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New insights into the vision system in flying fox: A spectacled flying fox, native to New Guinea and northern Australia, is shown hanging upside down. **Page 20**

Matthias Kleiner

Trust and Responsibility

Meeting expectations after the go-ahead for the Excellence Initiative, the Joint Initiative for Research and Innovation and the Higher Education Pact

Es ist vollbracht!" ("Mission accomplished!"). With these words, texted from the Federal Chancellery in Berlin to Bonn shortly after 4 pm on Thursday, 4 June this year, Dr. Annette Schavan, the German Federal Minister for Education and Research, delivered the most important piece of science-policy-related news of the next few years: the heads of the German federal government and states had passed the "three major initiatives". The Excellence Initiative, the Joint Initiative for Research and Innovation and the Higher Education Pact were not only continued, they were also given a considerable budgetary boost. By 2018, the federal government and the states will invest 18 billion euros in the three forward-looking initiatives, of which around five billion euros will flow via the DFG into basic research. This is the biggest joint programme for education, science and research in German history. Or, as *Nature* put it: "A historic deal for German science."

We had fervently hoped for this message from Berlin and had worked long and intensively towards it. The fact that we were receiving it now, in the Bonn Arithmeum, where the DFG and the Federal Ministry for Education and Research were, at the precise moment the political decision was made, awarding this year's Heinz Maier-Leibnitz Prizes, was somewhat surreal. From an internal standpoint, however, things couldn't have been more logical. The six new recipients of Germany's most significant prize for young scientific researchers represented, on that afternoon, the entire generation of young talent in our higher education and research institutions to whom politics and science have made such tremendous promises involving the three initiatives over the past few years – promises that they will now be able to fulfil.

Just as the prizewinning young researchers symbolise hope and the future of science and research in Germany on a small scale, the Excellence Initiative, the Joint Initiative for Research and Innovation and the Higher Education Pact represent them on a large scale. The decision to continue the initiatives was a decision in favour of this future. This is one of the reasons why, personally speaking, receiving this message from Berlin was one of the greatest moments in my career as President of the DFG to date.

Illustration: Frenz

That being said, however, it was not always easy to remain optimistic throughout the many months leading up to the decision and to hold fast to the belief that these initiatives, which were, from the very outset, both so desirable and so vital for science and the humanities, would eventually come into being. After many preparatory discussions and negotiations, the major scientific organisations presented their specific concepts to the political world last autumn. One thing was certain for us all: all three initiatives must be continued and their funding considerably increased. And we were convinced that we had the best arguments in favour of this.

The Excellence Initiative had already led to an unprecedented spirit of optimism in the German higher education and scientific landscape, with the first two rounds of the competition resulting in many impressive and internationally visible ideas, projects and facilities – not to mention several thousand highly qualified jobs for scientists and academics.

The major scientific organisations had already been able to use the Joint Initiative for Research and Innovation to expand their sponsorship programmes, thus further improving the chances for innovative scientists to receive funding, while the Higher Education Pact contributed to improving the academic education of more than two million young people in German higher education institutions – at the same time guaranteeing the DFG the additional 20 percent in overhead funding it now pays for nearly all funded projects.

While the political decision-makers recognised all these advantages and merits, it still took more than six months for the decision in favour of the initiatives to be reached – six months in which we could not always be sure of how things stood. Although there was less debate compared to the disputes that arose between the parties, the federal government and the states during the setup of the Excellence Initiative, another factor played a role: the three initiatives became caught up in the maelstrom of the global economic crisis. In light of the ever-increasing number of bad tidings from the stock markets and the headquarters of major corporations, of new declarations of bankruptcy and fresh controversies over government-issued indemnity bonds and economic stimulus packages, the three major forward-looking initiatives faced an uncertain future.

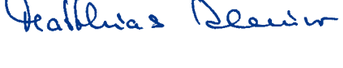
Time and again during these truly dramatic weeks we invoked an argument which springs from our deepest conviction. We firmly believe that, in times of crisis such as these, it is particularly important to invest more heavily in education, science and research. These fields, after all, are our society's essential sources of innovation – and thus of enhanced growth and prosperity.

With their decision in favour of the three initiatives, politics has recognised and confirmed this fact. In doing so, it has demonstrated courage and foresight. Credit is due first and foremost to Federal Minister Schavan and the science ministers of the federal states; they deserve our express gratitude, as do the Federal Chancellor, the minister-presidents and the finance ministers.

All these persons have demonstrated that politics trusts science, and that it takes science seriously. Science wants to – and will – prove itself worthy of the trust that has been placed in it – we owe it to ourselves. From many discussions with rectors, presidents and professors, we know that everywhere in higher education institutions and in research institutes, creative minds are ready to demonstrate their potential for generating ideas and achievements. The new round of the Excellence Initiative, with its competition between previously funded and new projects and facilities, will provide the ideal forum for this.

The major scientific organisations will use the newly gained freedoms in the Joint Initiative for Research and Innovation just as intensively. Here at the DFG, we want to promote young researchers even more effectively in the years to come. And we want to forge ahead more strongly with the transfer of knowledge from basic research to application, to follow more consistently the course which has already been set – that of "funding right through to the prototype". In this way we, too, will contribute to overcoming the crisis – and demonstrate how science carries society.

The big issue over the next few months will be implementing these concepts in our daily activities, and the efforts associated with doing so will consume everyone involved in science. This also applies to the Deutsche Forschungsgemeinschaft. During our preparations for and implementation of the new Excellence Initiative, we cannot allow our actual – and extremely important – mission of funding science and the humanities to be neglected; rather, we must continue to enhance our funding opportunities and policies. No doubt this will also involve additional resources and, therefore, a great deal of work and effort. This challenge is, however, well worth it!



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Lakes in the Sahara

Large bodies of water in the middle of the desert are not only a natural spectacle, they also contain extremely precise environmental archives. Sediments extracted from these lakes document climate evolution and provide information on dust storms, savannah fires and volcanic eruptions.
A journey to north-east Chad

By Stefan Kröpelin

Illustration: George

In a canoe on a salt lake. A drilling platform, consisting of two inflatables and some wooden planks, is anchored here. It has been transported across several thousand kilometres of Libyan and Egyptian, then Sudanese and Chadian desert to its present location.

Now, in the afternoon, the constantly blowing trade winds have settled down slightly and the sun burns a little less glaringly from the sky. To be sure of reaching land again in an oncoming storm in one of the windiest regions of the Sahara, the platform is tied to a palm tree on the shore by a 400 metre long rope.

Campsite in the Sahara: Researchers have arrived in Chad with expedition vehicles and coring equipment. Next to it: A drilling platform is anchored on the Yoa salt lake at Ounianga Kebir. The extracted cores (columns on the left and right margins) are a mirror of climatic history.

The water at the drilling point is 26 metres deep. The waves rock the boats, which are quickly covered with a white layer by the slopping salt water. A great deal of skill and manual dexterity is required to push the coring cylinder in the 35 metre long casing bit by bit deeper into the lakebed deposits and then to pull the heavy rods back up, metre for metre, ensuring that the valuable core is not lost. Sediment cores up to 9 metres long, all exhibiting fine lamination in the millimetre range, are extracted using this method.

While previous investigations of lake deposits in the Egyptian and north-Sudanese deserts allowed the climate history of the last humid period in the Sahara to be reconstructed for the time between approximately 10,000 and 1,500 BCE, practically no data existed for the following period. However, indicators of environmental and climate change in the world's largest desert during the past 3,500 years are extremely valuable for inferring recent dynamics in arid regions or for climate modelling in 'Global Change' programmes.

The remote north-eastern part of Chad remains to this day the least explored region of the Sahara, if not the whole of Africa because of its extremely harsh desert environment and notorious insecurity. The Ounianga lakes have therefore been neglected as a field for geoscientific research since their discovery by the French military geographer Jean Tilho early in the 20th century. It was not until January 1999 that a five week expedition was started in cooperation with Uwe George from GEO magazine in the hope of revealing the secret of the largest lakes in the Sahara. The aim was to investigate the palaeoclimatic potential of the Ounianga lakes and the surrounding areas.

The four square kilometre Lake Yoa at Ounianga Kebir lies in the centre of the Chadian Sahara. Rain almost never falls here, while annual evaporation reaches a world record of more than 6,000 millimetres – around 2,000 times the local precipitation. Evaporation losses, which approximate the water consumption of the city of Cologne with its population of one million, are compensated exclusively by the subsurface inflow of fossil groundwater. Soundings in the extremely saline water indicated a maximum depth of 26 metres.

To identify the properties of the sub-bottom deposits, an initial sample was taken with a gravity coring cylinder suspended on a wire line. The 50 centimetre long sediment core exhibited millimetre-thin layers with a characteristic structure, clearly indicating winter and summer phases. Exceptionally constant conditions are required for the formation of such fine lamination, especially in an oasis in the extreme desert. This observation supported the assumption that the bed of Lake Yoa conceals an environmental and climate archive, probably comprising the entire Holocene to the present day; that is, all the 12,000 years of the present post-glacial period.

The discovery of this exceptionally well preserved climate archive led to a new project in Chad within the Collaborative Research Centre 389 "Arid Climate, Adaptation and Cultural Innovation in Africa" (ACACIA). Following exhaustive preparation with the partner research authority in the Chadian capital N'Djamena and a three-month long transfer of the vehicles and drilling equipment from Germany to the east-central Sahara, the first systematic on-site studies began in December 2003. Using specially designed drilling equipment, it was possible to recover 4.5 metre long cores from the lake bed; they document the last 2600 years in detail.

The subsequent field campaign in the autumn of 2004 allowed deeper penetration into the increasingly compacted sediments by using a metal casing. Reaching the limit of the light-weight drilling method at a depth of 35 metres below lake level, cores up to 9 metres long were extracted, until a heavily compacted layer obstructed further penetration. The long sediment cores also displayed continuous fine lamination. Radiocarbon dating and counting of the single layers revealed that they record the past 6,000 years at a seasonal resolution. This new data base represents the most complete and precise Saharan climate archive available for the mid- and late Holocene.

The ongoing laboratory work, carried out in specialised, domestic and overseas laboratories, comprises sedimentological and geochemical investigations, high-resolution image analyses, dating and isotope studies, as well as detailed evaluations of the floral and faunal microfossil content. The 12,000 millimetre-thin layers allow not only uninterrupted insights into climate history and the evolution of aquatic and terrestrial ecosystems in the Sahara, they also provide information, precise to the year, on natural events such as large dust storms, savannah fires and volcanic eruptions, or on the first occurrence of certain crop plants such as the date palm. The data thus cover the mid- to late Holocene up to the time of modern nuclear tests and contemporary armed conflicts with a previously unattainable precision.

The findings also illuminate the climatic and ecological background of the prehistoric settlement history of the region. However, they primarily provide an answer to the question of whether or to which extent climate events and fluctuations derived from ocean and ice drilling cores can be applied to the continental African desert belt. In addition, they can help to evaluate computer-aided climate models and thus improve global climate forecasts.

> The research, which includes sedimentological, geochemical and other analyses, is conducted in specialised, domestic and overseas labs

The neighbouring Ounianga Serir basin (Arabic: serir = small), 40 kilometres east of Ounianga Kebir (Arabic: kebir = large), with its lakes is not only one of the most

Left: Lake Boku, fed by fossil groundwater, in the now sand-encroached basin of Ounianga Serir. The freshwater lake defies 4,000 years of extreme aridity. Next to it: Massive early Holocene lake deposits.

beautiful sceneries in the Sahara, but one of the most interesting study areas. In an almost rainless region the very existence of these lakes is remarkable. Just as in the case of Lake Yoa, they only exist due to the permanent influx of fossil groundwater, which accumulated during the last wet period. Together with Ounianga Kebir the lakes represent the relics of the early Holocene 'Mega Chad', once one of the world's largest inland lake systems. Although all of the Sahara's water bodies are doomed as a result of ongoing desiccation, dropping groundwater tables and encroaching dunes, they will subsist for at least a few centuries if groundwater inflow continues.

Over the past millennia, the constantly blowing north-east trade winds have wafted long tongues of sand into the basin. They have divided the once contiguous freshwater lake into 15 smaller lakes that cover a total area of approximately 20 square kilometres. With the exception of the central salt lake (Teli), they are more or less, and in some cases entirely, covered by floating reed mats which considerably reduce evaporation.

The open central lake, in contrast, evaporates significantly more and therefore acts as a gigantic evaporation pump, causing the lowest lake level at this point. As a consequence of the gradient, water is constantly drawn in from the higher freshwater lakes through the permeable body of the dunes before it gets salty.

This mechanism explains the existence of freshwater lakes – a paradox under the climatic conditions of the Sahara, where salinisation generally occurs very quickly due to the high rate of evaporation. This makes the Ounianga Serir ecosystem so unique. Comparable freshwater ecosystems are not known in the Sahara or any other extreme desert.

Because of the heavy erosion by wind only very few remains from older lake deposits are preserved on the surface. They are exposed

Illustrations: Kröpelin

Gentle giant: The 5.5 square kilometre, saline Lake Teli at Ounianga Serir. The islands were once at least 50 metres below the water surface. Bottom left: The author with native dignitaries. Right: An overloaded lorry reaches the researchers' quarters following an odyssey through the Sahara.

up to 80 metres above today's lakebeds. Based on radiocarbon dating, the finely laminated diatomaceous muds and mollusc-bearing chalks are early Holocene, i.e. 7,000 to 10,000 years old. The individual sediment sequences shall later be correlated with the climate archive of Lake Yoa at Ounianga Kebir.

By precision surveying of the higher lake deposits with the aid of the differential global positioning system (DGPS), it was possible to determine past lake levels. 'Virtual flooding' of digital elevation models based on these measurements allow an accurate reconstruction of the much larger extent of the Ounianga Serir lake during the last humid period. In geo-archaeological cooperation, this procedure also helps in the search for prehistoric settlements which were generally set up near shorelines and would otherwise be practically impossible to locate in the vast, largely sand-covered terrain.

The palaeoclimatic data set acquired so far shall be expanded. It is planned to continue the coring in Ounianga Kebir using heavier drilling equipment in order to record and better understand the environmental and climate development of the Sahara during the entire Holocene and possibly even the late Pleistocene, i.e. the past 130,000 years.

Dr. Stefan Kröpelin was the leader of the geo-archaeological subprojects "Sudan" and "Chad" in Collaborative Research Centre 389 "Arid Climate, Adaptation and Cultural Innovation in Africa" (ACACIA; "Kultur- und Landschaftswandel im ariden Afrika – Entwicklungsprozesse unter ökologischen Grenzbedingungen").

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▶ www.uni-koeln.de/sfb389

Illustration: Medienstelle Zürich

Left: A city council meeting in Zurich's town hall. The new apportionment procedure saw its debut in the city council elections on 12 February 2006. Below: A snapshot of events on election night.

Zurich's New Apportionment

How mathematics has played an essential role in giving an ancient democracy a new electoral system

By Friedrich Pukelsheim

On Sunday, 28 September 2008 the people of the Swiss canton of Schaffhausen were called to the ballot box to vote in the canton council elections. This was their first encounter with a new electoral system that had just recently been adopted in a popular referendum and won the confidence of the people. This system uses a new method to calculate the allocation of votes to parliamentary seats that had made its way directly from the ivory tower of science to the world of politics.

The first trial of the new electoral system took place in the canton of Zurich in 2004. Not only has it been used on numerous occasions elsewhere in Switzerland since then, but it has also found widespread acceptance. Dubbed "Zurich's new apportionment procedure" – also referred to mathematically as the "biproportional divisor method with standard rounding" – it is especially good at conforming to the Swiss tradition of popular democracy and proportional representation. This is particularly well demonstrated by the cantonal elections in the canton of Zurich on 15 April 2007, which are taken as an example here.

As is the case in all Swiss cantons, the canton of Zurich is divided into several electoral districts for the purpose of these elections, a system with a long tradition. In the middle of each legislative period the 180 seats on the cantonal council are allocated in proportion to the size of the population to each of the 18 districts. At present, the smallest district (Andelfingen) has four and the largest (Bülach) 17 seats.

In past elections, serious difficulties arose in the small districts, because if there are nine or more parties running for only four seats, for instance, then the voters for more than half of the parties are, unavoidably, left unrepresented. It is pure common sense to surmise that the objectives of proportional representation can only be achieved if – to put it bluntly – the term proportionality is taken very loosely in such cases. However, the electoral system is not governed by common sense; what matters is what the constitutional courts say.

In 2002 the Swiss Federal Court ruled that the constitutional right of all citizens to a system of proportional representation is indeed violated if the constituencies are so small that there are too few seats to allow proportionality. The reasoning behind this judgement was that it is not acceptable for the guaranteed right to equality, which the voters are entitled to under a system of proportional representation, to take 18 different forms in different districts of a common electoral region, such as a canton. No voter should be put at a disadvantage simply because they live in a small district. The right to equality applies equally to all voters, wherever they live in the region where the election is taking place, in this case the canton of Zurich. The electoral system thus needs to deliver this equality, as far as is practically possible. In the wake of this groundbreaking judgement, the parliament of the canton of Zurich felt obliged to revise its electoral system. Basically, either the small districts had to go, or another solution was called for.

This is where maths came in, as a better electoral system, capable of overcoming the weaknesses that had been identified in the old system, had in fact already been developed by mathematicians about a decade previously. The mathematician Balinski from the École Polytechnique in Paris had described a doubly proportional method of seat apportionment and presented it using empirical data from an election in Mexico as an example. When Christian Schuhmacher, head of the legislative service for the canton of Zurich, consulted the author (a mathematician at the University of Augsburg) for advice it proved relatively easy to adapt Balinski's method to create "Zurich's new apportionment procedure" (Neues Zürcher Zuteilungsverfahren, NZZ).

The new system is a two-stage seat apportionment procedure. In the first stage, a general distribution of seats called "super-apportionment" is performed for the entire electoral region, in which all of the 180 seats are apportioned to the parties in proportion to the total number of votes they received across the canton. This is done by dividing each party's canton vote total by a common divisor (which is specific to the election) and rounding the result to the nearest number of seats. In the 2007 elections, the divisor used was a "canton divisor" of 1531. The rounding to the nearest number of seats is necessary because dividing vote totals by the divisor does not result in an integer. The canton divisor is chosen by the returning officer administering the election so that all 180 seats are filled.

Super-apportionment guarantees is that each voter carries equal weight, irrespective of whether they live in a small district or a large one, thus complying with the constitutional principle of equality. Moreover, this procedure is clear and easy to understand. Since every vote total is divided by the same divisor, relative proportions remain unaffected, meaning that the concept of proportionality is implemented in practice. However, because only whole seats can be shared out between the parties, the result has to be rounded off at the end.

The second stage, "sub-apportionment", where the seats are apportioned to the party lists in the electoral districts, now is subject to more stringent requirements. This is because on the one hand the pre-specified districts sizes have to be adhered to, while, on the other hand, the total number of seats per party for the entire canton, calculated in the super-apportionment, must be met. Surprisingly, the sys-

Illustration: Zachariassen

		SVP	SP	FDP	Grüne	CVP	glp	EVP	EDU	AL	
					Oberzuteilung im gesamten Wahlgebiet						Kantons-
		[Wählerzahl / Kantonsdivisor -> Parteisitze]									divisor
Kanton Zürich	180	85056-56	54363-36	44622-29	29155-19	20235-13	16071-10	14608-10	7865-5	3532-2	1531
					Unterzuteilung an die Wahlkreise						Wahlkreis-
		[Stimmenzahl / (Wahlkreisdivisor x Parteidivisor) -> Wahlkreissitze]									divisor
Stadt Zürich, Kreise 1&2	5	7896-1	10749-2	8460-1	5241-1	2649-0	2215-0	679-0	413-0	850-0	6400
Stadt Zürich, Kreise 3&9	12	47555-3	54764-3	15438-1	24609-2	16226-1	10255-1	8042-0	1829-0	6322-1	16100
Stadt Zürich, Kreise 4&5	5	4183-1	9220-2	1890-0	5827-1	1231-0	2124-0	312-0	102-0	2606-1	5000
Stadt Zürich, Kreise 6&10	9	27483-2	41117-3	20345-1	21607-1	9041-1	9159-1	5017-0	1194-0	3872-0	15000
Stadt Zürich, Kreise 7&8	7	13793-1	19537-2	21011-2	15182-1	5741-1	6405-0	2995-0	496-0	1735-0	12000
Stadt Zürich, Kreise 11&12	12	47929-4	42863-3	16143-1	16368-1	13339-1	7208-1	6638-1	2572-0	2126-0	12000
Bezirk Dietikon	11	57231-4	26684-2	25153-2	10047-1	16580-1	4333-0	6269-1	1906-0	981-0	12500
Bezirk Affoltern	6	19914-2	11816-1	12410-1	4651-1	3499-0	3927-0	4923-1	2163-0	316-0	9100
Bezirk Horgen	15	106836-4	62794-2	78517-4	37310-1	32885-2	18088-1	20059-1	7089-0	2190-0	24600
Bezirk Meilen	13	105029-4	52763-2	88948-3	20940-1	22387-1	20755-1	11895-0	9507-1	1016-0	28000
Bezirk Hinwil	11	67980-4	27705-1	24812-1	20718-1	17620-1	10231-1	14428-1	15379-1	1138-0	18400
Bezirk Uster	16	120851-5	64071-2	55030-3	24819-1	24893-1	45108-2	15894-1	12036-1	2250-0	24000
Bezirk Pfäffikon	7	32800-3	12988-1	11569-1	12146-1	4968-0	3512-0	8561-1	4178-0	317-0	12700
Winterthur-Stadt	13	70175-3	64288-3	39605-2	37676-2	25834-1	14670-1	20193-1	7976-0	6637-0	24000
Winterthur-Land	7	34299-3	12341-1	12112-1	7777-1	5371-0	3305-0	8761-1	3322-0	316-0	13000
Bezirk Andelfingen	4	12845-2	4019-1	5122-1	3143-0	897-0	954-0	1534-0	1298-0	444-0	7000
Bezirk Bülach	17	140090-6	67833-3	55185-3	33619-1	25010-1	20238-1	23301-1	13584-1	1587-0	23000
Bezirk Dielsdorf	10	57674-4	21520-2	15743-1	12294-1	8485-1	6820-0	4713-0	4943-1	439-0	13000
Parteidivisor		1.02	1.07	0.91	1.013	0.89	1.1	1	0.67	0.7	

SVP Schweizerische Volkspartei — Grüne Grüne — EVP Evangelische Volkspartei
SP Sozialdemokratische Partei — CVP Christlichdemokratische Volkspartei — EDU Eidgenössische-Demokratische Union
FDP Freisinnig-Demokratische Partei — glp Grünliberale Partei — AL Alternative Liste / PdA

Kantonsratswahlen Zürich am 15. April 2007. Jeder Wähler hat so viele Stimmen, wie im Wahlkreis Sitze zu vergeben sind (linke Spalte: 5, 12, 5, usw.). Um die Wählerzahl zu erhalten, die im Wahlkreis hinter einer Partei steht, wird die Stimmenzahl durch die Wahlkreisgröße geteilt und standardgerundet (7896/5 = 1579.2 -> 1579, 47555/12 = 4094.52 -> 4095, usw.). Gesamtkantonal ergeben sich die Wählerzahlen 85056 für die SVP, 54363 für die SP, usw. (erste Zeile). Bei 180 Gesamtsitzen entfällt somit in der Oberzuteilung auf je 1531 Wähler rund ein Sitz (85055/1531 = 55.55 -> 56, 54363/1531 = 35.51 -> 36, usw.). In der Unterzuteilung sind die Wahlkreisdivisoren (rechte Spalte) und die Parteidivisoren (letzte Zeile) so berechnet, dass sowohl die Wahlkreisgrößen als auch die kantonsweiten Parteisitze genau ausgeschöpft werden. Dazu werden die Stimmenzahlen durch beide Divisoren geteilt und dann standardgerundet: 7896/(6400x1.02) = 1.2 -> 1, 47555/(16100x1.02) = 2.9 -> 3, usw.

Illustration: Pukelsheim

tem only requires a few minor – and very plausible – modifications in order to fulfil these more stringent requirements.

District divisors", which formed part of the old system and hence predate the introduction of the new system, are used to ensure that, within a given district, all parties are represented proportionally. The new system introduces additional "party divisors" to secure proportionality between the 18 district lists for any given party. Otherwise, the calculation is performed in exactly the same way as before. The number of votes is divided by the corresponding "district divisor" and "party divisor" and then rounded to the nearest number of seats.

The mathematical contribution is evident at two levels. On the one hand, it is necessary to ensure that the divisors (canton divisor, district divisors and party divisors) are easy to calculate. Given modern knowledge of algorithms and computing, this is not a problem. On the other hand, mathematics also provides structural insight that helps us to understand why, in the light of actual electoral practices, the new biproportional system is so good.

One of the most convincing structural characteristics is what in technical terms is called "coherence", the relationship between the overall problem and the partial problems contained in the overall structure. This is of practical relevance because, if there is disagreement over a seat, the disagreement does not usually affect all of the parties or all of the districts, but only a few of them. It turns out that, if the candidates wish to redistribute the seats they are entitled to and also do so using the biproportional method, the end result is exactly the same number of seats the method granted them right in the beginning.

To be more precise, the term "coherence" means that partial problems that can be embedded in the overall problem result in the same number of seats as that given by the solution to the overall problem. Whichever other party a dissatisfied party compares itself with – even if it is its closest rival – everything is alright, from a purely mathematical point of view. The new system reduces the potential for a parliamentary or legal argument whether seats are allocated "correctly". The theoretical notion of coherence thus contributes a very practical "conflict-reducing" strategy – a very special feature of the new Zurich apportionment procedure.

Mind you, structural elegance and mathematical clarity are no ends in themselves, but need to be integrated into an electoral system that has grown organically. For this to be successful, the historical roots are crucial, as are the constitutional principles and the relevant sociopolitical goals. Switzerland is a prime example of the fact that such modernisation of the electoral system can even be implemented rapidly in a decidedly traditional environment, while also enjoying broad political and public acceptance.

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Moving Forward in Central Asia

How science in Kazakhstan and Uzbekistan is looking to make international connections

By Hans-Dieter Bienert

The gaze searches in vain for water – and loses itself in a seemingly endless arid steppe. If there weren't scores of shipwrecks rusting away to draw your attention (see photo), and thousands upon thousands of little shells, you would never believe that you were standing on the former seabed of the Aral Sea – once the fourth-largest inland sea in the world.

Since 1960 its expanse of water has shrunk to a quarter of its original size, that is to say to three smaller lakes with an expanse of approximately 20,000 square kilometres. The historian Professor Makset Karlibaev, a member of the Uzbekistan Academy of Sciences, knows to explain this to a DFG delegation, which visited the western Uzbekistan town of Munjak in May 2008. One reason for the ecological catastrophe is the massive expansion of the irrigated areas for cotton monoculture and rice cultivation in the region. The consequences are disastrous: Salt efflorescence polluted with pesticide residues from the areas that have run dry and the contaminated drinking water are causing major health problems.

A large number of international research projects have since focussed on this problem. As a result of this work German archaeologists were able to show recently that as early as the 4th century B.C. there has been severe lowering of the water table – not least as a result of human interventions.

On their journey through Uzbekistan and Kazakhstan the DFG delegation of three experts and three representatives from the head office, tried to establish contact with researchers and scientific organisations – and in doing so encountered great interest. In numerous discussions and talks with academy and university institutes the desire for new joint ventures was voiced time and again. With much assertiveness the predominantly young scientists strive for international dialogue and expert partnership. In doing so, archaeologists, ethnologists and Central Asian researchers lead the way; after all, the countries of Central Asia are a priority field of research for them.

The Institut Français d'Etudes d'Asie Centrale in Taschkent also assumes a special role. Its director Dr Bayram Balci not only offers European scientists a research base and support on location but also helps with relations with the Uzbekistan authorities who occasionally maintain a cool attitude towards foreign activities.

A new departure can also be sensed in Kazakhstan research. Most notably the young universities want to embrace international standards systematically and quickly. They are the drive for the development of their country. Even though previously the focus was often directed towards the USA, the scientists of different disciplines are also very interested in intensifying cooperation with European countries.

The most recent example from archaeology was shown by the researchers from the cluster of excellence "Topoi – The Formation and Transformation of Space and Knowledge in Ancient Civilizations" who, together with Kazakhstan scientists, have started work in ancient kurgans on the outskirts of the former capital city Almaty. Further research projects, in Uzbekistan as well, are planned or were even able to be finalised on the trip. The joint ventures should continue to be strengthened and systematically supported – in the interest of science and the connection of this region with Europe.

Illustration: Bienert

Dr. Hans-Dieter Bienert is a programme director in the DFG's Humanities and Social Sciences Division.

The Diary of a Jack of All Trades

The German Empire, Republic, and dictatorship: Harry Graf Kessler was a chronicler of his era. At the German Literature Archive in Marbach his chronicle of the century is being edited meticulously – giving us a fascinating glimpse of "old Europe" page by page

By Rembert Unterstell

Even his appearance was unusual, colourful and dazzling. On the famous painting of him by Edvard Munch, painted in 1906, Harry Graf Kessler (1868–1937) was portrayed as he liked to be seen: As a flâneur, a subtle aesthete, elegant from top to toe, surrounded by an aura of cool Anglo-Saxon nonchalance. A German Dandy, as large as life, who may have appeared somewhat blasé both then and now.

But Kessler was more than just a narcissistic bon vivant. This is emphasised by his most profound biographer, the American historian Laird M. Easton, who spent a whole decade retracing the life of "The Red Count". Whether in the art world or in literary life, in day-to-day politics or the diplomatic service – Kessler wanted to be active and used his contacts, ranging from Albert Einstein to Gustav Stresemann, and from George Grosz to Josephine Baker, to do so. Yet in spite of his "10,000 friends", which even alienated his poet friend Hugo von Hofmannsthal, Kessler remained an outsider with a lot of acquaintances.

Restlessly moving between his abodes in Paris, London, Berlin and Weimar, he was no stranger to contradiction. By the end of his life, the wealthy banker's son, the socialite of Wilhelmine Germany, a lion of the salons, the art patron and man of letters of the Fin de Siècle, and not least the warmongering cavalry captain of the First World War and the failed diplomat of the Weimar Republic, had become a convinced republican and pacifist – "The Red Count", as his contemporaries called him, somewhat disparagingly. He died lonely in exile, having fled the Nazis, on 30 November 1937 in Lyon – and was soon forgotten.

Illustration: DLA Marbach

Without a doubt, Kessler's dedication in championing the cause of French Impressionism and the avant-garde in Germany was well known to art historians, and contemporary historians were familiar with his political role, for instance his brief service as ambassador to Poland in 1918. Yet his main, and most significant, achievement in life was in fact neither visible nor accessible – his extensive diaries. For no less than 57 years of his life, from 1880 until shortly before his death in 1937, he wrote a diary of his era – a "diary of the century" as the cultural publicist professor Ulrich Raulff, the Director of the German Literature Archive in Marbach (DLA), refers to it pointedly, and a "masterpiece of European diary writing". Care for a sample? As the war-weary Kessler stands before the Hohenzollern Castle in Berlin, which had been ransacked during the November revolution of 1918, he notes bitterly that: "*This environment gave rise to the World War, or the Kaiser's portion of blame for the war and to this chintzy, petty, illusory world which deceives itself and others with nothing but false values, its judgments, plans, plots and resolutions. A sick taste, a pathological excitement that governs the all too well oiled wheels of the state machinery! Now this spirit, null and void as it is, is left lying here as pointless clobber. I feel no pity for it, merely (…) dread and a sense of complicity for this world not having been destroyed long ago, but instead continues to persist in slightly modified forms all around us.*" (28.12.1918)

Illustration: DLA Marbach

Illustration: akg-images / © Edvard Munch / VG Bild-Kunst

Left: Three of Kessler's diaries dating from the war years 1914/15. Above: An almost indecipherable diary entry written on 7 August 1916. Kessler glued a postcard with a sketch on the right hand facing page. Right: A famous portrait of Kessler painted by Edvard Munch in 1906.

A telling diary entry. The world's greatest experts on it work at the DLA, located high above the river Neckar on the Marbach Schillerhöhe. The utilitarian building of the renowned literature archive stands in stark contrast to the aura of this "magical hill", looking more like a bunker on the outside. This is also where the leader of the Kessler project, Dr. Roland S. Kamzelak, is based. He is an expert on the edition and graphically enthuses about the documents relating to Kessler – letters, manuscripts for books and diaries – which the DLA, which has a collection of the legacies of some 1200 authors and scholars, procured in "circuitous and sometimes bizarre ways".

From the desk in his office Kamzelak looks out onto a gallery of portraits of Kessler and talks about the 16,000 pages of diary entries, a collected edition of which is being prepared in Marbach. The edition is planned to encompass nine large volumes, which have been being published one by one by Kamzelak and Dr. Ulrich Ott, the former director of the DLA, since 2004 by Klett-Cotta. The eighth volume (1923–1926) was published in spring 2009 and presented at the Leipzig Book Fair.

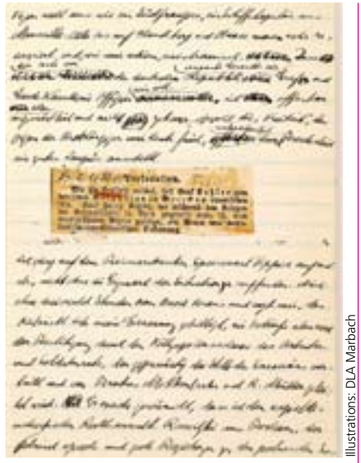
But let's take things one step at a time. It all started in 1995 with the word-for-word transcription of the 57 diaries. Kessler's handwriting, which was often hard to decipher, and the large quantity of material demanded great attention to detail and patience of those doing the work. In order to make this valuable source usable after having spent five years working on its transcription, the editors decided to publish the transcription electronically on CD-ROM initially. "A facsimile would have been of little use to researchers or readers", Kamzelak explains.

The reconstituted raw text has already brought Kessler's peculiar handwriting to light: Some readers praised the multifaceted descriptions by the cosmopolitan character, others the sharp-tongued analyses by the observer of his contemporaries, while others praised the elegant, often dazzling entries by this homme de lettres. Unlike Thomas Mann, the other great diarist

The Dandy as an army volunteer: Harry Graf Kessler in 1914 (above) and on the Eastern Front in the Carpathian Mountains in winter (third from left) with his officers. Right: Kessler frequently used his diary as a notebook, as shown by the newspaper cuttings he stuck in – these are from November 1918.

of the 20th century, Kessler did not write a "journal intime", Kamzelak explains. He uses the entries in his diary more as a notebook, allowing panoramic vistas of time, encounters and faces to emerge vividly. Kessler's elegant style of writing and his pictorial-visual language enable this historical document to become a notable literary work.

The publishers intend this to be a "hybrid edition" – an edition in print and in electronic format. It "takes the form of a new reference edition" and uses "the standard-setting editing tools of the future", as Kamzelak emphasises. What this means in practice, as the historian Dr. Günter Riederer explains at his computer in his spartan office, is that the transcription, written in Microsoft Word, is converted into XML (Extensible Markup Language) format and then processed using the programme

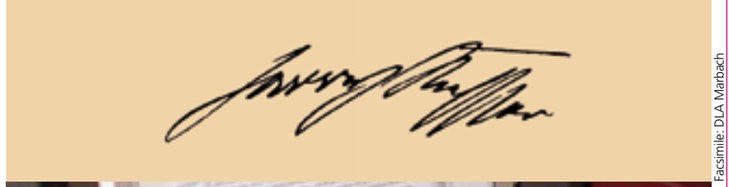


Illustrations: DLA Marbach

XMetaL according to defined edition specifications. During the creation of this computerised edition all of the indexed terms referring to individuals, works of art or literature, and places are recorded and sent to the edition database (EDDA) immediately, something that to date could by no means be taken for granted in editorial practice. The advantage of this is that the biographical index to the diary – Kessler mentions the names of about 12,000 contemporary and historical individuals – can be compiled for all of the volumes of the print edition in one go. At the same time, the index for the electronic version of the publication can also be prepared in the same way, putting modern software to work for a hybrid edition.

The feedback in response to the volumes published so far is very positive. The literary critic Fritz J. Raddatz from Hamburg, for example, praised the edition in the highest terms, writing in the newspaper DIE ZEIT "We all, after waiting so eagerly for years, have just cause to celebrate. What a pity that custom and conventions prohibit us from sending the publishers a crate of champagne. They have certainly earned it."

However, the editors also had to contend with some sharply-worded criticism. The literary scholar and expert on Kessler, Dr. Gerhard Schuster, wrote several articles in the "Süddeutsche Zeitung", in which he railed against the concept of the edition project as a reference edition on a scientific basis. The hopes of the research community that "this singular document would be commented line



Facsimile: DLA Marbach

Illustrations: Unterstell

Günter Riederer, who worked on the project, meticulously deciphers a page of the diary. Kessler's handwriting – his signature is shown in the middle – is sometimes challenging to decipher. The "Red Count's" diaries are first transcribed on computer and then published in print and in electronic format.

by line", in other words with conventional footnotes as used in historical-critical editions, have been dashed.

The editors themselves are unable to understand this criticism. They emphasise the fact that the need for "economy of time" had made an edition using an index as a reference the obvious solution. "A historical-critical edition would have taken 20 to 30 years to complete", Kamzelak estimates. In any case, the "actual diary would have been lost in the overwhelming mass of comments and notes". "From the outset, we wanted to allow Kessler to speak for himself and leave the commentary to the researchers in their various fields", Kamzelak explains.

Will the edition also be published online? The leader of the project gives a diplomatic answer to this question. The complete edition will be published in electronic format, that much is certain – whether it is on CD-ROM or online "depends on the negotiations with the publishers".

One thing is for sure, Kessler's diary gives both researchers and the general public alike an enlightening and ingenious glimpse into the past. This was surely how the Federal Minister of Finance, Peer Steinbrück, felt when he spent an entire evening reading excerpts with great audience appeal from the 1916–1919 volume in the Audimax at the Humboldt University in Berlin in late 2007. Just two years to go, then the final volume should be available in its red cloth binding. This diary, akin to a mountain range, written by an exceptional chronicler, a witness of the age of "old Europe" with its many facets, will then finally be able to be explored in full and researched in greater detail.

Dr. Rembert Unterstell is Publishing Executive Editor of "german research".

▶ www.dla-marbach.de

Illustration: Archive

Two good mates and an intercultural friendship. A perfectly normal and everyday occurrence – and yet with serious implications.

A "Wog"? No Way!

Understanding instead of prejudice: Educational researchers are studying the value of intercultural friendships to today's youth

By Heinz Reinders

Melanie is 15 years old and attends a Hauptschule, the lowest German school track, in Ludwigshafen, in southwest Germany. Twenty percent of the population there is of foreign origin or descent and in Melanie's class this figure rises to well over 60 percent, meaning that living together with people from other countries is a part of her everyday life. On top of this, Melanie views contact with peers who originally come from other countries as a real advantage. "I think that you can be very good friends with foreigners. I've noticed that the prejudice that some people have when it comes to foreigners is often completely unjustified."

Melanie has been close friends with Serap, a girl of Turkish origin, for the past year. It was difficult at first. "Bloody Muslims" she used to say, wanting nothing to do with those "wogs". Her friend Serap thought that the Germans always felt as if they were superior and were arrogant. There came a time, though, when she realised that these prejudices were wrong. "It really doesn't matter if we're Catholic Germans or Muslim Turks", Melanie says, "we can still be friends nevertheless".

Tina and Christian, who are both 16, see things pretty much the same way. All three of them took part in the interview study and were interviewed on their views of intercultural friendships. All of them agree that their friendships with Turks have seriously rattled the prejudiced opinions they used to have. His friendship with Bayram was an important experience for Christian. "I used to think that Turks in Germany just take our jobs, but now I think it's OK if they find work here, too." Tina, who has been friends with Fatime for over three years, had a similar experience. Thanks to Fatime she discovered that there are "good people" and "bad people" on both sides, Turkish or German.

These three teenagers are part of a large group of pupils from Hauptschulen whose best friend is of foreign origin. Their stereotypical images and impressions of foreigners have been permanently altered by these friendships. A total of 2000 young people of German and foreign origin were interviewed for the "Friendships in Inter-Ethnic Networks" (FRIENT) project. One finding was that four out of ten young people actively live out the integration that is called for by society and politics by having close friends with a different ethnic background. However, because there have been no studies of the impact of interethnic friendships on prejudice among young people in Germany to date, it was first necessary to conduct a qualitative interview study with 20 young people to get a better picture of the lie of the land. The key questions posed in the interviews with teenagers like Melanie, Tina and Christian were how interethnic friendships come about, what form they take and, most importantly, how they affect the attitudes of the young people themselves. Only on the basis of these interviews and the insights they provided into interethnic friendships was it then possible to design and perform a long-term study of the changes in prejudice.

Between 2003 and 2005, pupils at a Hauptschule in the Rhein-Neckar area were asked to complete a questionnaire in which they answered questions about their family environment, their friends and their attitudes towards immigrants. The data collected in these interviews was then evaluated in a longitudinal study (questionnaire survey). As well as this, the questions of why young people make interethnic friendships, and the significance of these relationships to them, were also of interest.

Probably the most amazing result was how close the findings of the qualitative interview study and the quantitative survey were. One key finding was that seeking and finding interethnic friendships can primarily be traced back to common interests as well as shared issues and problems during adolescence. This so called criss-cross effect, with topics and situations that specifically affect young people being significantly more important than ethnic origin, turned out to be a key criterion for the friendships that formed e.g. between Tina and Fatime and in Christian's case. Also, it became apparent from both of the studies that interethnic friendships are neither better nor worse than such relationships within a single culture. Even the answers to the main question posed by the study – whether interethnic friendships are beneficial for breaking down prejudice – were very similar in both of the surveys. The conclusion reached was that the longer an interethnic friendship has existed, the more markedly any prejudice that existed previously is overcome. Or, to put it another way: Young people with friends from a different ethnic background are far less likely to agree with xenophobic or discriminatory statements than their peers who do not have any friends from a different ethnic background. The mirror of empiricism shows that while the degree of prejudice against foreigners amongst pupils with intra-ethnic friendships remained stable over the course of a year, xenophobic attitudes were significantly reduced amongst those who had a friend of non-German origin.

The openness towards foreign cultures is also seen to increase as interethnic friendships develop over time. Whereas 71.6 percent of the young people with a friend of different ethnicity agreed with statements such as "I don't mind being in class with pupils from other countries" at the time of the first questionnaire, this has risen to 80.6 percent one year later. Although all of the young people surveyed became more culturally tolerant over the period of the study, the positive changes were particularly noticeable amongst those with a best friend from another country.

Social psychologists are able to offer explanations for this significant reduction in the level of prejudice brought about by interethnic friendships. As long ago as the 1950s, the American social psychologist Gordon W. Allport wrote in his book "The Nature of Prejudice" that prejudice can be reduced by contacts that are characterised, amongst other things, by sharing common interests, equal status and voluntariness. Friendships fulfil these criteria particularly well. Friendship with peers from another culture causes the friend's positive characteristics to be attributed to their entire ethnic group. The crucial factor for this "generalisation" is that the friend has to be seen as in some way typical for his or her cultural group and that the friendship needs to be pervaded by a sense of equality, of "being on a level playing field".

Illustration: Archive

Trust and closeness are decisive for the success of intercultural friendships.

The effects of interethnic friendships can also be observed within school classes. The studies make it apparent at different levels that the classroom climate is far less xenophobic if a large number of the pupils have a friend of different ethnicity in the class. Interethnic friendships have an especially beneficial effect in classes with an even balance of pupils of German and of non-German origin. This positive effect is not observed in classes with a very low proportion of pupils of either German or of non-German origin. The simple reason for this is, for example, that in a class with a proportion of immigrants exceeding 90 percent there are too few pupils of German origin available to form friendships.

Apart from these positive aspects of interethnic friendships there are, however, also drawbacks. The questionnaire survey revealed that the prejudice tended to return after interethnic friendships ended. Nevertheless, adolescents continue to benefit from their past friendships, since negative or exclusive stereotypes never returned to the same level as before the friendship. Also, there is greater willingness to form new friendships with their peers from other ethnic groups if young people have previously had an interethnic friendship.

If Melanie's, Tina's or Christian's friendships should ever come to an end then they will at least have reconsidered their prejudice and any xenophobic attitudes they may once have had, allowing them to make a crucial contribution towards a German society that is more open to dialogue in the future, too.

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Illustration: Peichl

Bright-eyed through the Day

Fruit bats forage only at night and rest during the day. But new studies show that, thanks to special sensory cells in the retina, their vision is not restricted to the nighttime

By Brigitte Müller

As dusk falls, the creatures of the night become active. "True" bats are able to orient elegantly and safely in the dark, always on the hunt for prey. Many people find them fascinating and spooky at the same time. There is talk of bats in numerous myths and stories.

Less shrouded in legend are the direct relatives of the bats, the flying foxes, also known as fruit bats. Both belong to the Chiroptera, which is the second most species-rich order of mammals, after the order of rodents. Biologists have identified some 900 species of bats and approximately 200 species of flying foxes. While bats are found nearly everywhere on earth, flying foxes are encountered only in the tropics of Asia, Australia and Africa. Many flying foxes are relatively large, weighing between 100 and 1000 grams, with wing spans of up to two metres. Bats and flying foxes use their wings not only to fly but also to regulate their temperature. During cold spells, they use small muscles to pull in and wrap the wings around their bodies like a coat. The head, nose and usually one foot are hidden below the wings, hence the inhaled air is pre-warmed. At temperatures between 18 and 30 degrees Celsius, the animals unfold this insulating skin and use it instead as a cooling surface.

Typical of bats is their complex echolocation system, which they can use to orient in total darkness. Flying foxes, on the other hand, have no echolocation capabilities. The exception to this is the rousette bat, a type of flying fox, which produces clicking sounds with its tongue, using it as a positioning tool. All other species exclusively use their large "night eyes" for orientation during their nocturnal flights. On very dark, moonless nights, flying foxes cannot forage and must go hungry.

At the beginning of the 20th century, anatomists Walther Kolmer of Vienna and Gustav Fritsch of Berlin examined the light sensory cells in the retina of the flying fox. Through an optical microscope, the researchers saw densely packed, uniformly slender light sensory cells, which they identified as rod photoreceptors responsible for night vision. In the early 1960s, Tübingen zoologist Gerhard Neuweiler confirmed the particularly good night vision of the flying fox.

His examinations showed that the eyes of the flying fox are very well adapted to night vision. This includes a spherical lens with large pupillary aperture, a high density of slender, light sensory cells (rods), a well-developed brightness discrimination ability and high light sensitivity. Several years later, an electron microscopic study of British neuroanatomists suggested discrimination between rod- and cone-like light sensory cells in flying foxes. Cones are the light sensory cells for daylight vision.

Doubts on the assumption that flying foxes possessed only night-vision-capable rods were substantiated by findings made by the American behavioural scientist Melville Brockett Fenton in the 1980s. He observed that Indian flying foxes leave their nesting places in the open treetops not only after dusk, but also during the day to either change their rest position, to

Illustration: Peichl

Glowing eyes: An Australian flying fox hidden in the branches of a tree. Right: Roost site of a colony of flying foxes in Australia. To sleep, the animals wrap themselves in their wings and thereby take on the appearance of tree fruit.

hide from the sunlight or to practice flying with the young animals.

Only in 2004 evolutionary biologists and microbiologists working with Wen-Hsiung Li showed that two species of flying fox possess the genes for a cone visual pigment sensitive to short wavelength (blue) light and one sensitive to long wavelength (green/red) light. This raised the question, "Are these genes actually used – i.e., are the visual pigments produced and, if so, in which light sensory cells?"

Frankfurt neurobiologists Brigitte Müller and Leo Peichl, together with Stephen Goodman, a field biologist from the Field Museum for Natural History in Chicago, have dedicated themselves to this question since 2004. Using histological methods, they studied the cone pigments and light sensory cells of various species of flying fox. They verified the production of cone pigments by using specific antibodies against the blue-sensitive and green/red-sensitive visual pigments.

All flying fox species that were examined were from Madagascar. The largest species is the Indian flying fox, which originated in Asia and has spread across the islands of the Indian Ocean as far as Madagascar, but not as far as the African continent. The second species, the medium-sized straw-coloured fruit bat exists only in Madagascar and in Africa.

Illustration: Dana LeBlanc, Lubee Bat Center, Gainesville, Florida

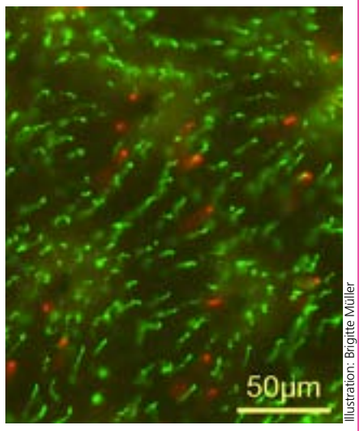

Illustration: Brigitte Müller

Close-up: The face and eyes of a Rodrigues flying fox. Bottom: Under the microscope: The labelled light sensory cells in the retina of an Indian flying fox. The green cones fluoresce in green, the blue cones in red.

The investigations revealed a number of interesting facts. The retinas of all examined species of flying fox had a high proportion of rod cells. This is a prerequisite for nocturnal navigation. A reflective layer found behind the retina verified another adaptation to the nocturnal activities of the flying fox. This layer, "tapetum lucidum", reflects the incident light onto the photoreceptors for a second time, thereby increasing the light yield; it is known to exist in mammals that are active during the night and evening, such as cats, dogs and deer.

As suspected by Brigitte Müller and Leo Peichl, in addition to numerous rods, all flying foxes possessed light sensory cells that contained cone pigments. These cones make up approximately 0.5 percent of all light sensory cells. Even if this percentage seems low it enables the animals to see in daylight, as suggested by studies performed on other animals that are active at twilight. For example, cats and dogs have only 2 to 4 percent cones. Even in humans, the retina contains on average only 5 percent cones. Thus, the retina of the flying fox is not evolutionarily unique, but is rather in line with the general blueprint for mammals, which includes both rods and cones. The examined Indian flying fox has two spectral cone types, one that contains the visual pigment sensitive to long wavelength light and one that contains the pigment sensitive to short wavelength light. As a result, the Indian flying fox is equipped with a set of cones that provides so-called dichromatic colour vision, which again corresponds to the basic blueprint of mammals. This means that they recognise only two of the three primary colours and cannot distinguish between red and green.

In the retinas of the other three genera of flying fox, or fruit bat, that were studied – the rousette bat, the straw-coloured fruit bat and the epauletted fruit bat – the blue cones were missing altogether, and only the green cones were present. These species are, thus, colour blind, as no spectral discrimination is possible with just one cone visual pigment. Such a loss of the blue cones is rare in evolution and has, up to now, only been observed sporadically in mammals. These findings suggest that, for the three affected genera of fruit bat, colour vision may be less important for survival than for the Indian flying fox.

During the day, the Indian flying fox roosts in open treetops, where it is badly hidden from birds of prey. A visual early-warning system may be beneficial to survival. The rousette bat, on the other hand, prefers to nest in caves, and the epauletted fruit bat prefers the darkest branched parts of large trees. This could explain why these genera have lower densities of cones than the Indian flying fox and, moreover, why they are colour blind.

The cones do not, however, aid any of the species in looking for food; this is because at night, the flying foxes, like all mammals, must rely on the more sensitive rods, which convey no colour information. This means, at night, all mammals see only grey.

Dr. Brigitte Müller is a scientific researcher at the Max Planck Institute for Brain Research in Frankfurt/Main.

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Illustration: Superbild

Detecting Sugar in Baby Food

When babies contract type 1 diabetes, could it be caused by their food? A large-scale study looks at the role of gluten as a catalyst

By Sandra Hummel, Maren Pflüger and Anette-G. Ziegler

Common diseases are often in the news. When the discussion turns to diabetes, most people think of age-related diabetes, the medical term for which is type 2 diabetes. Type 1 diabetes, which occurs already in infants and children, is far less well known. The patients, some of whom are still very young, will spend the rest of their lives injecting insulin several times a day. Roughly 10 percent of diabetes sufferers in Germany have this type of diabetes. Every year, around 2000 children contract type 1 diabetes.

Since the discovery in the 1970s of a group of antibodies referred to as islet cell autoantibodies, which attack parts of the insulin producing cells, medical science has assumed that type 1 diabetes is an autoimmune disease. Subsequently, researchers have focused on asking how the autoimmune destruction of the insulin producing cells in the pancreas comes about. They suspect that a combination of genetic factors and external influences is to blame.

At what stage of life does the disease affect patients, who is more commonly affected (genetics) and can the disease be diagnosed before the onset of clinical symptoms – these are all questions pertaining to the search for triggers of this serious illness. Research work in Germany, and especially in the context of the German BABYDIAB study, has delivered some seminal findings.

When it was initiated in 1989, the BABYDIAB study was the world's first study to follow the natural course of type 1 diabetes from birth onwards in children at risk, i.e., children whose parents have type 1 diabetes. Among their most important findings, they determined that autoimmunity against islet cells starts already in the first two years of life, and that children with a genetic predisposition to type 1 diabetes are 10 times more likely to acquire islet autoimmunity. They also found that children with early islet autoantibodies are highly likely to contract type 1 diabetes during infancy.

In view of this, the search for triggers concentrated on factors

which have an influence during early childhood. Food is the most prominent of these factors. The BABYDIAB study was able to demonstrate for the first time that children who are fed on solid food at an early stage have a significantly higher risk of islet autoimmunity. A survey of the BABYDIAB parents revealed that 5 percent of the children were given solid food when they were less than four months old, contrary to the recommendations of the Research Institute of Child Nutrition. Frequently, the food in question was baby milk thickened with gluten-containing grain flakes. In comparison to children fed exclusively on milk during their first four months, these children were four times as likely to develop islet autoantibodies and type 1 diabetes. Children with diabetes risk genes had an especially strong reaction to the early administration of gluten and developed complete islet autoimmunity. Very similar results were achieved by the American DAISY study, which commenced about four years later than the BABYDIAB study.

A scene from everyday life: What the researchers find out about the significance of baby food for the development of type 1 diabetes benefits not only children, but also mothers and fathers.

Gluten is a protein contained by most grains and has already been identified as the trigger of a chronic disease of the small intestine's mucous membrane, known as "coeliac disease". Curiously, the children of the BABYDIAB study exhibit a high predisposition not only to type 1 diabetes, but also to coeliac disease. These findings raised a number of questions, which prompted the Research Group on Diabetes in Munich to establish a study programme on the role of gluten and early children's nutrition in the genesis of type 1 diabetes. Can islet autoimmunity and type 1 diabetes be prevented by a gluten-free diet? And is gluten really the nutritional factor which triggers diabetes?

With these and other questions in mind, the interventional study BABYDIÄT started work in 2001. The aim was to prevent the occurrence of islet autoimmunity through the systematic administration of gluten-containing food in the sixth or twelfth month. One hundred and fifty infants were treated, all of whom had both first-degree relatives with type 1 diabetes and the diabetes risk gene, so that the children had a diabetes risk of 20 percent. Half of the families were instructed to eat gluten-free food for the first twelve months, while the other half was supposed to give the infant gluten only after the sixth month. The progress of these children has since been followed for an average of 2.8 years, and a first evaluation of the results is scheduled for the end of 2009.

Besides preventing islet autoimmunity, an examination was made, using the children's stool samples, of how solid food and especially gluten altered the intestinal flora and the frequency of gastro-intestinal disease. A very positive side-effect of BABYDIÄT is that mothers breastfeed longer and smoke less thanks to their participation in the study. In other words, they are living a healthier, more conscious life, which will have a positive overall effect on the development of their children.

Illustration: Superbild

The question also arose whether the elimination of gluten from the diets of children with several islet autoantibodies could prevent the onset of type 1 diabetes. In order to find out, children who had already been fed with gluten-containing food and who had a high risk of developing type 1 diabetes because of their islet autoantibodies were given a gluten-free diet for one year. Afterwards, the children were given a normal gluten-containing diet again. This experiment revealed that the one-year gluten-free diet did not protect the children from further development of islet immunity or type 1 diabetes. The conclusion of this study is that children with already existing islet autoimmunity cannot be protected from the progress of the disease by means of a short-term gluten-free diet.

Parallel to the interventional studies on children, studies were also conducted on mice with a 90 percent chance of developing a type of diabetes very similar to the human type 1 diabetes. The aim of these studies was firstly to find out whether it was possible to protect the animals from autoimmune diabetes by omitting gluten-containing grains such as wheat or barley from their diet. It was ascertained that the mice that were deprived of wheat and barley contracted diabetes much less frequently.

In a second experiment, the researchers asked whether renewed feeding of wheat or an isolated wheat protein increased the mice's diabetes risk once again. The answer they found was that feeding wheat in a small quantity increased the rate of diabetes in the mice, but not the feeding of isolated wheat proteins such as gluten, albumin and globulin or other products such as fruit and potatoes. The conclusion that may be drawn from these experiments is that the dosing of grain content influenced the development of autoimmune diabetes in mice. However, the strongest diabetes triggering effect was observed with very low doses.

A shared meal brings even infants together

Illustration: BABYDIAB study

Up to now, it has not been explained why the immune system attacks the body's own insulin. It is conceivable that insulin antibodies result from a cross reaction with food proteins. The infant's still premature immune system is confronted by food antigens already in its first few months of life. At this time, the intestine has a much higher permeability to larger molecules, which means that an interaction between the intestine-related immune system and food components is possible. Some children thus had types of insulin autoantibodies which were with very high probability activated by the intestine-related immune system. Interestingly, these antibodies also exhibited a reaction against cow milk. But further tests revealed that these antibodies played no direct role in the progression of diabetes in the children. It has therefore yet to be clarified what role is played by these insulin autoantibodies in the genesis of type 1 diabetes.

The findings gathered up to now have led to the design of the TEDDY (The Environmental Determinants of Diabetes in the Young) study, the world's largest research consortium, which is looking at the influence of early childhood nutrition as well as other environmental factors on the genesis of type 1 diabetes. In this study, over 7000 children from the U.S.A., Finland, Sweden and the Federal Republic of Germany, who have a heightened genetic risk of type 1 diabetes from birth on, will undergo regular checkups at short intervals. In the framework of the TEDDY study, it will be possible to test whether previous findings can be confirmed in other countries with different nutritional habits.

Dr. Sandra Hummel, **M. Sc. Maren Pflüger** and **Prof. Dr. med. Anette-G. Ziegler** work at the Institute for Diabetes Research at the TU Munich.

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Welcome to Tokyo!

Boost for scientific cooperation with the Far East: DFG opens office in Japanese capital

By Eva-Maria Streier

Kirsten Spannhoff has been working at Japan's Nagoya University for the last four months. The young woman from Germany's Münsterland region is a doctoral researcher in the "Complex Chemical Systems" International Research Training Group, which the DFG has been funding since the end of 2005 in both Münster and Nagoya. She reports on her personal learning experiences with infectious enthusiasm.

"Carrying out scientific research in a completely different environment gives you a whole new perspective on your own subject and research field", says Spannhoff. She feels at ease in Professor Kazuyuki Tatsumi's working group in Nagoya and, after taking an intensive three-week language course before beginning her placement, is also, to a certain extent, getting to grips with Japanese.

Mazakazu Nombo, also a doctoral researcher in the Research Training Group, has just returned from a three-month placement at the University of Münster. He too, has benefited greatly from his time in Germany, both professionally and personally. He was very taken with German culture, and he waxes lyrical about a weekend he spent in Berlin.

The short presentations given by the two young scientists as part of a symposium to promote young researchers won over the approximately 170 visitors from Germany and Japan who had travelled to Tokyo to attend the opening of the new DFG office in mid-April. The German Speaker of the Research Training Group, renowned chemist Professor Gerhard Erker from Münster, knows from personal experience that this is how lifelong scientific friendships are forged. "We give the young people free rein, and many of our conferences are organised by the doctoral researchers", says Erker. Every doctoral researcher in the Group spends six months in the exchange country, plus there are two joint conferences a year centred on mutually complementary topics.

"We've learned a lot over the past few years", Erker continues, "but this demonstrates just how successful promoting international science and humanities projects can be."

Maintaining and intensifying German-Japanese scientific cooperation is one of the DFG's major concerns. "Setting up the new DFG office in Tokyo underscores the significance we ascribe to bilateral scientific relationships", emphasised DFG President Professor Matthias Kleiner at the opening ceremony. Kleiner reminded the audience of the long history of German-Japanese scientific relationships that have, he says, created trust and respect. "Today Japan and Germany are facing similar challenges", he continued. He explained that both countries had set themselves the goal of creating a limited number of universities of excellence or increasing funding for Private Public Partnerships (PPP).

Professors Motoyuki Ono and Koichi Kitazawa, presidents of both the DFG partner organisations, the Japan Society for the Promotion of Science (JSPS) and the Japan Science and Technology Agency (JST) respectively, delivered short welcoming speeches, as did the German Ambassador Hans-Joachim Daerr and a representative from the Japanese Ministry for Education, Culture, Sports, Science and Technology. The keynote speech was given by Japanese Nobel Prize winner Professor Makoto Kobayashi, who strongly advocated in favour of communicating scientific findings to society. He urged the revision of education and upbringing in order to awaken an interest in science – on an international scale. Future generations and the global economy, he said, depend on the findings of science and research.

The DFG's Japanese office is, after Peking, Washington/New York, Moscow and New Delhi, the DFG's fifth foreign representative office. The director of the new office, Dr. Iris Wieczorek, who spent several years living in Japan during her studies (Japanese studies, sinology and computer science) while working on her doctorate, and who later published numerous works on the Japanese innovation system, outlined its functions: to support German scientists and academics in expanding their cooperation with their Japanese colleagues, as well as to serve as a focal point for Japanese scientists en route to Germany. The analysis and evaluation of relevant developments in Japan's scientific policy is also among its duties.

One of the main focuses of the bilateral cooperation programme is in promoting young researchers, and the Münster/Nagoya chemistry Research Training Group is just one of a total of four International Research Training Groups involving Japan. The other Groups are active in the fields of biology (Berlin/Boston/Kyoto), social sciences (Halle/Tokyo) and mathematics (Darmstadt/Tokyo).

The DFG's office in Tokyo is located in the German Cultural Centre, where it joins the German Academic Exchange Service and the Fraunhofer Society.

To support the setup and expansion of bilateral cooperation with Japan, the DFG has, since the beginning of the year, been offering the new "Initiation and Intensification of Bilateral Cooperation" funding instrument, under which applicants can, amongst other things, request funding for placements of up to three months at German or overseas partner institutes, as well as for joint events such as workshops and seminars.

The opening day concluded with a visit to the Meiji Shrine and a spectacular Shinto ceremony in which the new office was blessed.

Illustration: Ganter-Richter

Grand ceremony for office opening (from left): Director of the DFG's Japanese office Iris Wieczorek, DFG Vice President Konrad Samwer, Makoto Kobayashi, holder of the Nobel Prize in Physics, German Ambassador Hans-Joachim Daerr, JSPS President Motoyuki Ono, DFG President Matthias Kleiner, and Hirokazu Kumekawa from the Ministry of Education, Culture, Sports, Science and Technology.

Dr. Eva-Maria Streier is Head of the DFG's Press and Public Relations Office.

Fischer in Delhi

New director at the DFG office

There's been a change of leadership in New Delhi – the new head of the DFG's Indian office is Dr. Torsten Fischer. He takes over from Dr. Gernot Gad, who has headed the overseas office since its opening in autumn 2006. On the occasion of the handover in New Delhi, DFG President Professor Matthias Kleiner stated that the DFG will expand its efforts to strengthen German-Indian relations in basic research over the next few years.

Illustration: Schiffer

Premiere in Hanoi

Inaugural Leibniz Lecture

It made an impressive picture: Professor Konrad Samwer, Vice President of the DFG and a physicist from the University of Göttingen (at right in our photo) and almost two metres tall, stood surrounded by numerous members of his Vietnamese audience for more than an hour as he answered questions following his speech on "Glass – from an Old Material to Modern Physics". Solid as a rock, he patiently answered question after question and explained his experiments again. No one had anticipated such a high level of interest.

The DFG had invited guests to the world's first Leibniz Lecture via its representative at the German Embassy in Hanoi, Dr. Harald Leisch. More than 100 interested parties from universities, Vietnamese research facilities, other embassies and ministries attended – an encouraging response. The DFG aims to use the new series of Leibniz Lectures to showcase Germany's outstanding contributions to science and the humanities abroad – presented by winners of Germany's most prestigious science award, the Gottfried Wilhelm Leibniz Prize.

Konrad Samwer, winner of the Leibniz Prize in 2004, spoke on his core research area, the properties of metallic glasses. Samwer has worked with the low-temperature properties of this fascinating material since the days of his doctoral thesis, and his still-palpable enthusiasm for the subject makes the DFG's Vice President an effortlessly persuasive ambassador for science and the humanities.

Illustration: Streier

To this day, the tremendous potential for scientists and academics with German backgrounds in Vietnam and the high level of Vietnamese interest in cooperation projects with Germany provide a solid foundation for successful cooperation in research and development. This much was made clear during the visits by the small DFG delegation to the Vietnam National University and to the Vietnamese Academy of Sciences. As the German ambassador in Hanoi, Mr Rolf Schulze, pointed out in his opening remarks, however, the challenge now is not to rest on the laurels of strong past relationships, but instead to continue these into the next generation. The odds are in favour of this: Vietnam is a young country, and there are more than 250 jointly-funded research and education projects between Germany and Vietnam. Until now, however, most young Vietnamese with an interest in science are still travelling to the USA, England or France.

"Meet, trust, exchange" – with these words, Konrad Samwer summarised the matter after meeting with his Vietnamese physicist colleagues at the institute. The scientists will, he explained, need to get to know and trust each other before venturing into an exchange. In this respect, German and Vietnamese mathematicians have led the way – relations in this field have been exemplary for decades.

It is eminently conceivable that the first Leibniz Lecture has also paved the way for a fresh start in the field of physics.

Eva-Maria Streier

The Deutsche Forschungsgemeinschaft

The Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) is the central self-governing organisation responsible for promoting research in Germany. According to its statutes, the DFG serves all branches of science and the humanities. The DFG supports and coordinates research projects in all scientific disciplines, in particular in the areas of basic and applied research. Particular attention is paid to promoting young researchers. Researchers who work at a university or research institution in Germany are eligible to apply for DFG funding. Proposals will be peer reviewed. The final assessment will be carried out by review boards, the members of which are elected by researchers in Germany in their individual subject areas every four years.

The DFG distinguishes between the following programmes for research funding: In the *Individual Grants Programme,* any researcher can apply for financial assistance for an individual research project. *Priority Programmes* allow researchers from various research institutions and laboratories to cooperate within the framework of a set topic or project for a defined period of time, each working at his/her respective research institution. A *Research Unit* is a longer-term collaboration between several researchers who generally work together on a research topic at a single location. In *Central Research Facilities* there is a particular concentration of personnel and equipment that is required to provide scientific and technical services.

Collaborative Research Centres are long-term university research centres in which scientists and academics pursue ambitious joint interdisciplinary research undertakings. They are generally established for a period of twelve years. In addition to the classic Collaborative Research Centres, which are concentrated at one location and open to all subject areas, the DFG also offers several programme variations. T*ransregional Collaborative Research Centres* allow various locations to cooperate on one topical focus. *Cultural Studies Research Centres* are designed to support the transition in the humanities to an integrated cultural studies paradigm. *Transfer Units* serve to transfer the findings of basic research produced by Collaborative Research Centres into the realm of practical application by promoting cooperation between research institutes and users.

DFG Research Centres are an important strategic funding instrument. They concentrate scientific research competence in particularly innovative fields and create temporary, internationally visible research

Illustration: Querbach

priorities at research universities.

Research Training Groups are university training programmes established for a specific time period to support young researchers by actively involving them in research work. This focusses on a coherent, topically defined, research and study programme. Research Training Groups are designed to promote the early independence of doctoral students and intensify international exchange. They are open to international participants. In *International Research Training Groups,* a jointly structured doctoral programme is offered by German and foreign universities. Other funding opportunities for qualified young researchers are offered by the *Heisenberg Programme* and the *Emmy Noether Programme.* In so called *Reinhart Koselleck Projects,* the DFG supports especially innovative research undertakings by outstanding scientists and academics.

The *Excellence Initiative* aims to promote top-level research and improve the quality of German universities and research institutions in the long term. Funding is provided for graduate schools, clusters of excellence and institutional strategies.

The DFG also funds and initiates measures to promote scientific libraries, equips computer centres with computing hardware, provides instrumentation for research purposes and conducts peer reviews on proposals for scientific instrumentation. On an international level, the DFG has assumed the role of Scientific Representative to international organisations, coordinates and funds the German contribution towards large-scale international research programmes, and supports international scientific relations.

Another important role of the DFG is to provide policy advice to parliaments and public authorities on scientific issues. A large number of expert commissions and committees provide the scientific background for the passing of new legislation, primarily in the areas of environmental protection and health care.

The legal status of the DFG is that of an association under private law. Its member organisations include research universities, major non-university research institutions, such as the Max Planck Society, the Fraunhofer Society and the Leibniz Association, the Academies of Sciences and Humanities and a number of scientific associations. In order to meet its responsibilities, the DFG receives funding from the German federal government and the federal states, as well as an annual contribution from the Donors' Association for the Promotion of Sciences and Humanities in Germany.

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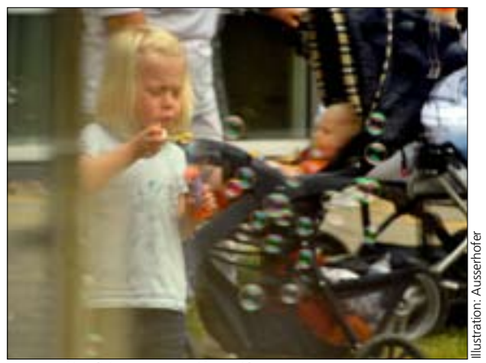

Illustration: Ausserhofer

An early-career researcher? These children accompanied their parents to this year's DFG Emmy Noether meeting in Potsdam. The DFG is strongly commited to supporting the compatibility of scientific careers and family life at German universities and research institutions.