
Photographs from the CSE archive

The woodsman

THE TREE RINGS

The characteristic feature of trees that grow in regions with temperate climate is that their trunk acquires a growth ring in each growing season. The growing season for trees corresponds to the spring and summer months, during this time a fresh growing spurt takes place, as a result of which trees increase their dimension both in height and width.
This increase in dimensions takes place as a result of new wood growth the colour of which is different according to the season when it has developed.

Wood, which is produced in spring, has a lighter colour while that produced in the summer acquires a darker colour because of the greater thickness of the walls of the woody cells. The alternation between clear and dark wood allows us to clearly distinguish the ring formation and, by counting the number of the rings, to know the age of the plant. The correct method for counting the number of rings is to start from the centre and move towards the outside. For a correct counting you must beware of the "false rings". These are formed when due to accidental causes (dry spell, insect infestation etc.) two rings develop in the same growing season. The one closest to the centre is the false one.

It is possible to count the rings before it is cut down by sticking an instrument (the Pressler core drill) into the trunk in the direction of the centre, which allows you to cut a pencil size sample (a "carrot"). You then count the number of rings in the sample.

Rings do not just reveal the age of the tree, but can also provide other information, including the environmental conditions in which the tree has grown. If you look at the stump of a tree after felling, you will see that not all rings are of the same thickness. This is because the climate is not always the same in

each growing season. Dry summers will produce narrower rings, as there will be less growth by comparison to a wet summer when the growth will be greater and the rings thicker. It has also been noticed that the density of the summer wood growth is correlated to the average daily temperatures between the months of July and September. By studying these features in centuries old trees it is possible to reconstruct the history of the climatic pattern in a given region.

By analysing tree rings it is also possible to learn a lot more information about events that took place in the area where the trees grew to the extent that they had an impact on their growth.

One can discover when the tree was damaged, when a fire might have taken place, when it was pruned, when the tree was damaged by frost or might have been the victim of a parasites infestation.

It is also possible to work out whether a tree gas grown in isolation or within a wood, whether and when there has been a thinning of the wood and how thinly the selection has been. It is even possible to work out if the wood may have suffered thinning as result of felling of trees due to wind or snow.

Alessandro Ceppatelli is the woodsman; photographs are taken from the CSE archive

Know-all corner

WHAT DO WE MEAN WHEN WE TALK ABOUT PROBABILITY?

In your opinion who is going to win the football match, Roma or Lazio? (these are the two contending football teams both based in Rome) Do you want to bet that it will rain tomorrow and we won't be able to go to the seaside? Do you think you are going to get a good school report? How much is two plus two? Have you eaten already? Is Gabriella taller or shorter than Lucia?

These six different questions can be divided into two groups: the first three belong to one group, the second three to another. The difference is that while no one can be sure of the answer to the first three questions, we can be certain of the answers to the other three.

Come to think of it, the first three could also have a sure answer, the snag is you must wait a little: the end of the match to answer the first question, the day after for the second and the handing out of the school report for the third. We can however answer the other three questions immediately.

The first three questions have something to do with the future, and no one knows precisely what the future holds. But even if we do not know it exactly, we are still very interested in the future. Precisely because we do not know what will happen, we do think about what might happen tomorrow, in an hour, or in ten years time. Come to think of it, even though we don't EXACTLY, EXACTLY, EXACTLY know how to talk about the future; it isn't the case that we are equally unsure about everything. On the contrary, there are certain things that we feel pretty sure will happen; indeed we would be prepared to bet money on it and feel confident we will win. There are other things, about which we would be much more cautious.

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Know-all corner (continued)

Let's look at some examples:

Tonight at 2.00 am I shall Be sleeping in my bed	ALMOST CERTAIN
When I grow up I shall live In a house with a sea view	POSSIBLE
I shall get married in twenty Years and one day exactly	VERY UNSURE
In ten minutes a frog will Jump in through the window	ALMOST IMPOSSIBLE

All four statements just set out above are about future events; all four statements are about **probability.**

To be more precise, the probability of each event is what we have set out in capital letters. So it is more "probable" that the first statement will come true, than the second. In the same way is more "probable" that the second statement will come true, than the third. And so on…

Who measured probabilities? Who decided that having a window with a sea view is more probable than the sudden arrival of a frog? We have made the decision. We have thought about it (even though not very long, to tell you the truth) and we have made a hierarchical list of "just-how-likely-it-is that-this-and-that-will-actually-happen". But as not everyone shares the same beliefs, will then the probability of a future event be rated differently according to the person that does the rating? Precisely! It is also easy to see why this should be so. Let's look more closely at the most outlandish statement we made, and which we rated with the lowest probability that it would actually happen, namely that a frog would jump in though the window in ten minutes time.

Let us imagine that Marta will bet Flavia that:"If within ten minutes a frog will jump through the window you will owe me an euro, if it doesn't I will owe you, do you want to bet?" Flavia thinks about it for a moment, than it dawns on her that she has never seen frogs jump through the window, nor has she ever heard anyone tell of such thing happening, so she calmly accepts the bet. As far as Flavia is concerned, the "probability" that the frog will jump through the window (the "event probability", technically speaking) is so low that it is practically inexistent, therefore she is sure she will win the wager. Flavia is not however aware that Marta has asked her accomplice Marina to fetch a frog from the pond, to hide herself on the balcony and, at a given sign, to throw the frog into the room through the window. From Marta's point of view the event is not practically impossible, as Flavia thinks, on the contrary as far as she is concerned, the event is almost certain (bar Marina being such a bad shot!). Marta knows things that Flavia doesn't and this allows her to have a different evaluation of the probability of this event. If this is so, then Marta's belief matches the "correct" probability and Flavia is wrong in her belief! Well, in this particular set of circumstances that is so, but only in these circumstances, more generally Flavia is right in thinking that it is almost impossible that a frog will jump through the window within ten minutes. There is therefore no ONCE-AND-FOR-ALL correct or mistaken probability, based upon her knowledge, Flavia's evaluation of the event probability is correct, and so is Marta's. That is to say the event probability does not have a life of its own in the outside world (like trees, cows or stones have) rather it is something lodging in our head and it changes according to our knowledge of things.

Scientists have concerned themselves with probability because card players were asking them about it. Almost four hundred years ago Chevaliere de la Mere, a famous gambler, paid a visit to a great philosopher and scientist who like him lived in Paris. The name of the scientist was Blaise Pascal. The gambler addressed the scientist along the following lines :*"My dear Mr Pascal, I was wondering whether you might be able to tell me, in exchange for fair compensation of course, what is the probability of each dice throw combination, so I would be better able to adjust my betting. Ideally, I would ask you to set out the probability of each and every dice throw in booklet form,...I would reward you well, mind."* Having thought about it, Pascal accepted the proposal. But the gambler required precise measuring of the probability, he would not be content with a list such as “possibly, almost possibly, a tiny bit more likely, almost certain and so on”. Put it another way he required probability to be quantified in numbers. So Pascal reasoned as follows: if the dice is well balanced, all sides should have the same chance of being “thrown”. So each and every possible two dice throw combination (let’s say, the first dice throws a 5, the second a 3. Or else the first throws a 1 and the second throws a 4 and so on) is as likely and as probable as any other combination. Then if a number representing the sum of the two dice thrown can be achieved with more throws combinations than other numbers, that number (i.e. the one representing the sum of the numbers shown on each face of the two dice thrown) will be more probable than the others. It is best to explain this point by drawing up a table showing the numbers that are thrown by dice A and those thrown by dice B and next to it the sum total achieved with each individual throw. This is exactly what Mr Pascal did, we will simply follow on his footsteps:

Dice A	Dice B	Sum
1	1	2
1	2	3
1	3	4
1	4	5
1	5	**6**
1	6	7
2	1	3
2	2	4
2	3	5
2	4	**6**
2	5	7
2	6	8
3	1	4
3	2	5
3	3	**6**
3	4	7
3	5	8
3	6	9
4	1	5
4	2	**6**

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4	3	7
4	4	8
4	5	9
4	6	10
5	1	**6**
5	2	7
5	3	8
5	4	9
5	5	10
5	6	11
6	1	7
6	2	8
6	3	9
6	4	10
6	5	11
6	6	12

If you look carefully, you will see that the table is made up of 36 lines (alright, for the know all amongst you, there are actually 37 lines but I am not counting the first line, as it is simply for the description of the contents of each column!). 36 corresponds to the product of each of the 6 possible numbers thrown by dice A times each of the 6 possible numbers that can be thrown by dice B. 6X6=36. Of all these possible 36 two dice throw combinations, several add up to 6 or 7, but only one adds up to 2 and only one adds up to 12. So Pascal thought that the best answer to give the Gentleman in question was as follows: *look carefully at the table above, count up how many times the two dice combinations that add up to the numbers you are interested in (let's say, 11,7,9 or other) comes up, now divide the number representing the frequency with which your combination is thrown by 36, that will give you exactly the probability of that chosen thrown coming up. I will show you one example, you can then do the rest by yourself. Do you want to know the probability that 6 is thrown? Now by looking at the table you will see that there are 5 times when the 6 combination is thrown (they are emphasised in bold so it is easier for all to see).Then the probability that the 6 combination is thrown is 5 divided by 36 (5/36), that is more or less once every seven throws. Do you get it? So you can now decide how to bet…*

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Know-all corner *(continued)*

We could also enjoy ourselves by following this advice every time that the situation arises…it may be a little boring, but it is efficient.

What about the case involving Flavia, Marta, Marina and the frog?
Unfortunately we have no dice or cards to study here, we must trust our commonsense. Luckily for us our brain is quite good at this, just think that Bruno De Finetti, one of the greatest mathematicians of the XX century, after a long period of study, came up with the conclusion, that the probability of an event corresponds to the amount we are prepared to bet upon that event happening…

Alessandro Giuliani is our know-all, he is also a Researcher at Istituto Superiore di Sanità (Italian National Institute of Health), Rome;
photographs are taken from the CSE archive; Roberto Cozzolino drew the frog;
the other drawings are by Annette Tillmann

Incredible! But could it be true?

Fleas wars - cannon shot struck by a flea

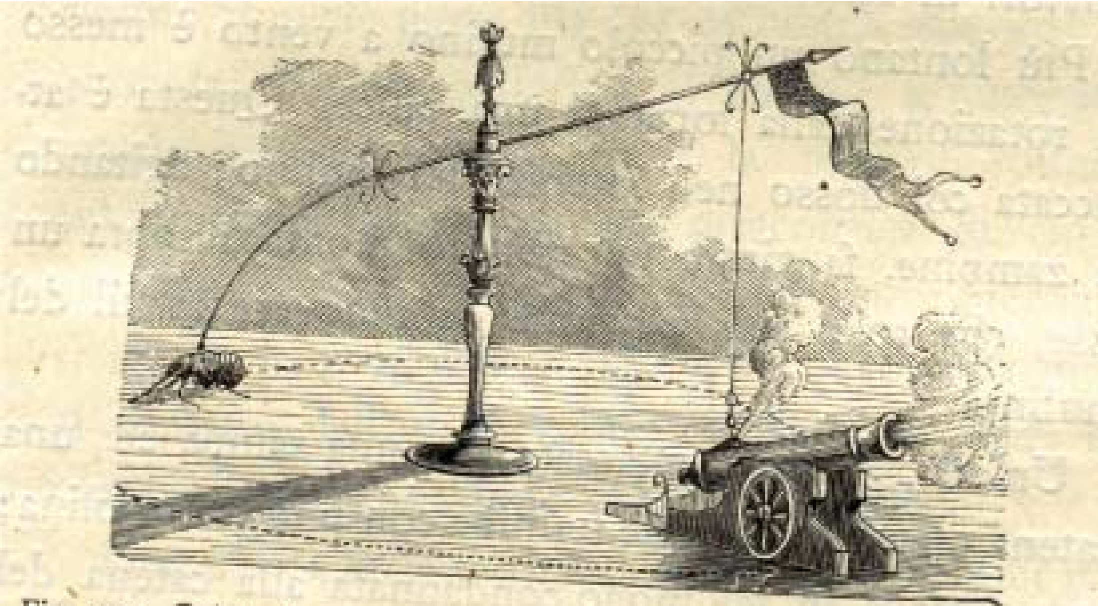

Fig. 203. Colpo di cannone tirato da una pulce (dal vero, ingrandito).

HIGH TECH - the latest American swimming aid

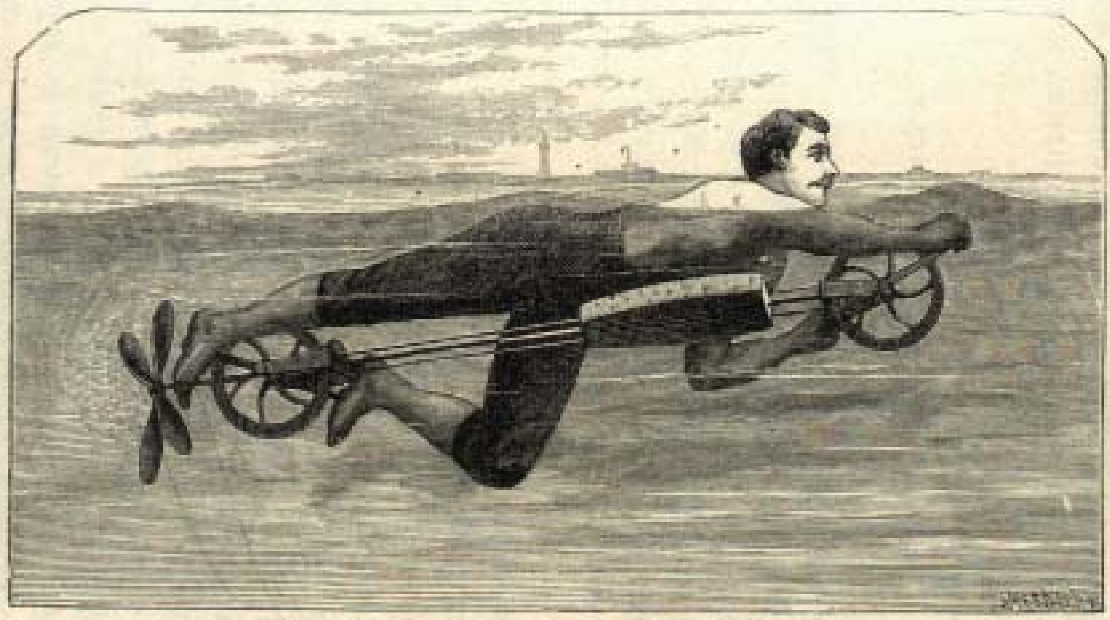

Fig. 196. Nuovo apparecchio americano per nuotare.

Drawings taken from le Ricreazioni scientifiche
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(footprints)

free electronic newsletter for children

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