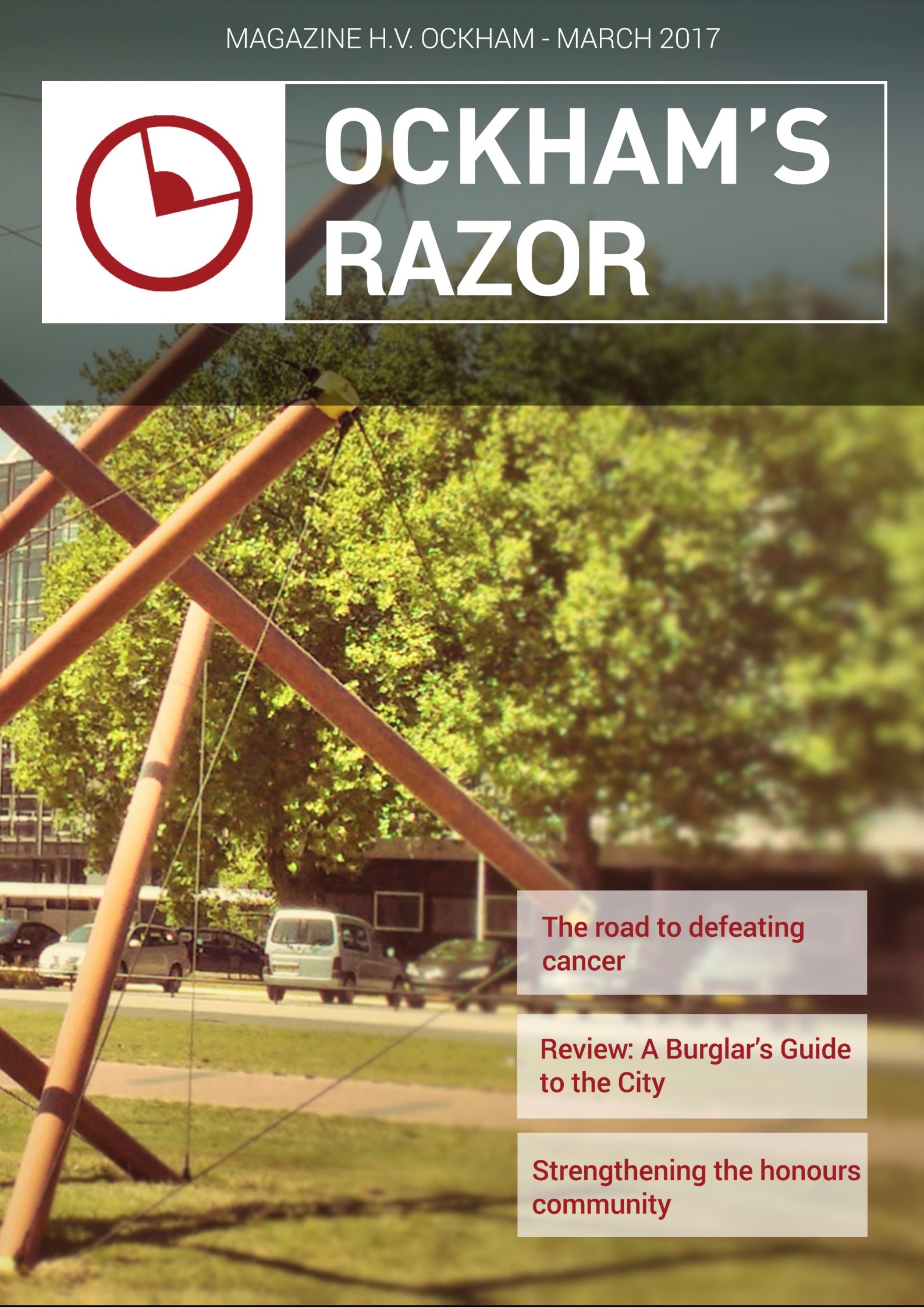
MAGAZINE H.V. OCKHAM - MARCH 2017

OCKHAM'S RAZOR



The road to defeating cancer

Review: A Burglar's Guide to the City

Strengthening the honours community

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Special thanks to:
Thijs Lieverse, Maura Dantuma, André ten Elshof, Jennifer Herek

Volume 2 Issue 1

FROM THE BOARD

Dear Reader,

We started off 2017 like most, looking forward to a year full of opportunities, challenges and the chance to experience that with our members. We hope you enjoyed your holidays and have been able to get back in the rhythm of work and study. For us, the board, it is an interesting time, with the new generation of honours students beginning their programme.

Our year started off immediately with a challenge, filling the committees. While we may have had a slow start, we have been seeing many exciting activities, ranging from an inspiring Roboteam lecture organized by the SympCie to the struggles some of us experienced on ice with ACCIE's ice-skating activity. One of the most important things H.V. Ockham has to offer to its members is the community, which we as a board have been trying to reinforce over the past few months. We also invite you, the members of our wonderful association, to participate in our activities, be part of this community and bringing along your friends from the honours programme!

While looking back at all the cool stuff we have done is quite fun, we prefer to look forward. We have many months ahead of us, and with it, many opportunities to make H.V. Ockham shine. We thank all of you for the opportunity given to us to be the board of this wonderful association. We wish you an amazing and enjoyable 2017, and we hope to see you at our activities and drinks!

Best regards from the board,

Thijs Lieverse
Chairman of H.V. Ockham

EDITOR'S LETTER

Dear Reader,

Proudly we present to you this new edition of Ockham's Razor. After reading this magazine you will be up to date with the latest activities of our association. You can read about the celebration of Ockham's Dies, the Master introduction activity, and the first lunch lecture of this academic year by the RoboTeam Twente. Besides these activities, you can find out all about wrapping presents, scoring the perfect leg in darts and tackling educational segregation.

For our entrepreneurial readers we have two interesting articles as well. You only need to determine how ethically you want to obtain your wealth. For those who do not care about the origin of their wealth, you can find out if the Burglar's Guide to the City can help you out. For those more compliant with the law, read all about spin-offs in an interview with one of the university's professors: André ten Elshof.

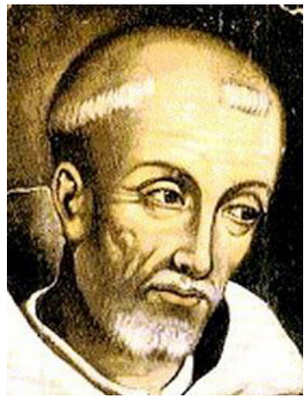
Of course our science oriented readers have not been forgotten. Read all about radio waves in "The sky is not the limit" and find out how you can listen to the ether just like the world's largest intelligence agencies. Also, you can find out about the experience of former Honours student, Maura Dantuma, with her work on a promising technique on the road to defeating cancer.

Finally, as Editor in Chief, I would like to thank the rest of the Editorial Board for the enormous amount of work that has gone into the making of this magazine. Unfortunately, at the moment, the editorial board only consist of four people. If you, the reader, feel like you can and want to contribute to the next edition of this magazine in any form, please contact one of the members of the Editorial board or the Board of Ockham. Any input in the form of advice, ideas, articles, columns, art, time or anything else you feel is relevant to the Honours community, is highly appreciated.

We hope that you enjoy the first edition of Ockham's Razor of this academic year.

Leon Smook
Editor in Chief

COLUMN



Strato - Crazy

By Martin Essink

We have the privilege to live in a democracy, or do we? Elections in the United States are over, now it is our turn to choose the people that will speak for our minds. This year we have more choice than ever before. We might even have a hundred parties to choose from, all with their own opinion on the certain topics, and all have their own followers. The result is that after every election it is becoming more and more difficult to find a majority that is willing to work together. Should we change the system? Maybe. If we change to the British or American non-proportional system we are saved, saved from the 17 million different political parties! Oh wait… maybe not. Remember those controversial outcomes of the elections in the UK and… the US? Countries that are represented by a minority now, of course we want that. What if we just organize a soccer match between all political parties. The outcome might even be more logical and predictable than the outcome of ordinary elections. We would have a clear winner, and we would be relieved from all those political advertisements. Though there is just one solution that beats them all. No elections, hail the dictatorship!

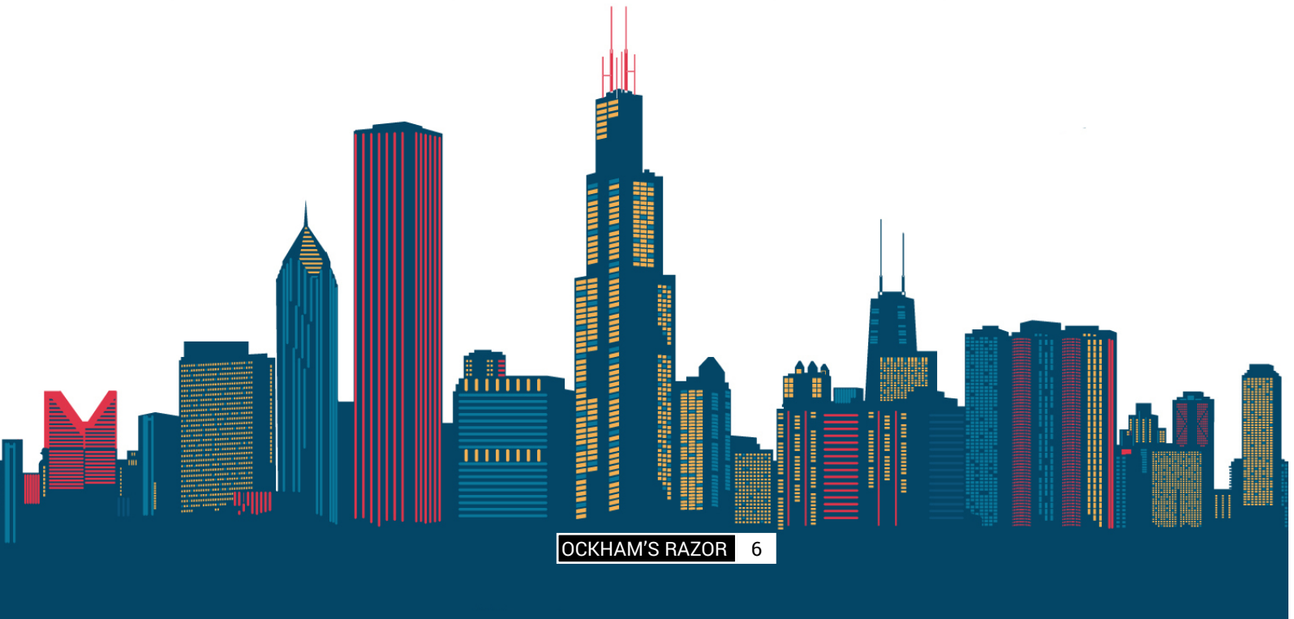
A Burglar's Guide to the City

What do architecture, soil types, and working schedules have in common? They all determine how likely your house or workplace is to be burgled. At least, that is the central argument of Geoff Manaugh's A Burglar's Guide to the City. Assisted by security consultants and FBI agents, hobbyist lock-pickers and reformed burglars, Manaugh extensively explores the nature and history of burglary.

A Burglar's Guide to the City covers a sprawling variety of subjects. In a section on burglary law, for example, we learn how a structure is legally defined, and that it is possible to 'break into' an area even if it has no walls or other visible boundaries. Another chapter, early in the book, describes the author's experiences with the aerial surveillance teams that watch Los Angeles from helicopters. This leads into a discussion on city planning, and an interesting aside on bank robberies in Los Angeles.

These reporting, informative chapters are also interspersed with the stories of bizarre or noteworthy heists of the past century and a half. For example, George Leonidas Leslie, on whom most Hollywood representations of bank heists are based, is covered. Leslie, a former architect who was estimated to be responsible for 80 percent of American bank robberies in the 1870's, made use of his architectural knowledge and contacts to access the building plans of banks. A slightly more surprising example is the story of a criminal nicknamed Roofman. Having learned the fastfood chain's standardised floor plans and worker routines by heart, Roofman knew exactly when and where to strike to rob no less than 40 McDonalds restaurants across the United States. When the cash registers were emptied, and only a few employees were present, Roofman would drop down from his hiding place between the ceiling tiles, take the money, and disappear the same way he came in.

This diversity makes *A Burglar's Guide to the City* an enjoyable series of vignettes on crime and architecture. All of these stories and tangents work towards a single thesis, however; The way we build and use our urban environment determines how burglaries take place. In fact, Manaugh argues that "burglary is designed into the city as surely as your morning commute", and he has the arguments to back this up. Despite the way this idea is echoed over and over again, *A Burglar's Guide to the City* is an entertaining, interesting, and occasionally surprising read. But perhaps the strongest argument for reading the book is that after finishing it, you will never look at a building in the same way again.



180 and the Perfect Leg

Over the change of the year we have all been able to enjoy some outstanding darts of the PDC world championship. Several well-fed men took turns throwing arrows at a board with semi-random numbering. Each leg they tried to get a perfect score, finishing a 501 leg using only 9 darts.

To examine the options of finishing the perfect leg, we need to take into account the rules of play. For the perfect leg, the most important rule is the obligation to finish a leg with a double or a bullseye. Using some basic arithmetic, we will find that the average dart will need to achieve a score of around 57 if the player were to finish with a double 20 or bullseye. This means that all darts before the finishing dart need to be high valued trebles. Taking into account all these factors the number of possible 9-darters is 3.

On televised contest players will mostly aim for the treble 20 to achieve a three-darts maximum of 180 and they will only switch to the treble 19 in case the treble 20 is blocked by a previous dart. This practise highly reduces the number of possibilities in which a perfect leg may be finished. From now on, it is assumed that the first 6 darts have scored either treble 19 or treble 20. This means that there are only limited remainder scores ranging from 141 to 159.

If we delve deeper into the 9-dart finishes that have been broadcast on live television, we will see that there are only few sequences of treble 19's and treble 20's have led to a perfect leg. From 1984 until 2016 only 5 different configurations of the first 6 darts of a nine darter have been recorded. These configurations are listed in the table below. These five configurations have been finished with three darts or less. The most common finish is T20, T19 and D12 after having thrown two 180s.

Configuration	Number of times thrown
6x T20;	36
5x T20; 1x T19	7
4x T20; 2x T19	1
3x T20; 3x T19	2
D20; 5x T20 (obligatory double start)	3
	49

Most televised perfect legs have been thrown by Englishmen, with Phil Taylor accounting for over 20% of the televised 9-darters. Together, Michael van Gerwen and Raymond van Barneveld scored 10 perfect legs, also accounting for over a fifth of the televised 9-darters.

Knowing that it is hard to finish a perfect leg, tournament organisers generally give a prize to players that throw a 9-darter during their tournament. Prizes for these 9-darters have been variable and range from several thousand pounds to even 102 thousand pounds in 1984. Sometimes, just as in golf for a hole in one, the award for the perfect leg is a car. During the UK Open in 2004 and 2005, It has even been 501 bottles of Budweiser.

Scotch tape: Why perseverance pays

Sometimes a roll of Duct tape can save lives. Fox news reported on a man and his dog having been saved from starvation in 2016. The pair got lost in the mountains of California in the United States. After several days the man got the idea to use the Duct tape to call for help. He wrote the word "help" on a rock near his camp site. Several days later rescue crew saw the call for help and the man was saved [1].

It can be seen that a simple roll of tape really can be a life saver and we should be glad to have it. Also Duct tape's smaller brother, Scotch tape, can come in handy in life threatening situations. What else would you use if you have to add a graph in your lab report? Or if you have to reseal a packet of pasta? Or if you just want to hang something on the wall? That is right; you use Scotch tape.

You might not really have thought about it much, but Scotch tape is a rather interesting name. Why exactly is the tape called Scotch? And what does it really consist of?

When I first started with the research for this article, I thought probably some Scottish inventor made up the versatile tape. However, that turns out not to be the case. The real story behind the name is even more interesting and turns out to be a perfect example of the American dream.

[2] Richard Drew tried to set up a career as a banjo player, but scraping enough money together with his gigs, he started a mechanical engineering degree at the University of Minnesota. However, after 18 months he felt he made the wrong choice and quit his studies. He turned to the newspapers and responded to a job add of 3M. He application letter contained the following text:

"I have not as yet been employed in commercial work and am eager to get started. I realize that my services would not be worth much until a certain amount of practical experience is gained, and I would be glad to start with any salary you see fit to give...I am accustomed to physical labor, if this be required, as I drove a tractor and did general farm work." [2]

[2] He got the job. The first years he was put to test various grains of sandpaper, but as time went by he was allowed to test 3M's products at local auto shops. In that time two colour paint jobs on cars were very popular. However, the painters needed to cover the already painted part of the car before they could paint the rest with the other colour. Several improvised methods were applied, mostly involving newspapers being stuck to the part that needed to be protected with adhesive. The downside to that was that often when removing the protection, parts of the paint would come loose. Drew observed this problem and thought to himself: I will find a solution to this.

[2] As Drew worked at a sandpaper producer's he figured his company had access to many of the knowledge he needed. He set out testing for various sticky substances that could work as a non-damaging adhesive for the tape. After several trials and errors he found a working formula with a mix of cabinet maker's glue and glycerine. He applied this to a crepe like paper that could peel off easily fromm the paint, but still be protective enough.

[5]

[2] Drew kept working on improving his design. However, progress did not come easily and the development of the product began to take a disproportionate amount of time according to Drew's boss, William McKnight. He ordered Drew to stop with the project and focus on the sandpaper instead. Drew, however, was determined to solve the paint problem and kept working on the project in his spare time.

[3] During one of the first test runs, he only put the adhesive on the side of the tape and not in the middle. He went out to test his tape at a local body shop painter. One should know that the frustrations of the constant failing paint jobs sometimes could enrage the painter. This trial the protective tape did not stick to the car properly because it had too little adhesive on it. Frustrated the painter exclaimed: "Take this tape back to those Scotch bosses of yours and tell them to put more adhesive on it!" As you might guess, the Scotch kind of stuck and so the product got by its name.

[2] Slowly but surely Drew developed a working tape and thought it time to start production on a larger scale. His boss, William McKnight, did not see the potential of the tape and refused to purchase the machine that could mass produces the tape. Drew, still determined, found a loop hole around the problem. As an employee he was allowed to place orders of under $100 dollars. So he bought the machine in parts and assembled it himself.

[2] Drew constantly wanted to improve his product and an upcoming new material, cellophane, sparkled a new idea. He could redesign his tape using this cellophane so it would be completely transparent. Now his boss, who completely changed his attitude towards Drew, did support him. Cellophane had one problem though. It was very fragile and tore easily. But that did not set Drew back and he designed the machinery to produce the new transparent adhesive tape himself. And so Scotch tape as we know it was born.

[2] Scotch tape found its way into everyday life. It even made 3M one of the only companies that thrived during the great depression. People got creative using this sticky tape. Bankers fixed their currency. Ladies fixed their broken nails. Housewives fixed small holes in clothing. Farmers fixed cracks in eggs. NASA used it during the moon landings. Researchers even used it to make graphene!

As you can see, something as simple as tape can have a great story behind it. Scotch was the story of an engineer that spotted a problem and set himself to solve it. Now 3M, a company that started with just sandpaper production grew to be a multibillion multinational conglomerate. How the perseverance of one man really can change the world!

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[2] Zachary Crockett, The Man Who Invented Scotch Tape, 30 December 2014, https://priceonomics.com/the-man-who-invented-scotch-tape/ (retrieved 27 January 2017)
[3] Mary Bellis, The history of Scotch Tape, 5 September 2016, http://inventors.about.com/od/sstartinventions/a/Scotch_Tape.htm (retrieved 27 January 2017)
[4] Wikipedia, 3M, 27 January 2017, https://en.wikipedia.org/wiki/3M (retrieved 27 January 2017)
[5] American Chemical Society National Historic Chemical Landmarks. Scotch® Transparent Tape,19 September 2007 ,http://www.acs.org/content/acs/en/education/whatischemistry/landmarks/scotchtape.html (retrieved 30 January 2017)

AN INTERVIEW WITH ANDRÉ TEN ELSHOF

A lot of research is going on at the University of Twente, with 1500 researchers, around one hundred disciplines and departments, and a similar number of professors. For this edition of Ockham's Razor, I talked to prof. André ten Elshof about his work, spin-off companies, the role of universities in society, and his experiences with honours students.

Can you tell us a little about your background and how you ended up at the University of Twente?

"I studied Chemical Engineering at the University of Twente, and then did my PhD in materials science. Afterwards, I left for a few years to work at AkzoNobel's coatings department, in Sassenheim. When I was asked to become a lecturer, I returned. Anyway, I have been around since 1987, with some interruptions. A university and its roles always keep changing, so it never gets boring."

What research group are you connected to and what are you currently working on?

"I work in the Inorganic Materials group, specialising in inorganic and hybrid nanomaterials. Inorganic materials are mostly stone-like, they are hard and brittle. This makes them difficult to shape. I try to find simple methods to create structures on a micrometer or nanometer scale from these materials. For example, I explore new ceramic nanofibers, but also two-dimensional oxides. These are layers of oxide materials that are only one unit cell thick. They are very similar to graphene, which is a rather famous material, and have all kinds of interesting properties while being as flexible as a sheet of paper."

Continuing from the ceramics: the spin-off company Eurekite originates from your research group. Can you tell us a little about that?

"That started off with a PhD candidate who worked on spinning nanometer-scale fibers out of ceramic materials. Because these fibers are so small, materials made of them would have a very large surface area relative to their size, which is interesting for many different kind of applications. Students on graduation assignments got involved with that, and one of them had the ambition to start a company for the production of functional nanoparticles. A lot of companies already do this, so nanoparticles are a difficult market to get into. You really need a niche, something nobody else can do. The nanofibers turned out to be that niche, and so Eurekite was founded. There are fantastic possibilities; miniscule, highly sensitive sensors, insulators, and many other potential applications."

How are your own experiences with the spin-off and in what ways are you still involved?

"I co-founded the company, actually. In the early stages of a knowledge-intensive company like this, intellectual property is very important. If the knowledge and techniques are not protected, established companies will simply outcompete you. I have been involved with a lot of the patents the company is based on, but on a day-to-day basis, Gerard and his team determine the course of the company. As the Chief Scientific Officer, my role is to provide advice on a strategic level; I identify potentially interesting directions for their research and possible hurdles on the way. People from Eurekite also occasionally use university equipment the company wouldn't have access to otherwise."

And how do you view the relation between science and business in general? Is it logical that a scientific development immediately leads to a company being built around it?

"Forty years ago, science was supposed to be a non-commercial, objective search for the truth. Nowadays, society asks something different from researchers. Knowledge has to be applicable, not just written down in a book in a library somewhere.
On the other hand, the real quantum leaps in knowledge cannot be made in a commercial setting. There used to be large research labs run by, say, Shell or Philips, where groundbreaking research was actually possible. Those things aren't possible anymore, as companies want to see payoff from their R&D in five to eight years at most. At a university, it is possible to delve into concepts that may not lead to any practical applications in the next twenty years, and I think it is important that there is room for that kind of research.

Science should also stay trustworthy, in a sense; not too dependent on commercial considerations. An example of the dilemmas you can get into happened a few years ago, during the flu pandemic. A prominent Dutch virologist working at a university advocated as a scientist for large-scale vaccination campaigns in television programmes. A few days later, it became public that he was a shareholder in a company that produces vaccinations. Some spin-off from his own research. I have no reason to believe that he was not speaking as a scientist by that time, but obviously for the general public it can give off the wrong message."

For something completely different: how much do you see of the honours programme and how do you feel about it?

"There are some former honours students around, but generally speaking, I am not really involved with honours. Last year, I did supervise an individual honours project, by Andrea, who wrote a research proposal on a hybrid energy harvester. She did very well and it was an enjoyable experience overall. I think it is good that the university offers such opportunities to broaden your horizons."

Thank you for your time. Is there any takeaway message you would like to share with the readers?

The global society faces a lot of challenges in the coming century, and I see the current generation of students playing an essential role in helping to solve or alleviate these. I hope people will make the effort.

Name: Prof. dr. ir. J.E. Ten Elshof
Education: Chemical Engineering at the University of Twente

2011 - current: Professor at the University of Twente in the Faculty of Sciene & Technology

SCIENCE NEWS

Verlinde vs. Einstein

The work of Dutch string theorist Erik Verlinde has recently drawn a great amount of attention. One of the most notable problems in current theoretical physics is finding an explanation for gravity. Einstein's theory of relativity did this by assuming that space-time curves around heavy masses. In this model, gravitational attraction would entail one mass 'falling into' the depression in space-time produced by the other mass. Verlinde's ideas, on the other hand, attempt to describe the cosmos on the small scale in terms of quantum information. More specifically, Verlinde states that large-scale phenomena, including gravity, are the result of large amounts of such information interacting.
These ideas are not uncontroversial, however. Despite already being hailed as 'the next Einstein' by Dutch talk show De Wereld Draait Door, Verlinde faces strong criticism from other theoretical and experimental physicists. Regardless, the idea that one of the most notable scientific theories of the past century is still being challenged and refined seems remarkable.

Tackling educational segregation

The National Think Tank (Nationale DenkTank) has recently published its final report for 2016. The National Think Tank is an organisation that gathers a group of Dutch graduates and young professionals every year to discuss current problems in society. This year's theme was education, and specifically the separation between practical and academic education.
The National Think Tank proposes several solutions to improve the position of practically schooled starters and increase the integration with the academically educated. These ideas include initiatives to improve the financial planning and behaviour of MBO students, talent programmes for teachers, and an exchange programme between MBO and HBO. Proposals by the National Think Tank are generally taken up at a high level, up to and including government policy.

How to wrap holiday presents

The holiday season will be past by the time this edition of Ockham's Razor is published, taking with it a challenge we all know: how to neatly wrap a present. As it turns out, a lot of mathematical work has gone into finding ways to do this with a minimum of paper wastage. Assuming a cuboid present of length l, width w and height h, the minimal amount of paper to be used would be just enough to cover all faces of the box: 2(lw+lh+wh). This would produce a large amount of edges that need to be taped over, however. The classical way of wrapping, with a seam along the longest side of the present and two flaps taped over the smallest faces, turns out to be remarkably efficient. To wrap around the larger faces of the box, the paper needs to have a length of 2(l+h), and to allow the flaps to cover the small faces, it has to be (w+h) wide. This yields a total surface area of 2(lw+lh+wh+h2); only 2h2 more than the most efficient wrapping method. Another strategy is to take a square piece of paper with sides equal to the diagonal of the present. For square presents, this is just as effective as the classical method. However, it fits the patterns on the wrapping paper together better!

ACTIVITIES

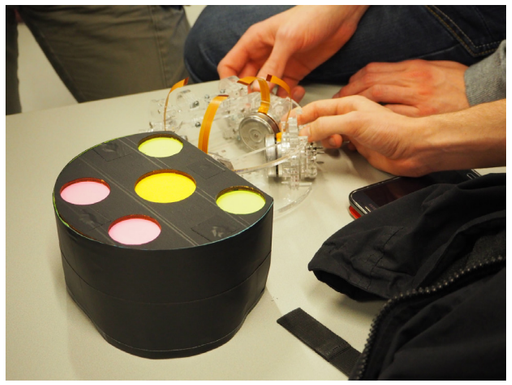
On Thursday the 8th of December the master introduction took place, which goal was to integrate the new honours students into Ockham and to make them know each other better. The evening started with a dinner, where only the master students were invited. The dinner consisted of lovely Chinese food and started a little later than expected due to some conversational difficulties with the Chinese restaurant's staff. Nevertheless, the food was appreciated and fulfilled everyone's desire for money, power and food… well, at least the food. The pubquiz started when the other Ockham members had arrived. Although everyone was invited to participate in the pubquiz, the master students were preferably put in the same groups. Four groups with pretty weird names were formed to challenge each other in the epic battle of knowledge. The winning team (Team Cheetos) did not only receive the honour of being the best, but also got a very sexy black Pete costume that would perfectly fit an 8 years old child.

On the sixteenth of November, Ockham has celebrated its birthday. It started with a fancy dinner with the fanciest student food: pizza. Due to honours classes, the Ockhammers were unfortunately split in two dinner groups. After the honours classes, everyone came together and the Ockhammers were divided in groups. These groups fought and struggled to get the first place in the games competition that has been held.

The games were based on old-fashioned Dutch games like touwtrekken, sjoelen and zaklopen. Next to those agility-related games, the Ockhammer's intelligence was tested in Thirty Seconds, Pictionary and several puzzles they had to solve. Everyone tried his or her very best, but only one team could be the winner. The members of the winning team were Guido Ritsema van Eck, Carl Beekhuizen, Sangitha Harmsen and ….They all got awarded a tasty chocolate letter as their prizes.

After the games, the iron core of Ockham sat together in the Ockham room with crisps, heksenkaas, brie and drinks for hours.

As latest activity we invited the team of the newly started RoboTeam Twente. This team has taken the challenge (and opportunity as well!) to start a football team in the RoboCup. In this RoboCup they have to use a small pre-built robot to compose a team of footballing robots. By programming the robot can be moved in a desired direction. This seems easy, however to let a team of players be controlled correctly and synchronously as a team is very difficult. Tactics and strategy play a big role! One of the key features they want achieve this year is to programme it in a clear manner using block schemes. In this way non-informatics guys can help improving the strategy of the team as well. We wish the RoboTeam Twente the best and hope they will finish first!



“Strengthening the honours community”

An interview with Jennifer Herek

As of January 2017, I am the Honours Dean of the University of Twente. It’s an honor and a privilege—perhaps even somewhat daunting—to follow in the footsteps of Miko Elwenspoek who served as the previous Honours Dean and was the founding father of the Honours Programme here at the UT. Luckily Miko will continue on as advisor and teacher in the coming year.

I came to the UT in 2006, when I was appointed full professor and chair of the Optical Science group in the Faculty of Science and Technology (TNW). My research focuses on fundamental interactions of light and matter, using ultrafast laser pulses tailored to manipulate molecules and nanostructures. In 2011, I received an NWO Vici grant to explore “Artificial Molecules on the Nanoscale.” And around the same time, I was invited to join the programme committee for establishing a University College here in Twente.

The University College concept has a lot in common with my own Bachelors education at a liberal arts college in Wisconsin, USA, and I was thrilled to help bring this type of education to the Netherlands. A broad, diverse curriculum with focus on academic forming and personal development is the essence of liberal education, and is also characteristic of our Honours Programme. I followed my Bachelor of Arts degree with a PhD in chemical physics at California Institute of Technology and a research career that spanned Sweden, Germany and the Netherlands.

In 2012 I became the founding Dean of the University College Twente. The College provides the honours-level Bachelors programme Technology and Liberal Arts & Sciences (ATLAS). Its central location in the Citadel underscores the mission to provide and promote excellent education at the heart of the UT. It also houses the growing honours community, encompassing the College as well as Ockham and the Honours Bureau. Naturally, as Dean of both UCT and Honours (and a physicist!), I will strive to strengthen the honours community by seeking and designing opportunities for constructive interference.

I’m a strong believer in honours education. For me, it started with the GT program in fourth grade. I was 10. Pulled out of the regular classroom a few hours each week, the “gifted and talented” students received extra challenge and stimulation. We worked in small groups, with a teacher specially trained in differentiated learning, and were encouraged to aim high and reach further. How I thrived inside that educational setting! On the outside, however, I cringed at the label and couldn’t help feeling a bit ostracized. The culture of excellence, of striving for the best and being proud of your accomplishments, has become more mainstream in America but is still a stretch here in the Netherlands. Of course everyone has inherent gifts and talents. The challenge is to identify, embrace, and nurture them—the earlier the better—to develop to the fullest potential.

I’m looking forward to further developing the Honours Programme, in all its variations including new initiatives, and working together to develop a culture of excellence that resonates loudly at the UT.

Name: Jennifer Herek
2011 - current: Dean University College Twente
2006 - current: Professor of Optical Sciences
2017 - current: Dean of Honours

The road to defeating cancer

An article by Maura Dantuma

Currently, chemotherapy is often used to treat cancer and it is known to be an unpleasant medicine. Beside the quickly dividing cancer cells it also attacks healthy cells. You can imagine that severe side effects can appea. Nowadays researchers are trying to develop new techniques and medicines that exclusively attack cancer cells.

During my master thesis I worked on a promising new technique for this application in the physics of fluids group at the UT. The technique consists of a combination of drug loaded nanodroplets with ultrasound. Drug loaded droplets will be injected into the blood stream. Generally, these droplets are too large to escape from the bloodstream and will therefore just circulate through the vascular system. However, in tumorous tissue, gaps between the cells in the vessel wall are larger which makes it possible for the droplets to escape; The droplets will diffuse out of the bloodstream. When these droplets get exposed to sound waves they can undergo a phase change which converts them into bubbles, a phenomenon known as acoustic droplet vaporization. Bubbles are good ultrasound scatterers and are nowadays successfully used contrast agents in ultrasound imaging. The formed bubbles can therefore be used to check whether the loaded droplets (or bubbles) reached the right location inside the human body. When the location is correct, a second, more intense sound wave can be sent which makes the bubbles explode. Upon this explosion, the cell wall of the surrounding cells gets damaged and the medicines are able to diffuse into the tumor cells. Because the droplets are only able to leave the bloodstream in tumorous regions, no healthy tissues will get damaged.

If we want to apply this technique in clinics it has to be optimized, such that we can inject as little as possible droplets into the body and such that we do not need to use very strong sound waves which might be harmful for the body. In order to optimize, we need to understand what exactly is happening with the droplet when it is exposed to a sound wave.

I developed a model, based on the resonance theory which can predict whether a droplet will vaporize when a certain sound wave is applied. A sound wave will affect the pressure and temperature inside the droplet. When these changes are known, we also know whether the boiling point will be reached and thus if the droplet will vaporize or not. The resonance theory says that the droplet starts oscillating in response to ultrasound. In the low pressure part of the sound wave, the droplet gets decompressed and the pressure inside the droplet will decrease, where the pressure is the lowest in the centre of the droplet. The opposite will happen in the high pressure parts of the ultrasound wave. This oscillatory behaviour will be the strongest at a certain frequency (or pitch) of the sound wave, which is called the resonance frequency. The temperature inside the droplet was expected to increase due to viscous heating. This phenomenon was therefore included in the model. Experiments still have to prove whether the model is correct. If it is, we understand a bit more about the physics behind acoustic droplet vaporization and we are a step further towards the development of a new treatment for cancer.

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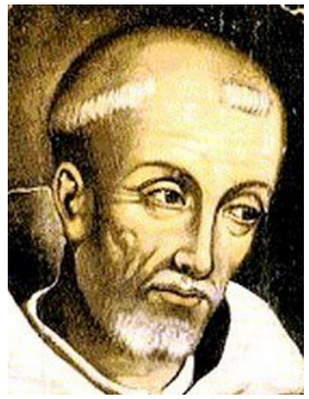


Travel for All

By Leon Smook

Traveling by train is one of the most time-consuming activities many students have. From the university to your internship location, from your parents' home to Enschede or just a citytrip for fun. All of us will at one point in time find themselves in the Dutch public transport system. And we might take it for granted that we get everywhere in the country within a manageable amount of time. Yet, I think this deserves some extra thought, consideration and appreciation.

Take the scheduling, for instance. Recently the Dutch national railways (NS) introduced a new schedule that has improvements for most travellers. A higher frequency of trains on the most used trajectories, shorter transit times and more capacity on trains. Imagine having to plan this schedule, taking into account variables like over 400 railway stations, time sharing of the infrastructure, logistics of train carriages, traveller intensities on different tracks, other transporters and personnel planning. It might not come as a surprise that the most recent changes in the schedule have taken over two and a half years to plan.

Knowing this, I think we should all appreciate the quality of this planning. Appreciate that, even though there might be delays from time to time, you can generally trust to be at your point of destination in time. Appreciate that you can sit down during the entire journey. And appreciate that there is even a public transport system.

Next time when you are experiencing a delay, just think about the amount of time it would take you extra if you had planned the schedule yourself. And realise that the extra half hour, hour or even multiple hours of delay are nothing compared to the time used planning the schedule. And in case you still cannot appreciate the public transport I have only one advice: get a drivers licence and a car and drive yourself. But remember: alcohol takes time to get out of your system.

The sky is not the limit

More than ever do we depend on wireless signals. They have become such an integral part of our technology that we could not imagine a world without anymore. We use these signals every day, and mostly without noticing it. You might know that your phone sends signals to the cell tower nearby, or that your laptop communicates using Wi-Fi. But there is a lot more in the air than you might think.

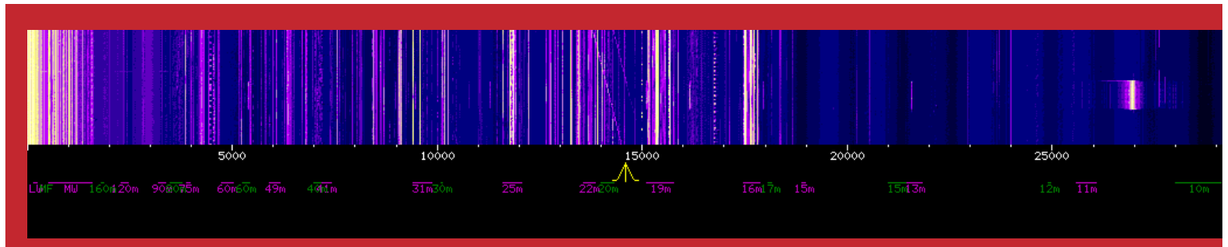
It might have happened that when you walked out of a clothing store with your newly bought clothes, the alarm went off. You probably know that this is because of one of those sticky labels in one of the items you bought. What you might not know is that this system is not that different from another system that most of us use on a regular basis: your public transport card. Both these items receive enough energy from a signal that is sent out by the receiver to be able to send a reply back containing the desired information.

Now where the signal of your public transport card only works over a short range, many other signals work over a much larger range. Take FM Radio for example. The signal that you are listening to comes from an antenna tens or maybe even hundreds of kilometers away. Now on your normal radio you can only listen to a limited range of frequencies. In this range you will only find your typical radio stations, but what would happen if you could turn that dial further, a lot further?

A device that is able to do this is called a "software defined radio", or SDR in short. These devices are able to receive signals over a broad range of frequencies and send them to a computer where they can be analyzed. Since in the last few years these devices have become very cheap, just about anyone can get one and discover everything that is in the air. If you do not have such a device, there even is a SDR that is run somewhere at the University of Twente that can be accesses online by everyone.

So let's look at all the great stuff that is floating around in the air! One of the first things you will find after the FM radio stations is the signals from certain weather satellites. If you have the prober antennas and the timing is correct it is possible to receive and decode the signals from these satellites. This means that you will be able to receive images from outer space yourself!

If you go to slightly higher frequencies, you will be able to receive the broadcasts that some radio amateurs send out. Something that is not as popular as it used to be many years back. If we keep increasing the frequency, we will come across a very strong signals around 170Mhz, which are typical for the Netherlands. On these frequencies the emergency services communicate with each other. Of these signals there is only one signal that can be decoded though. This is the P2000 system. You might have found websites where you can see the messages that are the signals that are sent to the emergency services. This is where they come from.



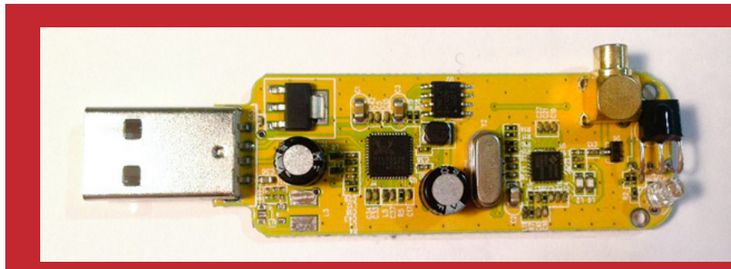
Now if we keep increasing the frequency we will keep finding all kinds of random signals that strongly depend on where you are. If we reach 433Mhz though, we find another very interesting place in the spectrum. This frequency is used by many household appliances, as it can be used freely. The most common use of this frequency is by wireless thermometers. This might be an appliance that you did not think of, but it is one that sends out very regular signals containing the current temperature. This means that with the right software we can read out the temperature from our neighbor's thermometer.

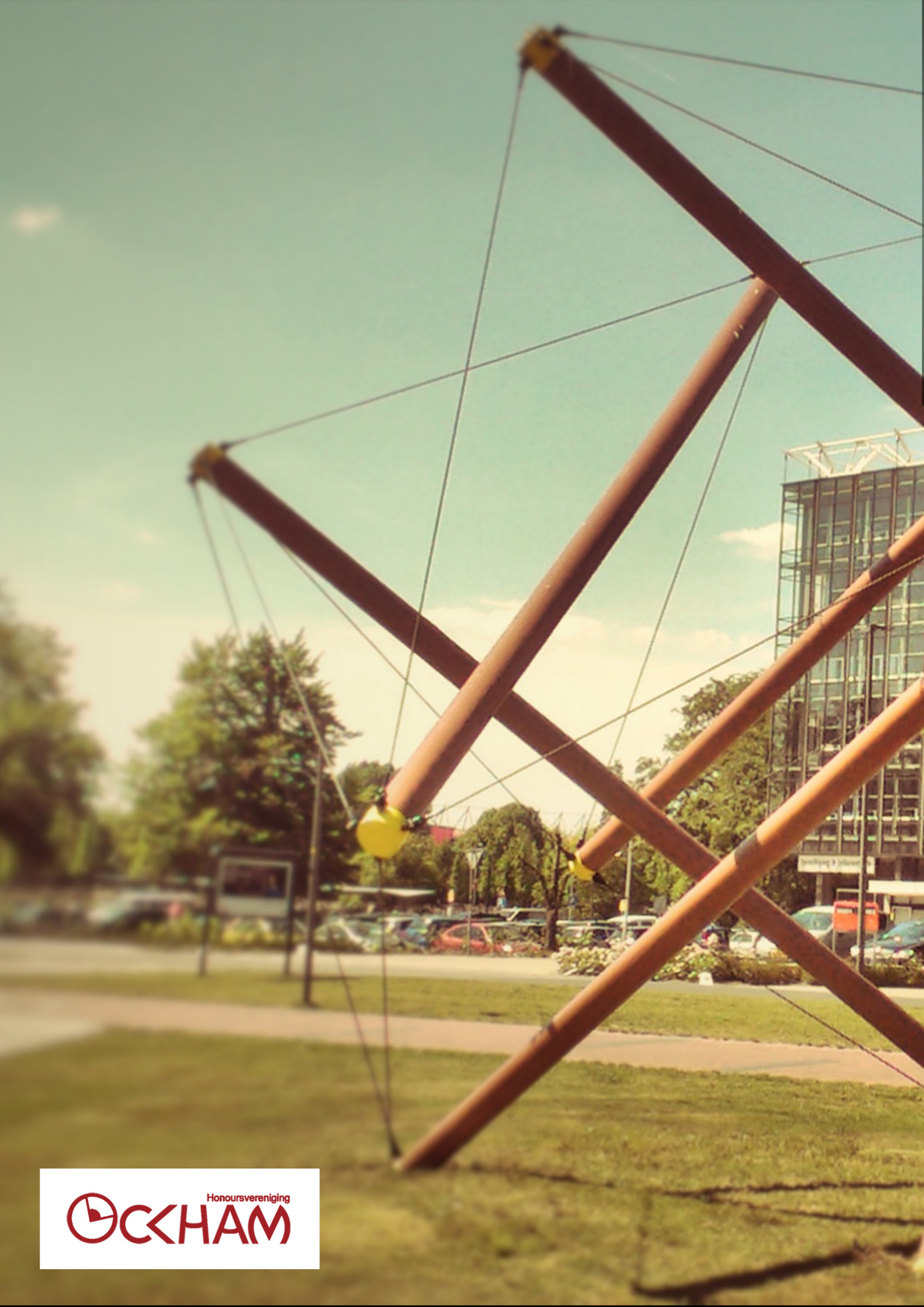
Further in the spectrum one can find the signals that are sent by wireless microphones or headphones. So are you wondering what your neighbor is listening to on his wireless headphones, this is the way to find out. You will also be able to listen to the communication from the well-known "walkie-talkies" in this range.

If we move on from here we will mostly find data communication such as GSM, Wi-Fi and television. There is one more signal that a SDR is very useful for. At the frequency of 1090Mhz one will be able to find the signals from actual aircrafts. From this data it is possible to put the different aircraft in the area on a map, thus making your own personal radar.

Of course there is a lot of fun in finding these signals and seeing what you can do with the information that you receive. There are some downsides too. The biggest downside lies in safety and security. Many of the signals that we are able to receive were designed many years ago and have not been encrypted. This means that we can sometimes receive and decode signals that were never intended for the general public. The use of encryption of such signals is increasingly popular, but not yet enough. There are still too many signals that are not secure enough, that actually should be.

If you do like to play around with software defined radio, this is possible by going to the UTwente WebSDR (http://websdr.ewi.utwente.nl:8901/), or by getting your own receiver of around $10.

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