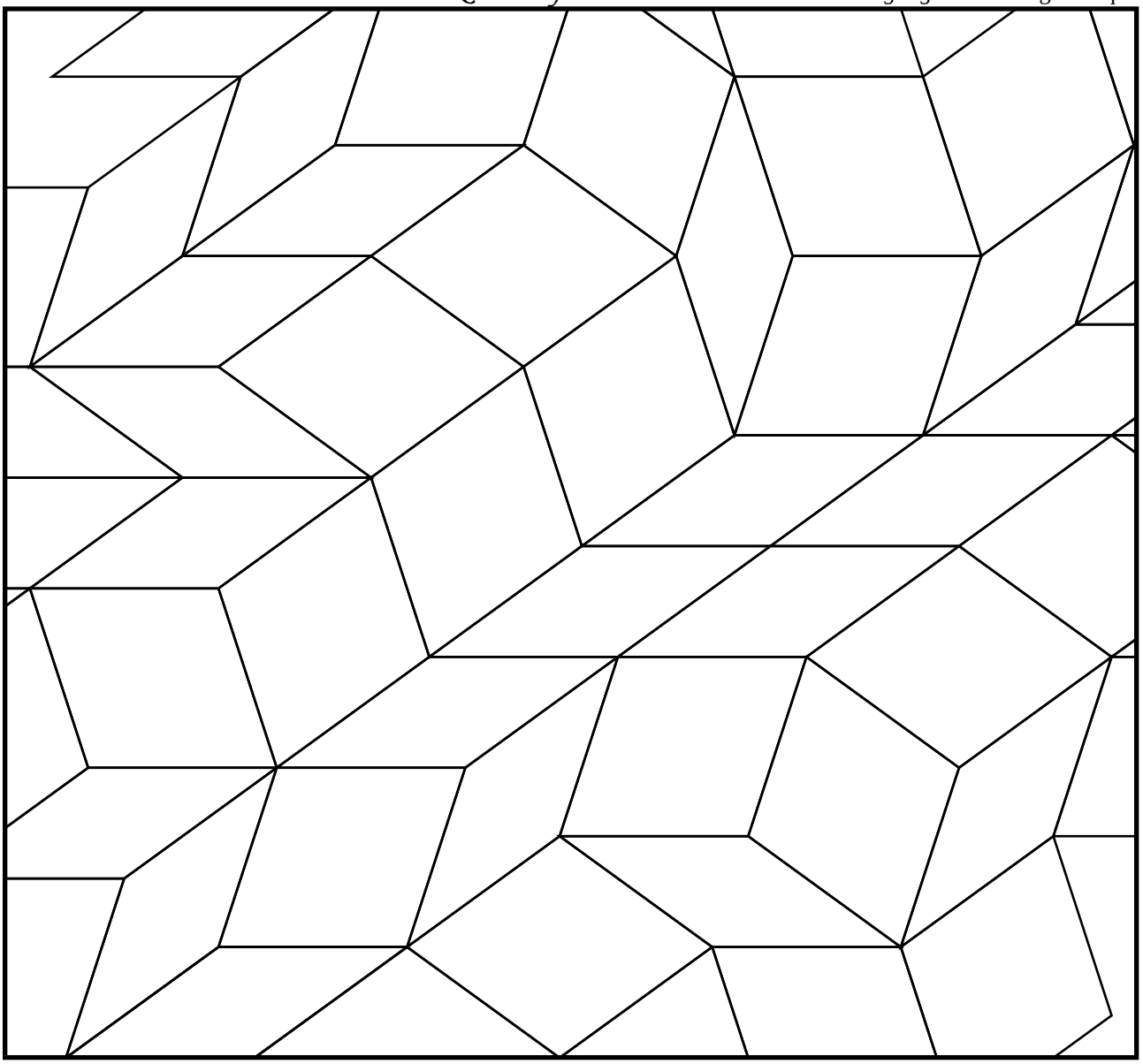
Bulletinen

15 maj 2017

Svenska
Matematikersamfundets Bulletin

Redaktör: Ulf Persson
Ansvarig utgivare: Milagros Izquierdo



Conversation with Yves Meyer : *Ulf Persson*
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Joint Meeting: ***CAT-SP-SW-MATH*** *Umeå , 12-15 juni 2017*

Bulletinen

utkommer tre gånger per år I Januari, Maj och Oktober. Manusstopp är den första i respektive månad

Ansvarig utgivare: *Milagros Izquierdo*
Redaktör: *Ulf Persson*
Adress: *Medlemsutskicket c/o Ulf Persson*
Matematiska institutionen
Chalmers Tekniska Högskola

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SVENSKA MATEMATIKERSAMFUNDET

är en sammanslutning av matematikens utövare och vänner. Samfundet har till ändamål att främja utvecklingen inom matematikens olika verksamhetsfält och att befordra samarbetet mellan matematiker och företrädare för ämnets tillämpningsområden.

För att bli medlem betala in avgiften på samfundets `plusgirokonto 43 43 50-5.`

Ange namn och adress på inbetalningsavin (samt om Du arbetar vid någon av landets institutioner för matematik).

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(medlem i matematiskt samfund i annat land med vilket SMS har reciprocitetsavtal):
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Ständigt medlemsskap: *2 500 kr (engångsinbetalning)*

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Här återfinnes bl.a. protokoll från möten

STYRELSE:

ordförande *Milagros Izquierdo*
`013 - 28 26 60`
`president@swe-math-soc.se`

vice ordförande *Klas Markström*
`090-786 97 21`
`vice-president@swe-math-soc.se`

sekreterare *Olof Svensson*
`011-36 32 64`
`secretary@swe-math-soc.se`

skattmästare *Frank Wikström*
`046-222 85 64`
`treasurer@swe-math-soc.se`

5:te ledamot *Jana Madjorava*
`031 - 772 35 31`
`bm5@swe-math-soc.se`

Detta Nummer

Detta nummer kommer liksom tidigare att domineras av en av mina intervjuer, och jag väljer återigen att kalla den med den mer passande beteckningen 'konversation'. Denna gång handlar det om Yves Meyer, aktuell som Abelpristagare 2017. Jag träffade honom första gången i samband med ICM i Hyderabad 2010 där jag presenterades för honom av Mumford. Meyer hade då belönats med Gauss-priset, och eftersom mitt uppdrag i Hyderabad var att för European Mathematical Society (EMS) räkning intervjua Fieldsmedaljörerna tyckte jag att det även kunde passa bra att intervjua en Gausspristagare. Jag kontaktade senare Meyer per e-post och ställde några oskyldiga frågor. Hans respons var mycket entusiastisk, och besvarade de flesta av mina frågor i långa essäer. Dessa publicerades (om än i något förkortad form) i 'the Newsletter of the EMS'[1] och senare i oavkortad form i mina två sista Utskick[2]. Den konversation jag nu låter publicera ägde rum på Meyers spartanska kontor den 19 januari 2012[3]. I samband med Meyers utmärkelse har Jan-Olov Strömberg, en pionjär inom teorin för krusningar[4] som går tillbaka till sent 70-tal, på synnerligen kort varsel inkommit med en artikel om just krusningar. Den har två syften, dels att utgöra en hyllning till Meyer, dels att ur författarens personliga perspektiv presentera utvecklingen.

Arne Söderqvist inkommer med ytterligare en redogörelse för offentlig verksamhet och dess olyckliga tendens att på falska grunder efterlikna privat näringsverksamhet. Det vinstbegär som utmärker den senare tjänstgör även som potentiell falsifiering av just denna verksamhet, ett kontrollerande element som saknas i det offentligas epigoni. Lars Wern bidrager dels med ytterligare en bokrecension och dels med en betraktelse över sitt älsklingsgebiet - kosmologin.

Slutligen inkommer vår avgående ordförande med några slutord samt en årsberättelse. Däremot kommer den tillträdande ordförande (som vi formellt inte känner förrän efter årsmötet nästa månad) att ta till orda först i höstnumret som sig bör. Till höstnumret planerar jag även att publicera en artikel av Leif Önneflod som handlar om kategoriteori och dess relevans till grundläggande aritmetik (när jag var liten talade man om 'räkning') för små barn.

Göteborg den 15 maj 2017
Ulf Persson (redaktör)

[1] Till min stora tillfredsställelse visade det sig att denna artikel utgjorde basen för den biografiska sketch Abelkommittén lät inkludera i den broschyr de publicerade i samband med tillkännagivandet.

[2] november 2010, maj 2011

[3] under samma parisresa under vilken jag även konverserade med Illusie. Jag tar tillfället i akt att liksom i fallen med intervjuerna med Hersh, Illusie och Mumford i föregående nummer tacka på det hjärtligaste Bengt Johansson vid NCM som gjorde dem möjliga genom resebidrag.

[4] Mig veterligen förekommer ingen vedertagen svensk terminologi, som vanligt av den enkla anledningen att inga vetenskapliga artiklar om detta författas på svenska.

Tack för dessa två år

Milagros Izquierdo

Vid samfundets årsmöte i Linköping den 12 juni 2015 valdes en ny styrelse med mig som ordförande. Min tid som ordförande går ut i samband med samfundets årsmöte i juni. Med detta brev tackar jag för mig.

Först av allt vill jag tacka styrelsen för ett bra samarbete och ert engagemang i samfundet! Det är många som på så många sätt har bidragit till samfundets verksamhet, stor tack till alla er!

Jag skrev för två år sedan att jag hade som ambition att matematiken ska vara mer synlig i samhället och vad matematiker gör (och uppnår) ska kommuniceras tydligt, till omgivning och internt bland matematiker. Är matematiken mer synlig? Nja.

Men jag hoppas att med Joint Meeting i Umeå börjar vi att ha mer vetenskaplig verksamhet och matematiker i Sverige träffas under några dagar för att diskutera och prata matematik, matematikundervisning och matematikens roll i samhället.

Matematik och annan vetenskap är universella företeelser och bidrar till välstånd världen över, men den mår inte bra av gränser och pekpinnar. Jag vill uppmana alla oss att vara vaksamma så att matematiker från hela världen kan resa, träffas och arbeta fritt. Jag är övertygad att det gagnar matematiken och samhället.

Sist men inte minst anser jag att samfundet kan bidra och har en roll i den matematiska gemenskapen och samhället i stort. Det kräver arbete från oss och jag står till förfogande.

AMEN

AMEN (Archimedes Mathematics Education Newsletter) ges ut av David Wells, som medverkade i februarinumret av Bulletinen i år. Den senaste utgåvan (AMEN #5) gavs ut i början av denna månad, med undertiteln 'the disaffection issue'. Ur innehållet kan nämnas 'Mathematics Education and moral issues', 'Disaffection, anxiety and appreciation', 'Examinations: four scandals', 'Gender, mathematics, and connected knowing','How much mathematics should be taught?' och 'What is to be done?'. Hur får man tag på denna? Författaren sände den till mig personligen, men i dagens tidevarv är det bara att googla. 'AMEN Wells' fungerar bra och jag fick upp länken `amendavidwells.blogspot.se` vidare klickning ger `https://drive.google.com/file/d/0BwT4tltuHZVdb3V2eGZpZGdsYmM/view`

Tankar om tjänstetillsättningar, om privatisering och om didaktik

Arne Söderqvist

I februarinumret av SMS-bulletinen skrev jag om tjänstetillsättningar inom offentlig sektor genom social nätverksrekrytering. Följden kan i så fall bli att verksamheten likriktas på ett olyckligt sätt. Man kan hävda att några enstaka undantag från regeln om obligatorisk utlysning av lediga tjänster inte spelar någon större roll. Detta är dock en felsyn.

En kritisk massa har allt inflytande

Det behöver ingalunda vara majoriteten av personalen på en arbetsplats som är nätverksrekryterad för att det ska bli problematiskt; det räcker med att dessa personer utgör en kritisk massa. Inom akademisk verksamhet är det vanligt att personalen har inflytande på vilka som utses till chefer. Ska till exempel en ny proprefekt utses, får den avgåendes "kronprins" antagligen stöd av samtliga inom nätverket. Även om en majoritet inom personalen inte tycker sig ha hedersskulder pga. nätverksrekrytering och därmed anser sig fria att lansera andra förslag, får de svårt att enas om en motkandidat som kan få lika stort stöd. På samma sätt blir det vid val av fackliga representanter och skyddsombud. De nätverksrekryterade har hela verksamheten i sin hand.

En arbetsplats är normalt inte demokratisk

En arbetsplats behöver inte vara demokratisk. Enligt lagen får cheferna "leda och fördela" arbetet efter egen bedömning. Kanske det i regel fungerar bäst så, men endast under förutsättning att chefen är vidsynt och har rätt kompetens för verksamheten och själv inte nått sin position utan reella kvalifikationer. Det vore en överdrift att påstå att någon försöker vara chefen till lags av ren övertygelse; i själva verket är det fråga om ambition att ligga väl till inför löneförhandlingar med mera. Äkta hängivenhet mobiliseras i stället då det gäller att boka tider på tennisbanan, att hjälpa varandra med sjösättning av segelbåten eller att planera en gemensam fest; en "inre krets", de socialt nätverksrekryterade, är ju "gamla bekanta" sedan lång tid före anställningstillfället. Då "gänget" samlas till exempelvis kräftskiva, gärna i personalrummet, talar man förstås en passant om "jobbet". Man kan då enas om en gemensam policy i någon fråga, såsom den förestående tjänstefördelningen. Skulle någon utanför denna inre krets kalla övriga utomstående till ett möte för att samråda om någon avgörande fråga skulle det istället betecknas som uppvigling och vara straffbart.

Det måste råda öppenhet

Det får inte vara så att en exklusiv grupp inom personalen får ta del av nytillkomna fakta före de övriga. Ett exempel kunde vara om man fått i uppdrag från högre håll att anordna nya kurser. Om informationen först bara når "de edsvurna", kan det leda till lobbyverksamhet för egna syften. Ett exempel på detta är när KTH i Södertälje fått i uppdrag att ha hand om delar av Lärarlyftet I och dessutom att bistå vetenskapsparken Tom Tit med att komplettera sin verksamhet med inslag av matematik. Då vidtalades en person i kollegiet långt innan uppdraget blivit offentliggjort. Verksamheten skulle vinna på så stor öppenhet som möjligt och en diskussion om vem som hade den bästa kompetensen för att ta sig an de

olika arbetsuppgifterna. Beträffande Tom Tit så blev det ingenting av det projektet. En god möjlighet att intressera barn och ungdomar för matematik rann därmed ut i sanden.

Verksamhetens behov

Personalen är till för att klara verksamhetens behov och inte tvärt om. Vid KTH i Haninge fick jag en gång beskedet av min avdelningschef att jag skulle undervisa i fysik på Basåret, förutom matematik. Han berättade också att han utsett en kollega till mig att inreda ett fysiklaboratorium; något sådant fanns ännu inte. Jag frågade då om kollegan också skulle undervisa i fysik. Då fick jag svaret "Nej, men han behöver en extrainkomst." I min blåögdhet trodde jag först att inredningen av fysiklaboratoriet skulle ingå i de ordinarie arbetsuppgifterna. Jag hade gärna åtagit mig uppdraget utan någon extra arvodering. Mitt svar gjorde emellertid att jag slapp undervisa i fysik, vilket jag i och för sig inte haft något emot. Det var svågerpolitiken som fick mig att reagera. Konsekvensen blev att jag fick omedelbar förflyttning till KTH i Södertälje, efter vad som kallades mitt "utbrott".

Skenutlysningar åstadkommer stora obehag

Då tjänster skenutlyses, då man avser att tillsätta någon speciell person men formulerar en annons ändå "för att hålla ryggen fri", kan många personer indirekt bli drabbade. Inte bara för att de gått miste om tjänsten; det torde ju ändå bara vara en av de sökande som kan bli tillsatt, utan för att de alldeles i onödan ägnar möda åt att formulera sitt CV och kanske till och med offrar tid för en anställningsintervju eller på att förbereda en provföreläsning. Förhoppning vänds till besvikelse och när det verkliga förhållandet klarnat kan det leda till att man fortsättningsvis håglöst avstår från att vidare söka ledigförklarade tjänster. Universitet och högskolor har som sin främsta uppgift att meritera sina studerande, men tycks i stor utsträckning inte själva bekymra sig om meriter. På så sätt diskvalificerar man ju faktiskt även sina egna utbildningar! Inom familjeföretag brukar man minsann vara noga med rekryteringar. Man har förstås rätt att anställa precis vem man vill, men innan ett generationsskifte äger rum brukar man noga ha sett till att efterträdaren verkligen är mogen att ta över. Offentlig verksamhet får däremot skattebetalarna subventionera om den fungerar illa. Bristande kompetens hos den rekryterade drabbar därmed hela samhället.

Privat kontra offentlig sektor

Jag var i min tidigare artikel i SMS-bulletinen inne på att privat företagsamhet är självreglerande, vilket offentlig verksamhet inte är. Orderingång, bokslut och eventuella reklamationer avslöjar hur pass väl det fungerar. I värsta fall kan det leda till konkurs. Ett tänkvärt exempel är IT-företagen som växte som svampar ur jorden i början av seklet. Där tänkte alla i personalen på precis samma sätt och ingen hade några alternativa idÃ©er då IT-boomen var över, bara några få år senare. Konkurserna stod som spön i backen. Inget fel i det, men konsekvensen man fick ta var att verksamheten upphörde. Man kan inte låta offentlig verksamhet gå samma väg. För att verksamheten ska fungera under alla omständigheter krävs en personal med en mångfald idÃ©er.

Kopiering ad absurdum

Det är en vanlig uppfattning att privat verksamhet fungerar effektivare än offentlig verksamhet. Följden har blivit att man inom offentlig verksamhet successivt infört regler som tidigare bara gällt inom den privata sektorn. Ett exempel är "interndebitering" avseende

egna tjänster. För drygt femtio år sedan infördes strejkrätt för offentliganställda. Trots att jag var ett av konfliktombuden inom Lärarnas riksförbund vid lärarstrejken 1989, var jag principiellt emot att strejkrätt införts. Den offentliga sektorns viktigaste uppgift är att driva samhällets infrastruktur och därmed ge service åt såväl företag som åt allmänheten. En strejk drabbar alltså främst "tredje man", medan motparten faktiskt tjänar på den genom innehållna löner. Att vi alla är delägare i infrastrukturen och får del av de inbesparade medlen är en obetydlig bonus i jämförelse med allt besvär strejken åstadkommer. En strejk inom den offentliga sektorn blir lätt detsamma som ett stryptag på samhället. Hur långvarig strejken än blir, så riskerar inte verksamheten att bli nedlagd. Ett privat företag kan däremot bli utslaget vid en konflikt och personalen därmed bli friställd. Den offentliga arbetsplatsen finns kvar när konflikten väl är över. De strejkande tar alltså inte samma risker som man måste ta som privatanställd.

Individuell lönesättning

Att lönerna numera ska förhandlas individuellt inom offentlig verksamhet är också något man infört med privat verksamhet som förebild. Den bakomliggande tanken är förstås att effektivisera. "Lön efter prestation" låter ju som en rimlig devis. Men frågan är bara hur man mäter exempelvis en lärares "prestation". Inom universitets- och högskoleväsendet har måttet blivit lärarens examination. Man bortser helt från att lärare kan frestas att sänka sina kvalitetskrav. Inte nog med att hög examinationsgrad är ett godtagbart argument i en löneförhandling. Genom välvillig examination kommer läraren förstås också undan med färre omtentamina att rätta. Inför mina egna individuella löneförhandlingar har jag begärt ut lönelistor för mina kolleger. Jag har vid varje sådant tillfälle bemötts med obstruktion och först måst berätta att det faktiskt är fråga om offentliga handlingar. Då jag kommit till löneförhandlingarna har jag ofta haft två arbetsgivarrepresentanter som motparter. En fråga jag brukade få var hur jag kunnat få ut lönelistorna jag medförde. När jag svarade att det var fråga om offentliga handlingar brukade jag bemötas med "Det var inte meningen att du skulle känna till dina kollegers löner!" Själva satt mina motparter med all relevant information och det var alltså meningen att jag skulle vara så oinsatt som möjligt. Ingen jämbördighet mellan parterna, alltså. Förhandlingarna började alltid med en genomgång av mina studenters kursutvärderingar. Jag sade att dessa enligt reglerna enbart var till för att eventuellt utveckla kurserna och inte utgöra underlag för individuella lönepåslag. Men omdömen om mig som "för teoretisk" och "för akademisk" ansågs så allvarliga att de inte kunde förbises. I övrigt var det bara "vad man hört" som tog upp. KTH har devisen "Vetenskap och Konst" i sin logotyp och jag hävdade att en bedömning med rykten som grund knappast kunde stämma in på den devisen. Synpunkterna haglade; när den ene frågade ut mig passade den andre på att fundera ut sin nästa fråga. Jag tilläts inte få någon betänketid. Jag begärde oftast att få slippa mina lönesamtal, men jag blev då kallad till dessa spektakel.

Tanken med individuell lönesättning felaktig

En tanke med individuella löner har varit att lärare med högre individuella påslag skulle bli förebilder för sina kolleger. Men hur skulle så kunna bli fallet om det inte är meningen att man ska känna till kollegernas löner? En ologiskhet, minst sagt. Inom det svenska skolväsendet har det avsatts statliga medel både för kommunala skolor och friskolor för extra

arvoden åt "förstelärare". Vem som utnämnts till denna post och vars undervisning därmed ska vara rättesnöre för kollegerna, känner alla naturligtvis till. Men det är skolans rektor som utser "förstelläraren" som antagligen utvalts som den inom kollegiet som har en världsbild som ligger närmast rektors egen. Att utnämningen kan uppfattas som "orättvis" inom kollegiet är inte det största problemet. Det allvarliga är istället den likriktning som uppstår. Lärare med egna goda idÃ©er kan tendera att lägga sin egen professionalism åt sidan och följa sin påbjudna förebild för att istället ligga bättre till inför den kommande löneförhandlingen.

"Ordinarie tjänst"

Inom staten förekom tidigare begreppet "ordinarie tjänst". Tanken bakom denna typ av tjänst var att om en innehavare intog en obekväm ståndpunkt i någon fråga, så skulle detta på intet sätt kunna äventyra anställningen. Då sådana tjänster förr debatterades i media nämndes uteslutande de "otillbörliga förmåner" de varit förknippade med. Förmodligen bidrog detta ensidiga synsätt till att de ordinarie tjänsterna avvecklades. Att begreppet ordinarie tjänst en gång infördes till samhällets fromma har troligtvis fallit i total glömska och att det på många sätt faktiskt skulle vara till dess gagn att sådana tjänster återinfördes, är nog en fjärran tanke hos de flesta. Man kunde invända att sådana tjänster lätt kan missbrukas, till exempel genom att innehavaren kanske inte ens visar sig på sin arbetsplats. Men en sådan risk är så gott som obefintlig och värd att ta. Det ska förstås bara vara objektivt oförvitliga personer som kan få komma ifråga vid tillsättningarna.

Benämningarna "närande" och "tärande" fullkomligt missvisande

Ofta hör man att privat verksamhet är "närande", medan offentlig verksamhet istället kallas "tärande". Uttryckssättet är vulgärt missvisande. Julglitter produceras antagligen endast av privata företag. Jag kan inte inse att det kan ha ett större värde än vad till exempel en lärare producerar. Men missuppfattningen har lett så långt att man fått för sig att offentlig verksamhet blir effektivare om den övergår i privat regi.

Privatiseringar ofta ogenomtänkta

Ett av nationalekonomins fundamenta säger att all verksamhet som kan ge en högre avkastning än "den riskfria räntan" är förknippad med en risk. Sedan att par årtionden tillbaka är det tillåtet att starta friskolor i Sverige. Tanken har varit att kommunerna ska kunna avhända sig en del av skolansvaret till aktörer som förespeglar högre effektivitet, genom att betala ut "skolpengar" för eleverna. När friskolor har startats har ofta kommunerna frikostigt tillhandahållit byggnader och materiel till en billig penning. Detta har förstås inneburit en lyckosam start för friskolorna ifråga. Och visst gick de flesta av dem med vinst också, under flera år. Ser man närmare på hur detta gått till, vilket har gjorts i bland annat några TV-reportage, så förstår man bakgrunden. Lärartätheten är lägre, lärarna är ofta sämre utbildade, klasserna är större, skolbibliotek med bibliotekarie kan saknas och man kanske inte har någon egen matsal utan delar ut matkuponger som gäller på McDoland's, istället för att servera eleverna lunch. Förespeglingen att skolan skulle kunna drivas effektivare än i kommunal regi har alltså inte infriats. Dessutom har numera ett antal friskolor verkligen gått i konkurs. Att så skulle komma att ske, var egentligen ganska enkelt att förutsäga för den som kände till några av nationalekonomins grunder. Vid en konkurs får kommunen ifråga återta ansvaret för eleverna. Aktörerna har alltså ett förmånligt skyddsnät, genom att kunna avhända sig

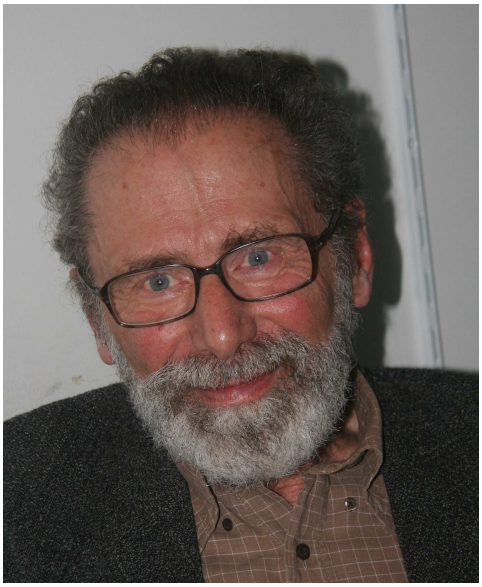
alla konsekvenser. Men om en kommun har dålig ekonomi kan den inte tvinga någon friskola att ta hand om någon undervisning; det är bara "russinen i kakan" friskolorna vill ta för sig av. Det råder alltså inte någon symmetri. Att begränsa vinstuttaget vid drift av både friskolor och privata vårdinrättningar räcker inte. Om vinst uppstår måste den återinvesteras i verksamheten. Den som köper en vara eller en tjänst kan reklamera densamma om kvaliteten visar sig undermålig. Vanligen får man då en rimlig kompensation. Om leverantören gått i konkurs kan man ställa sina krav till konkursförvaltaren. Men den som utsatts för undermålig skolundervisning får själv ta kostnaden i form av bortkastad ungdomstid, den värdefullaste tiden i livet. Dessutom kan så småningom inträdet på arbetsmarknaden bli försenat. Någon kompensation för detta torde inte vara möjlig att få. Andra problem som uppstått i samband med privatisering är att offentlighetsprincipen samtidigt upphört att gälla. Detsamma beträffande personalens yttrandefrihet. Hur ska arkiven hanteras när en friskola gått i konkurs? Den frågan verkar fortfarande vara obesvarad. Ett exempel på illa genomtänkt privatisering jag själv har erfarenhet av är från KTH i Södertälje. Vaktmästeriet där privatiserades medan jag fortfarande tjänstgjorde där. Tanken var att minska kostnaderna. Där bedrog man sig! En omedelbar följd blev att man inte kunde ringa internt till vaktmästeriet längre. Man måste först ringa till företaget ISS växel. Det gick inte längre att "slinka in" till vaktmästarna för att be om en tjänst. Sådana måste beställas i förväg för att sedan faktureras. En ganska omfattande byråkrati uppstod. All materiel hos vaktmästeriet övergick i ISS ägo. Sådant som var avskrivet fick KTH enligt lagen inte ta betalt för. Så småningom kommer en ny upphandlingsomgång. Vidtalas då en annan aktör, med ny personal, uppstår än en gång en "inkörningsperiod" innan verksamheten åter kommer att fungera någorlunda.

Didaktiker försöker styra

En annan sak jag har häcklat förr är didaktikernas intåg på KTH och då inte bara i Södertälje. Detta har lett till andra vansinnigheter. Till exempel inköptes "mentometerknappar" och lärarna uppmanades att anpassa undervisningen genom att ställa frågor studenterna kunde besvara med en knapptryckning. Svaren blev anonyma, men på en dataskärm kunde man se hur stor andel som svarat si eller så. Jag fronderade och jag motiverade min vägran: att dela ut mentometrarna och att samla in dem igen skulle ta dyrbar tid, svinn av mentometrar skulle uppstå, de skulle gå sönder vartefter och batterierna skulle ta slut. Jag ville inte heller anpassa min undervisning till ett knapptryckande. Lärare som visade låtsad entusiasm, alltså sådana lärare som befann sig i en beroendeställning i enlighet med inledningen av min artikel, låg förstås bättre till i de kommande löneförhandlingarna. Det dröjde dock inte länge innan mentometrarna förrådsställdes i hopp om att de snarast skulle falla i glömska. Ska man kunna dra lärdom av några erfarenheter, måste dock begångna misstag hållas i minnet.

Conversation with Yves Meyer

Ulf Persson



Ulf Persson: So are you ready?
Yves Meyer: I feel like being on the couch of a psychiatrist.
UP : That was what David Mumford also said.
YM : Really?
UP : What I find very striking about your career is the way you have changed fields.
YM : Lest you, and others, get the wrong impression I must from the onset stress that I moved from one mathematical topic to another one mainly because I moved from one place to another. I could not stay more than ten years in a place. I became anxious to move, like the gipsies. I am a gipsy. When I am offered a new position in a new department, my new colleagues will ask new questions. Then I am forced to move from one subject in mathematics to another one.
UP : So it has nothing to do with you finishing a field, getting bored, and moving to fresh pastures?
YM : For you to understand it properly, let me give a very specific example. My most spectacular move happened when I was invited by Guido Weiss at Washington University. This happened in 1974. I was eager to work with Guido. But at that time Guido was busy with the administration of the University. I was given an office. Raphy Coifman entered 30 minutes later and told me I should work with him on Calderon's conjectures. I did not even know what a singular integral operator could look like but I accepted by curiosity. Two months later we could prove the boundedness of the second commutator. After this start I have been working with Raphy Coifman for more than thirty five years. Within a week I will celebrate Raphy Coifman at Yale. Let me repeat. Each time I moved on to another topic it was the same story. I would not have moved unless someone forced me to move. The point would instead be to know why people treated me as a potential collaborator.
UP : And why is that do you think?
YM : I do not know. One could think, which I fear that you might do, that I am a conqueror restlessly invading new territories in mathematics. Quite the opposite. My friends took that decision for me.
UP : Really?
YM : You must also understand that this has not always been appreciated by my colleagues. You should support your local department and not flee to another place. Many of them have seen it as fickleness on my part, in some cases it has even been construed as down-right

deception and betrayal. But I cannot help myself. In order to understand the reason for those changes you must be aware of my background.

UP : Would you care to elaborate on that?

YM : Surely. I grew up in Tunisia in the late forties and early fifties. It was a country of divisions. French was spoken of course, and needless to say I belonged to that community, but also Italian and Arabic, and I did not understand those languages. That made me feel restless and eager to cross those frontiers. I simply abhorred the idea of being imprisoned within a single community.

UP : And this does apply to mathematical disciplines as well?

YM : Very much so. But let me continue on the subject. My sister has carried this crossing of frontiers even further than me. We returned to France in the late fifties which was a hard time in France. The country was almost on the eve of a civil war because of the Algerian crisis. Because of this crisis de Gaulle was able to stage a come-back based on the promise of uniting France and he actually made good on his promise. A civil war was averted but the moral reputation of France was permanently tarnished. My sister was so disgusted with France that she left for Morocco, where she married an Arab and started a family. She still lives there and speaks Arabic. She has really been able to transcend her upbringing and I admire her very much for that.

UP : But to return to mathematics. To change into a new field is not easy, in fact you have to start from scratch, and that is something most mathematicians shy away from. Having worked so hard to master a subdiscipline they do not want to jettison all that investment. You have to start from scratch there famously being no Royal way to mathematics.

YM : I really had to start from scratch each time, I knew nothing about the new field.

UP : Still starting from scratch is not really the case would you be honest. You did not enter a new field humbly by working your way up from the bottom, did you not just jump into the middle of it? Sink or swim. In a way it bespeaks a certain arrogance. You have been quoted as saying *Whenever you feel competent about a theory, abandon it!*.

YM : What do you mean arrogance? I am not arrogant, I do not understand what you mean. Have I not impressed you with the real cause of my changes of field. It has nothing to do with arrogance. Should I have to repeat it all again? And that quote has been, I believe, spread by Ramachandran. I assure you it has no basis in reality.

UP : I do not mean arrogant in any critical let alone deprecative way, what I simply mean is a lack of timidity which often can be seen as arrogance.

YM : I was not timid, I agree, but arrogance is not the opposite of timidity.

UP : I guess you are right. Arrogance is often a cover for timidity. When I was young I often was accused of arrogance, but really I was only very unsure of myself. This is why arrogance so often is associated with youth. How foolish we all were when young. Maturity comes with age and hence the wisdom it brings is often useless coming as it does too late, and unfortunately you cannot pass it on to future generations either, because each generation is entitled to make its own mistakes and come to their own (belated) maturities.

YM : Yes I was foolish when I was young, and would I have had the privilege of living my life over again I would proceed far more cautiously. But I also realize that this would have been a mistake. I did foolish things when I was young, but so much of my eventual success

and happiness is due to my youthful recklessness. Maturity makes you less reckless and that might be appropriate for an older age.

UP : I on the contrary feel more reckless today than when I was young, and I wish I had been less timid then. So in other words you do not regret the way you led your life and the choices you made?

YM : On the whole that is true. As I explained my upbringing instilled in me an urge to cross frontiers, not to stay confined. This has been a Leitmotif in my life, so deeply ingrained as to question it would be meaningless as it lies at the core of my very identity. I should have been a writer, a novelist. Reading over and over Les Essais makes me feel that Michel de Montaigne was my older brother.

UP : I envy you your sense of initiative and realize that I would have greatly benefitted from the same. It is such a pity that we never met earlier and I could have been advised by you.

YM : I do not believe in giving advice. As you already mentioned, you can never pass on your own maturity to others, at best you may express it and perhaps hope that it might inspire some resonance in receptive minds. Had we met then you would probably have been impervious to my advice, which I might not even have been able to formulate properly at that time. I simply had the instincts of a Nomad.

UP : You are right. You were naturally a Nomad. Specific advice does not survive a change of context. But I am afraid that we are digressing a bit too much, even if the essential charm of any interchange is to be found in digression. Changing fields seems so natural when you describe it, but it cannot be so easy.

YM : It is not easy. And as you say I do not really do it from scratch. The secret is collaboration. You cannot do it on your own, unless perhaps if you are a Gauss, you need the help of others. In fact in a new discipline I am usually out of my depths, and that means in practice that I am always out of depths due to my restlessness. If I am given a paper to referee in one of my own fields I am unable to do it, I have to give it to a student.

UP : In other words you often do not know the basics?

YM : True.

UP : Is it not an act of arrogance to work in a field in which you do not know the basics?

YM : You are coming back again and again to the issue of arrogance. What is really up your sleeve? To answer your question, it is not necessary to know the basics as long as you have the support of somebody who really knows it.

UP : To you the social component of doing mathematics is very important.

YM : It is important to every mathematician.

UP : But in your case you carry it to the extreme.

YM : I do not like this way of putting it. It implies somehow that I am overdoing it, that it somehow is not fair.

UP : I apologize. I did not really mean it this way, I just wanted to be a bit provocative.

YM : It may be true that I am a bit extreme in the sense that to me mathematics is a social thing or nothing. I simply love to interchange with people, it does not have to be mathematics. It can be literature, poetry, philosophy, politics you name it.

UP : And mathematics is just one of those things?

YM : Yes. And that is important, mathematical communication at its deeper level, is no

different than communicating on literature or politics. Mathematical communication is as little a matter of conveying technical information as it is in the case of a philosophical or literary discussion.

UP : So how do you start collaborations?

YM : It cannot be planned, it is a matter of accident. Just as the example of Raphy Coifman I just told you about. You remember?

UP : Of course I do.

YM : All my great collaborations have started as accidents. I may have planned a collaboration but something might have intervened and I have instead hooked up with someone else. There are many such instances.

UP : So what does it take?

YM : Basically it is a matter of sympathy. Human sympathy. And mathematics is of course a human thing as anything else. This is the foundation that has to be there, and then you need a spark, and that is usually a question that strikes you.

UP : And if there is no foundation for an interchange there will be no material to ignite. The foundation you only become aware of gradually?

YM : That is a good way of putting it. It is as with friendships, they often start so inauspiciously, so you might be led into believing that there really is not much to it, that friendships can be based on almost anything. I believe that there has to be mutual sympathy, the extent of which you are only gradually made aware of. To me my mathematical collaborators are friends. Deep friends. Doing mathematics is simply a way of expressing friendship. I love Zygmund. He has always taken such a fatherly interest in me, ever since I first met him. I loved that. I think of him as a father. Or take again the case of Coifman. He is a brother. We are different as mathematicians. Coifman is somewhat of a dreamer. We complement each other beautifully.

UP : And this brings to the practical question of how to collaborate. To many mathematics is such an individual activity. It is pure thinking, working out things for yourself, and to interact with someone else seems to be at best a distraction. Autonomy and independence seem to be cardinal virtues in a mathematician, maybe more than in any other discipline. Is there really such a thing as a true mathematical collaboration? Would it not be more appropriate to say that mathematical collaboration is a matter of dividing the territory in two or several parts and assigning each to a collaborator and then combining it. In other words as if you were writing a dictionary each author being given a initial letter.

YM : What you present is of course a caricature, and I guess you are trying to be provocative again. Nothing could be further from the truth.

UP : I know. But please go ahead.

YM : As I already told you. Coifman and I complement each other beautifully. We act like two cog-wheels in relation to each other.

UP : I know that feeling. I once had a very fruitful collaboration in which I very tangibly got this sensation of cogs meshing into each other. Mathematical reasoning often manifest themselves as chains of arguments, or steps on a ladder if you prefer. I very much felt that we each took every other step. Where one of us got stuck, the other could supply the necessary leverage. And vice verse. In other words each alone we would have accomplished nothing,

we would each separately been stuck on the first or second step. Together we did something qualitatively new that would have been beyond the powers of each of us individually. That was something of a revelation to me. I had previously thought that in mathematical collaboration the norm is not given by the integral but by the supremum.

YM : This was probably something that was told to you in the guise of a meaningful advice. My advice is never to give advice and above all never to accept them. My life would have turned to disaster had I followed advice that I have been given.

UP : You told me once about Gabriel's advice to learn the new language of Algebraic Geometry.

YM : It was very well-meaning advice of course, and who knows it might also have been given in the spirit I still give advice.

UP : You mean in the sense of not being expected to be followed.

YM : Exactly. But of course, I cannot really know.

UP : But still collaboration may be simpler said than done, and how does it work in practice?

YM : To refer back to your concern about autonomy in mathematical thinking, mathematical communication is not on the level of conveying precise information. It is about conveying ideas. Coifman might have an idea. It is invariably vague and may not make much sense at first. I take this idea and retreat, trying to make it more precise, and in so doing taking it to the test, doing some tedious calculations if need be. This kind of mathematical activity is best done in privacy, no one can really help you, interference will simply be invasive and destructive. But once I have done this privately I can return to Coifman and we can look for the next level. Mathematical collaboration is about providing motivation, suggesting approaches, it could be as simple as pointing to a reference. That humble act is also a form of collaboration.

UP : What would you have been without collaboration?

YM : My lot would probably have not been different from that of the majority of Ph.D's. You write a thesis and then you publish a few papers related to it, and then your research activity peters out. Instead you redirect yourself and become involved in teaching and doing administration. And your creative impulses may be channelled into purely private furrows.

UP : For most people, if you get stuck in a sub-field you eventually get bored. It stops making sense to you. If you are persistent you may stick to it by mastering a machine you can use to endlessly churn out new but ultimately pointless results. Mathematics becomes a chore. To summarize our discussion to up to now, your frequent changes of disciplines have not been the effects of conscious career decisions, instead they are due to a combination of two deep strains in your personality namely a nomadic restlessness and a desire for friendship. Two straits that are very much intertwined and may as a result be impossible to separate. is this a fair summary?

YM : It is a fair summary, and I am particularly pleased with the emphasis it makes on friendship.

UP : Maybe we could make a slight digression and talk about Zygmund. You refer to him as a father-figure and he obviously meant a lot to you. When did you first meet him? I guess it was on a visit to Chicago.

YM : You guess wrong, it was not Chicago. I met him in a book, in his book on Trigonometric

Series. It was back in 1964, I was preparing my Ph.D. and this chance encounter had a very momentous effect on me. I fell in love with Antoni Zygmund, that means I fell in love with his mathematical style. His book on Trigonometric series was a collection of truly fascinating problems on Fourier expansions, presented in such a refreshing way to somebody who had been brought up in French Bourbaki style. It was like giving up say 'L'être et le nÂ´eant' by Sartre and getting your teeth into 'Anna Karenina' by Tolstoy.

UP : But you did no meet him in the flesh.

YM : You mean personally. No that came later. Let me now digress on the uprising of May 1968 in Paris. That fabled spring. I was a young professor at the time and joined my students walking the streets of Paris. Through some move of the crowds I was pushed inside a group of students in humanities. We were stopped in "rue Tournon" by a large police squad which was aimed at protecting the Palais du Luxembourg which is the place where the French Senate is working. We could not move further and we were staring at the nearby buildings. The day was over and it was becoming dark. Suddenly from an hotel which is located in rue de Tournon, at the second floor a window opened and an old man came to the balcony. I immediately recognized Zygmund (I had already attended several lectures by him at Orsay) but the students in humanities did not know whom Zygmund was. Zygmund was smiling. Then this extraordinary sympathy and communication between people who never talked before took place. The students understood the meaning of Zygmund's smile and shouted "come with us, grandfather". Zygmund did not understand what the students asked him to do and returned to his room. I told this story many times to Zygmund. He was so pleased. I also told the story to many other American mathematicians. The story was repeated again and again and eventually Zygmund was viewed as one of the leaders of these big demonstrations.

UP : But it was also in Chicago you got to know him?

YM : Of course, It was there where he was based. I was a young man at the time and far more mobile. Yet I was twenty six before I actually met him. You know, from the start Zygmund treated me as a child who still was in need of advice. I loved this. I loved this attitude of his. And his style of course. To him a problem should always be given the most concise and simplest formulation, and in order to solve it, you should first treat an illustrative example.

UP : This is very much in the spirit of Mumford. Mathematics should, according to him, be presented much more through illustrative examples than via general statements and theories.

YM : I agree. But that is anathema to the spirit of Bourbaki, when a problem should be raised to its most general and abstract nature before being ready to be attacked.

UP : In many cases the necessary generalizations are rather obvious and routine once you are intimately familiar with the crucial cases. I remember my father once telling me that what you needed to learn were the extremal points, then you could fill in the rest by linear interpolation. He did not express himself in this formal way, but he drew a picture for me that conveyed the same metaphorical meaning. Yet, I must admit, that there are abstractions which are not formal but essential, and that the best proponents of the Grothendieck school understood this.

YM : Yes of course, the proof by Deligne on the Ramanujam conjecture on the growth of the

coefficients of the τ-function is a case in point. This was incidentally based on a reformulation by AndrÂ´e Weil.

UP : With a lot of input by Grothendieck as well. Still for many of us this is not an option to do mathematics.

YM : While we are discussing it, there is also a third approach, one that unfortunately, or perhaps fortunately, works by chance and hence cannot be systematized..

UP : ...which is..

YM : .. reformulating the problem into a very different branch of mathematics.

UP : This testifies beautifully to the interconnectedness of mathematics, which to me has profound philosophical implications. Anyway this all brings us to the next topic. The industrialization of mathematics. An industrialization brought about by mass education and the concomitant financial structure of support.

YM : I guess I should in some sense plead guilty. I have had fifty-five doctoral students.

UP : That is a lot. Can you actually maintain deep friendships with all your students?

YM : I think of my students as my family. I feel tender towards every one of them. My main responsibility as a thesis advisor has always been to try and make them into independent mathematicians. In that way I can leave them and trust that they take care of things in my absence.

UP : Now many more people are getting Ph.D's in mathematics (to say nothing about other subjects). This is made possible by mass education and the financial pressure on institutions to educate many Ph.D's. In the past academic life could be very leisurely and pleasant, free from many structures, such as publishing. The philosophers at institutions such as those of Oxford and Cambridge never had to worry about publishing papers it was enough that they lead scholarly lives of study and reflection and engaged themselves in brilliant conversations. As far as they survive beyond their deaths this is due to some of their lectures being preserved through notes taken by students and later edited for publication. In short it was a monastic life accountable only to God or to your own individual conscience.

YM : Indeed an idyllic existence.

UP : To an outsider its weakness is obvious. It is a system that if it does not actually encourage idleness it condones it. Thus from a bureaucratic point of view the inherent tendency to idleness has to be checked. It is as if we would mandate the number of prayers monks perform in order to make sure that they are diligent. We do not care of the praying per se only that the monks are busy and do not shirk their duties.

YM : This is amusing.

UP : I might have been digressing. The point I wanted to make was a subservient one actually. If there is an obligation to churn out so and so many Ph.D- students, the responsibility of completing the degree is taken away from the student and instead laid at the door of the advisor and the department. By completing the degree the student does a service to the institution; knowing that there is a strong incentive for the institution to complete the degree, the student can reasonably expect to sooner or later getting finished almost regardless of his or her own participation.

YM : You are again drawing something of a caricature?

UP : Maybe, but you agree that there is something to it?

YM : It is inevitable that the structure of academics will change fundamentally as a consequence of this change of scale. Although I am not as pessimistic as you seem to be about the possibility of nevertheless preserving the fundamental mission of a University. If I may be allowed to elaborate...
UP : ..by all means.
YM : Science, including mathematics, is a social enterprise.
UP : Granted.
YM : In mathematics there is still room for both the traditional 'l'art pour l'art' as well as applications. In fact mathematics cannot really survive on just one, it needs the combination. In particular we need applications. Mathematical institutions require resources and they somehow need to give something back. This is a necessity as well as a social obligation.
UP : So mathematics will be more and more like big science, with mathematicians acting as engineers.
YM : Yes, in principle, if in a smaller way. There will be a need for large projects in which individual mathematicians subordinate themselves.
UP : Actually I suspect that many mathematicians would feel more comfortable with in a sense being told what to do rather than to conceive their own research programs and to try and carry them out.
YM : I think that this is true, and I do not think that this development is necessarily bad. But mind you I am no technocrat at heart, in fact at the lycee I followed a humanistic bent, studying Old Greek and I loved it.
UP : Illusie told me that you once won a price in Greek composition.
YM : This is untrue by the way. So I turned to science only later. To go back to my point, there is always going to be a place for pure mathematics. Mathematics internally motivated. There is no contradiction here. There are compelling practical problems that need to be addressed, but those problems also stimulate pure mathematical thinking. And this attitude of pure mathematical thinking will be necessary if we are going to overcome challenges posed by practical problems.
UP : I guess in such an environment there will be a pressure to be productive. Still the various ways of measuring productivity seem to me selfdefeating. Take the example of the so called h-index.
YM : Yes I am very familiar with it. When there are questions of promotion or job applications, those indexes play a very important role.
UP : There is a tradition in basic schooling of measuring achievement on an almost continuous basis, and as I grew up with that I accepted it almost unthinkingly. The giving of grades has been criticized on the basis that it inhibits learning for the sake of learning and making the taking of tests an end in itself. I have always thought that such objections are exaggerated. If you genuinely love to learn something at school I had always figured that if you are not stupid you will automatically do well. But maybe I am naive.
YM : Zygmund used to tell me that he would never have been able to take all those French entrance exams. He could solve problems, but never quickly.
UP : But now on a higher level I see the perfidious influence of such a system especially in the hands of bureaucrats. It will encourage easy research and the creation of artificial cliques that

refer to each other. On the elementary level tests and grades may indeed serve the purpose for which they were devised, namely to force people to study and to become disciplined, but once you have acquired the basics and learned to discipline yourself, although it is far from clear to what extent that can be actually be learned, there should be no need to continue.

YM : I am very well aware of the problem, and when I said that they are important, does not necessarily mean that I condone them, only that I state a fact of life. For want of alternatives they will play an important role for better or for worse in the necessary act of making a selection of candidates.

UP : I would like to change tack and address the question of mathematical ability. There is such a thing as inherent mathematical ability is there not? Or is it, as it is fashionable to claim, just a case of successful instruction and imprinting?

YM : Certain learning is definitely intrinsic and automatic, if one can really think in terms of learning.

UP : You are thinking of what ?

YM : The acquisition of language, to learn to talk your mother tongue. A child will do so without prompting as long as it is surrounded by native speakers. There is no instruction going on, it is as if the child knows it already, that it has only to be uncovered.

UP : It reminds me of Plato's poetic assertion that all knowledge is inside us, ignorance is a case of amnesia, and learning is really just a way of remembering what we have always known.

YM : I love Plato, so I very much like this way of expressing it. More scientifically though, the ability to speak is hard-wired in us, only the particular form our speaking will assume is a matter of input from the particular environment we happen to find ourself in.

UP : This reminds me of the story of the English child who expressed such a relief of not having been born in France as she knew no French. This idea of hard-wire is of course the old idea of Chomsky.

YM : Yes. Chomsky pointed out that there is not enough input to explain the rapid mastery of such complex matter. As you may know the child inflects all verbs regularly at first, on later realizing that there are a few exceptions.

UP : Or even more strikingly, children that grow up in an environment in which pidgin is spoken endows it automatically with a rudimentary grammar and creates what I believe is called a creole. I have always found Chomsky's ideas on language very congenial. He developed them as an illustration of the various forms the learning process could take. Other examples being how to make visual images of visual input. However, congenial as they may be, I do not find his concrete realization of a universal grammar very convincing, which does not mean of course that there is none, only that he might not be the one to realize it. Nor do I believe that there is any neurological basis for his claims, but that is hardly his fault, considering the primitive level of our current neurological knowledge.

YM : This is not true. There is now evidence of a neurological basis for language. I can refer to the work of StÂ´ephane Deheane.

UP : That is good to hear, although I remain skeptical as to the explicitness of such neurological links, and believe it has more to do with suggestive evidence.

YM : It is interesting that we do not need instruction to learn to talk...

UP : ... nor to walk for that matter. Talk and walk the two basic skills we learn in early childhood. 'Talk and walk' so succinctly put in English. Sorry interrupting you.
YM : We need not to be taught speaking, but most people need to be taught to read this is not at all natural.
UP : It is of course not part of our biological inheritance, it is a relatively recent cultural acquisition. It is interesting though that it is much easier to learn to read using the alphabetic codification than the hieroglyphic as say represented by Chinese characters. One would naively think it would be as easy to memorize a visual symbol as a spoken word, in fact one would even suspect that it would be easier considering the dominant role played by sight among our senses. But to become literate in Chinese is a difficult process, and while the child easily absorbs several thousands words within a year or two, that same child will devote several years of schooling to learn the same number of characters.
YM : Of this I do not know. I prefer to speak about things I know.
UP : The point is well taken. But what about mathematics? How much of this is intrinsic and hard-wired? I have a very vivid memory from my childhood. I was with my father making up a haystack at the farm of my maternal grandparents up north. I was told somehow that thirty plus thirty was sixty. I knew that three plus three was six, and remember that I thought that it all hangs together, and from that moment on I could count. It was as if the structure was already there, I only had to be pointed to it. I also should emphasize that it was different from those typical 'I see' experiences, which result after you have grappled with a problem and than see in a flash how it all hangs together. In this case, as far as I can remember, there was no previous problem that was given a solution. The insight was not retrospective.
YM : So your point is that not only learning to speak but also to do basic elementary mathematics is automated.
UP : Yes. But perhaps not for all children. We who are mathematicians all have the experience of mathematics coming naturally and easily to us. I am speaking of course of the initial encounters, not our more mature mathematical struggles. But maybe not all children have this ability, and if so maybe it is cruel to try to force it on them. Just as it would be cruel to force everyone to play a musical instrument or perform athletic feats.
YM : This is interesting.
UP : The issue is of course extremely sensitive, so perhaps instead of openly speaking about ability one should speak about temperament, even if that does not change anything in principle. But the whole issue about education and inherent ability is so ideologically charged, one has to tread lightly.
YM : One does indeed. But as I said it is very interesting.
UP : Take such an example as the quadratic equation. Many students, perhaps most, seem to have trouble with it and learn the formula by heart wondering why they should ever bother. When in practical life do you have occasion to apply it? But to a burgeoning mathematician, just the suggestion of completing the square is so striking that once you have seen it you can never forget it. To this day I am still completing the square every time I have occasion to solve a quadratic equation, just for the pleasure of it.
YM : In mathematics, unlike other subjects, you do not have to rely on any authority save that of your own reasoning. In physics you are told about the result of the Michelson-Morley

experiment and asked to believe it. It is like being asked to believe in God.
UP : This brings me to the issue of popularization of mathematics, or vulgarization as you say in France. The difficulties are obvious, but mathematics has one real advantage compared to other subjects, as you just indicated. In mathematics we can give them the 'real thing'. Namely an argument that needs no external justification. Hardy tries to show the beauty of mathematics by giving the proofs of the infinitude of primes, or more precisely that any finite list of primes is incomplete, and the irrationality of the square root of two. Those arguments are so simple and so compelling that Hardy probably cannot conceive, as he writes them down, that not everyone will be moved by them.
YM : The latter is very doubtful. And I do not think that Hardy was so naive as to believe it. As you already pointed out many people are immune to even simple mathematical arguments.
UP : It is a mystery to me. People who can perform complicated mental reasoning in playing games, be it chess or cards, and nowadays also sudokus, are being stymied by simple mathematics.
YM : Yes I am astonished as well, and I also recall PoincarÂ´e being puzzled, writing about it in one of his books. But perhaps, as you indicated, speaking about temperament instead of ability, may nevertheless be more illuminating.
UP : What introduced me to deductive thinking was of course Euclidean geometry. And I remember what excited me above all was the power of thought, not so much the results themselves, but the way you got to them. Now this old tradition has been taken out of math curricula and at best replaced by some more descriptive geometry with the teeth of deduction pulled out.
YM : I very much liked Euclidean geometry at school. As you said it combined deductive thought with the pleasure of drawing pictures. This combination of abstract thought and visual representation making the former so tangible is something I liked so much in the mathematical theory of quasicrystals, Penrose tilings, the findings of D. Shechtman, I.Blech, D.Gratias and J.W.Cahn, and medieval Islamic art.
UP : You cannot have everything. And Euclidean geometry has of course another very important cultural aspect, namely putting us in direct touch with our classical heritage.
YM : Yes, as I have already told you, I pursued a classical education in lycÂ´ee, reading Plato. Euclidean geometry very much fitted into this.
UP : By the expression 'direct touch' I actually mean something rather precise. Why is history so interesting?
YM : Tell me!
UP : Human nature is essentially the same throughout history, but the circumstances it finds itself in are very different. Our humanity being the same we are able to identify with the actors of the past and thus to engage ourselves in their struggles which become fascinating as they take place in exotic surroundings. Without this identification we would not be able to care.
YM : That is true. Go on!
UP : And what is history about?
YM : You seem very excited.
UP : I am. Do you know of the British historian Collingwood?

YM : No, tell me about him!

UP : According to Collingwood history was the reconstruction of the past into the context of the present. In particular he stressed that above all it was about the reconstruction of past thought. He inveighed against the prevailing tendency of so many historians to cut and paste, to simply regurgitate what had already been written about the past. To me Collingwood makes historical research into a scientific discipline in the sense that it starts by asking questions and considers everything as potential evidence. In fact very much like a forensic investigation. And just as a witness may lie, historical documents may to, and thus we should never take them on face value, and instead try to interpret them. But of course the humanistic element which separates human history from natural history and the natural sciences, is the reconstruction of thought. By studying Euclidean Geometry we are also able to relive the thoughts of the ancients. This is what I mean by 'direct touch'. Nothing is more intimate than sharing a thought.

YM : This is what I tried to convey by emphasizing the role of friendship in mathematical collaboration. And also what makes the history of mathematics so exciting. A true history of mathematics should not be a dry catalogue of facts but a delineation of how mathematical ideas evolve, and as you say, allow you to participate in the thought processes.

UP : As you as a mathematician can identify with. Mumford has recently been engaged in historical work. He told me that he found his history colleagues so cautious not to say pedestrian in their approach. They were constantly warning him against jumping to conclusions and thus commenting the cardinal sin of anachronism. To ward of the latter is of course a professional duty of historians, but yet once you engage in the mathematical reasoning of the past you cannot but identify with it and thus go beyond what accidentally happens to be documented. To abstain from this option is to clip your wings and close the door to any deeper historical understanding. The documentation of the past is fragmentary indeed, but this should serve as an invitation to indulge your imagination, rather than an obligation to turn it off.

YM : A mathematician is more capable of writing the history of mathematics than a historian. I remember André Weil lecturing on this subject at the ICM at Helsinki. What he wrote reminds me very much what you tell me about Collingwood.

UP : If a historian does it the danger is indeed that it degenerates into mere cutting and pasting. I am happy that you reminded me of Weil, I had forgotten about his paper. I should read it again with my more mature hindsight. And a final point, history can never be accurate, just as science is always tentative. History will always need to be rewritten, that is what Collingwood means by the phrase 'the past reconstructed in the present'. Caution alone gets you nowhere.

YM : But what you say about mathematical insights being given in a flash is not really accurate. The examples you refer to are exceptional, most of our mathematical knowledge come from long chains of deductions as you have already indicated.

UP : This is really true, and I think that this is a point on which outsiders, which in practice means philosophers, not really get when they think of mathematics as a formal game in which truth is rigid being deductively anchored. My point is that personal conviction does not stem from the long chains or reasoning, how easy is it not to overlook or go astray, but from the

way our results mesh with other results and even throw light on them. Mathematics is a web and it is its interconnectedness that reassures us about its soundness. I would like to invoke Popper in this context.

YM : How exactly?

UP : Falsification. When we test the validity of a mathematical result we also reason forward to see whether it contradicts anything we already know. In other words we subject it to attempts of falsification. Often a string of arguments seem flawless but then they nevertheless lead to a contradiction.

YM : I know. Every mathematician has this experience. In fact often.

UP : It is only when you have it that you know that you are seriously engaged. You are then forced to look at them very carefully, in a sense it is not that different from identifying a bug in a computer code. Eventually you resolve it.

YM : You cannot rest until you have come to a resolution. A mathematician cannot live with contradiction. But I see your point, had you not been aware of the contradiction you would not have discovered the mistake in the reasoning.

UP : And making mistakes is not only regrettable it is inevitable and without making mistakes we would learn nothing. It lies at the very core of living and discovering. By the way do you think that the classification of sporadic groups is complete? Would it not be wonderful if a new one would be discovered? The world would be a richer place.

YM : It is true that the proof, a collective effort indeed, is so complicated and extensive that no single individual can have an overview of it, let alone check to his or her satisfaction every detail. This bothers Jean-Pierre Serre I know. He refuses to see it as established as long as the proof is still under revision and new snags are continually discovered if resolved.

UP : Yes it is believed that all the gaps are indeed in principle fixable.

YM : But this bothers Serre. As long as there are gaps, the case is not yet closed, and potentially there will exist other groups. But Serre is I think exceptional in wanting to command every step in a mathematical proof. Most people do no usually entertain such ambitions, and as the proof of the classification of simple groups shows, such ambitions are no longer feasible for individuals, not even Serre. Instead we are going to be forced to take things on faith. Mathematics is after all a collective enterprise and I would even think of it as a brotherhood. This idea appeals to me very much as you may understand.

UP : Yes Serre is probably exceptional, being able to see in a flash a far longer chain of arguments than we do. But of course he has a point, unless a result is firmly anchored in deductive reasoning, as the philosophers claim, it is not secure. Deductive reasoning provides an objective measure which we should not easily discard. But when mathematics becomes more complicated I fear it will change into something else, and here I have to be careful and state precisely what I mean.

YM : Yes do. I am very curious.

UP : I think that one should make a clear distinction between mathematics per se and the human activity of doing mathematics. This distinction is crucial to a mathematical Platonist.

YM : Of which you are one?

UP : Yes. Non-platonists do in general not make a distinction between human mathematical activity and mathematics as such. They find such a distinction not only naive but senseless.

YM : It is hard to argue against their position.
UP : Yes, by the very nature of the discourse, and I agree that we are entering on theological turf. My point is the obvious, that when mathematics become more complicated, it changes the human activity of doing mathematics. Mathematics will appear more like biology to its practitioners. Mathematics on a relatively simple stage is very much accessible to the human mind. It engenders in us feelings of understanding and beauty, which are by the way intimately linked. Understanding and beauty do not belong to mathematics per se, it is part of our conception of mathematics.
YM : You mean that mathematics will become ugly and opaque?
UP : Not necessarily. But I suspect it will appear more ad hoc, just as the biological world.
YM : It will become more of a science.
UP : That is perhaps a better way of putting it. It might be very exciting, but perhaps it will no longer attract people with classical mathematical abilities or should I say temperaments.
YM : I think that you are a bit pessimistic. As I have already pointed out there is always room for l'art pour l'art, what do you say in English?
UP : You use the French of course 'Art for the sake of art' does not have the same symmetric ring to it.
YM : Good. There will always be classical type of mathematics. Do not worry.
UP : I do not really worry. Although I believed when I was very young, and had only very limited experience, that everything in mathematics had been discovered.
YM : This is a very common conception of mathematics, in fact fostered and even encouraged by the classical school-curricula.
UP : Then I worried that all the easy things had been discovered in mathematics and regretted that I had not been born earlier in history.
YM : And been dead by now.
UP : In a way this is a worry which in a slightly generalized form haunts many contemporary students of mathematics. Are there still exciting areas of mathematics which are accessible without years of study and do not necessitate learning large technical apparatus. When dynamical systems and iterations were revived in the late 70's I got very excited. I particularly remember a talk at Columbia given by Douady, It seemed to be a new exciting area which you could enter without having to know so much. And the existence of one such area implied the potential existence of others. It was reassuring.
YM : I guess what you are after is fresh areas of mathematics which you can still master with flashes of insights.
UP : This is the charm of elementary mathematics, you can fully understand it on all levels, and it revives your own original joy of discovering mathematics, a joy which can be lost when the subject becomes too technical and tedious.
YM : You are talking about nostalgia. But this is one of the virtues of applications, seen from the view point of the pure mathematician, namely pointing out unexpected avenues of mathematical inquiry. As to myself I have often changed fields, as I have told you, and by changing fields I have relived over and over again the fresh joy of this youthful discovery of mathematics you refer to.
UP : It seems almost too good to be true.

YM : Yes, it is almost too good to be true. But that past statement is only almost. It is true. But to return to the issue of popularization, which is really a question not so much of mathematical instruction as to make people see and appreciate the beauty and fascination of mathematics.
UP : This is very hard as we agreed, especially if you are immune to the beauty of a simple mathematical argument. I was told by Illusie and Villani about a current exhibition on mathematics at Cartier. Illusie thought it too flashy.
YM : I do not know, I have not seen it. But I can report from maybe a similar spectacle. I was recently asked to participate in an event combining mathematics and psycho-analysis. The psycho-analyst is Daniel Sibony. I admire him.
UP : This seems potentially a very exciting combination. There are people who think that we may unearth the secret of mathematical thinking. But I suspect that this was not what is was all about.
YM : I agree that the combination is intriguing. By the way did you know that the father of one of my collaborators - Guido Weiss, was a psychoanalyst? Indeed Eduardo Weiss was a friend and a collaborator of Sigmund Freud.
UP : Why should I know?
YM : You never know. More interesting though was that he appears as a character in Italo Svevo's book 'Confessions of Zeno'. Do you now the book?
UP : The one in which the protagonist Zeno tries to quit smoking?
YM : Exactly. A wonderful book. I have read it many times.
UP : It is hilarious. I could not stop laughing. I should read it again.
YM : And not only that. Another of Weiss relatives appears also as a character. The book is really a family Weiss saga in disguise.
UP : It is striking how often characters in novels are drawn from real life. Naively one would think that the authors just make them up from scratch.
YM : I love novels. I have read the novel 'Life and Destiny' by Vasilij Grossman five times. I almost feel as a character in that novel.
UP : I am going to make you into a character.
YM : A foolish one I fear. But I do not really mind. But please show some discretion as to what you reveal. It is one thing to say something, quite another to write it down.
UP : The printed word has such authority.
YM : And it is isolated from a context. A conversation is a true context in which you can properly judge what somebody is saying, not only by the factual words used, but more importantly by the tone of voice, the facial expression, gestures, and above all the flow in which the statement is being made. As printed all of that is absent, and the words can be taken out of its textual context as well.
UP : I will be careful. But I must admit that I am getting lost.
YM : I am not lost. We were talking about mathematics and psychoanalysis, or more accurately I was going to reveal to you what I brought up to the audience. Daniel Sibony and I were discussing in front of an audience of a hundred people who were not mathematicians. The theme of the discussion was to know in what sense mathematical objects exist.
UP : What did you bring up?

YM : I was trying to convey the essence of mathematics.
UP : That is very ambitious.
YM : You have to be ambitious, but you can be very modest about it anyway. I brought up the Platonic Solids and impressed the audience with its long history, and then I brought them up to date by invoking the classification of finite simple groups.
UP : They are very much in the same tradition. One one hand in mathematics we have general facts, about functions, varieties, numbers etc in general; on the other hand we have those very special but rich structures, each with their own individuality, and which seems to be amenable to an almost inexhaustible study.
YM : Those special structures are like gifts from heaven. It would indeed be wonderful, as you suggest, would we have overlooked a simple group.
UP : You have already mentioned the visual satisfaction that Euclidean geometry provided. Do you think of yourself as a visual person, in other words do you like pictures in general and do they play an important role in your mathematical thinking?
YM : I love the book by Agn‘es Desolneux and David Mumford on pattern recognition. Do you now it? I reviewed it for the EMS Newsletter. Have you seen the review?
UP : No I have not. I must have missed it, but of course I can readily get a copy. What about music? One always hears about the special affinity mathematicians are supposed to have with music. It is a very nice and somewhat flattering idea, but I fear it is essentially romantic. Of course there are some formal mathematical connections, but those I think are superficial.
YM : I love music of course. But I never learned to play an instrument. My parents were too poor. But later in life I have listened to a lot of music. Mostly classical, but I am not a snob, some folk-music, especially from South America has moved me deeply. In fact I hold some of it on the same level as the very best in classical music.
UP : When it comes to art I usually have no problem identifying the painter even if I have not seen the particular painting before. In music it is very different, even pieces which seem very familiar to me I have a hard time identifying, and I would consider it beyond my power to identify the composer without first knowing the piece.
YM : I have no problem with that. I need only to listen to a few movements and I can recognize a Mozart. It comes of course from having listened so much.
UP : I always have detested popular music. Singing and listening to popular songs, which seems to be so important to most people left me cold. However, I have always had a liking for classical music, which I have attributed to snobbism. Both mathematics and classical music are part of a sophisticated culture and I suspect that much of the fascination of mathematicians for predominantly classical music is a result of this connection. In other words it is a matter of taste rather than genuine passion. However, when I was a teenager there was a radio program that was introduced by a piece of music which I found very nice. I remember thinking that pop music could indeed be quite nice. Many years later I encountered the same piece again and it turned out to be by Bach.
YM : That is very funny. You seem not to be entirely un-musical after all.
UP : That is what I like to think. It could be that only one in ten, or some such fraction, is what we call tone-deaf, and I might not be at that low level, only almost. But I think

that one should make a distinction between musical ability and the ability to be emotionally moved by music. Intrinsic mathematical ability manifests itself early and clearly, I mean on the level of picking up arithmetic naturally, not be stymied by completion of squares, as we have been mentioning, and seeing a proof in Euclid being able to reproduce it immediately, just as I believe some one with musical ability can repeat a melody once heard, because it has been 'understood'. But having basic mathematical ability is as little of an indication of becoming a real mathematician as musical skills makes you into a composer. My point is that you can appreciate music on the emotional level without understanding it as music. While with mathematics you have to understand in order to appreciate, there really being no equivalent of an emotional reaction. This points to a fundamental difference, I think, between mathematics as an art, as we all tend to view it, and art in the more traditional sense. This does not mean that I disqualify the artistic element in doing mathematics, personally I think much of it would not be understandable without it, only that it has to be qualified.

YM : There is music in poetry too. Mallarmé raised to a religious level 'L'art pour l'art' which we have referred to repeatedly during our conversation. He wanted to create a pure poetry of sound and shorn off any meaning. I think this is impossible. Great poetry is not a formal exercise in word music, it is above all an expression with meaning. The musical beauty is a side effect, an extra bonus if you prefer.

UP : Great poetry is not written with a conscious adherence to meter, I believe. The poet is probably unconscious of following a meter. It reminds me of Leibniz suggestion that music is subconscious counting, which many people have confused with mathematics,

YM : In particular during times of crises great poetry is written. Strong emotions are around and need to be expressed. I am thinking in particular of France during the War and to the poem 'Liberté' by Paul Eluard.

UP : Yes tell me about the war. I belong to the generations born after the war in the western world, and have thus had a cosseted existence, known nothing but increasing affluence, and in particular been spared the traumas of history. Admittedly I grew up in the shadow of the Cold War and the threat of nuclear annihilation, believing that the end of the world was imminent and that I and my contemporaries would never experience adulthood; but of course those fears were abstract and in principle not different from religious hysteria. When it came to quotidian existence they had no effect. The tremendous changes in daily life brought about by technology and which transformed the lives of our grandparents had no parallels in our lives, save possibly the advent of the personal computer.

YM : I see what you mean. Take the case of my friend Coifman's parents and their escape from Eastern Europe via Turkey and their emigration to Israel having lost everything and having to start from scratch. Those kinds of dramatic stories were common. They surely must make an impact on you. My own experiences of hardship are modest in comparison. I spent the war years in Paris with my parents.

UP : You were born 1940

YM : No, I was born in 1939, but still it was during the pre-school years. As a child I was of course protected from the awareness of the situation, but also the population in general was shielded from what was really going on. I of course had no idea of what happened to the Jews. Those operations were taking place at night for fear of popular demonstrations.

UP : I guess it was similar in Germany itself. The authorities knew that what they were doing was shameful, and acted surreptitiously.
YM : It became only really dangerous during the Liberation. I mean to us who were not Jews and in addition like the majority of the population kept a low profile. True, at the very end there were widespread starvation as Germans allocated as much food as possible to their own resources, but on the other hand if you had some connection with the countryside you could get by, or in case you were rich, there was always the black market. I think it is also noteworthy that the Americans flew very high when they bombed, just as they did in Vietnam, to avoid danger to themselves, while the British dared their lives and flew very low when they dropped theirs, and hence were more accurate.
UP : Causing less collateral damage as it is termed.
YM : Exactly.
UP : So ironically the Americans caused more havoc than the Germans.
YM : The Vichy regime used the same words. Casualties occurring in these huge bombings were inevitable, and we are of course very grateful to the Allies for the Liberation.
UP : What about anti-German feelings?
YM : My parents came from Alsace. My father from Strasbourg itself and my mother from Mulhouse. They had a high regard for German culture. And so had many others. Churchill for example, at one point it seemed as if he actually preferred Hitler to a Communist alternative.
UP : Churchill was an imperialist and very conservative. Bertrand Russell had a very high opinion of Germany too. In fact he thought that it would have been better that Germany had won the First World War than the Allies. He thought of it as a more liberal society. In retrospect he was right.
YM : There would have been no Hitler had that happened.
UP : Most likely not. But that is the basic weakness of counter-factual history. Had it occurred we would have had no inkling of what we would have missed. There simply could have been no talk about, 'at least we had no Hitler'.
YM : That is very true. Orwell too did not believe in the extermination camps, he thought that it was just propaganda.
UP : Orwell wrote that anti-German sentiment was much more virulent during the outbreak of the First World War than at the beginning of the Second. He also wrote that during the First World War the British had come to admire the Germans and despise the French.
YM : I read that too. In fact I read through the collections of Orwell's writing, I mean his journalism, diaries and letters.
UP : So did I in the late seventies. They made quite an impression on me. The hysterical anti-German propaganda during the First World War had the unfortunate effect of immunization. We should not judge too harshly those who in the 30's underestimated the German danger. Not in order to ameliorate but to critically ask ourselves what similar mistakes are we liable to make in the future. That is an example of what learning a lesson from history means.
YM : Very true. Hindsight is easy, the real challenge is to apply it to the future. To me the real trauma was the Algerian War as I have already told you. There is a saying in English 'My country, right or wrong' I do not believe in it.
UP : It is actually a title of one the volumes of Orwell you referred to earlier.

YM : Yes, I know. It definitely is not my attitude. France behaved shamefully.
UP : It is interesting that France built up most of its colonial empire after the Napoleon bubble burst.
YM : Yes, starting with Algeria around 1830 I believe. Algeria, unlike Morocco or Tunisia, was actually an integral part of France, a departement. That made for troubles later. There are two ethnic groups in Algeria you know.
UP : No I did not.
YM : There were the original Kabyles, mostly living up in the mountains, and then the Arabs who came later. During the War of independence (1954-1962), Kabylia was one of the areas most affected, because of the importance of the maquis (aided by the mountainous terrain) and French repression. Several historic leaders of the FLN came from this region, including Hocine Aït Ahmed, Abane Ramdane, and Krim Belkacem. After independence some of the Kabyles had to leave for France which looks paradoxical since they previously fought against France. Indeed Kabyle leaders were not given the credit they deserved and the Tamazight/Berber language was not recognized by the new rulers of Algeria. Many Kabyles and Arabs who left their home country and emigrated to France never became properly integrated and harbor a lasting resentment, not to say hatred towards the French. It is a social problem that festers still fifty years later. One of my graduate students, Ali Haddad, is a counter-example to what I am saying.
UP : The French have still not properly come to terms with the Vichy years, nor have they made proper amends for the Algerian war. It is still a wound that has not healed and has been reopened recently. I have with some regret referred to my own pampered upbringing. Such induces a romantic view of the past.
YM : Especially when it comes to the environment. To the environmentalists the past is somewhat of an Eden, relatively unspoiled by man. But they forget the misery that life in the past necessarily involved. Take such a simple fact that in Paris a hundred years or so ago people died from cholera en masse, because their drinking water was taken directly from the Seine. If you were rich you had access to springs, otherwise.
UP : This is not usually what we think of when we imagine a turn of the century in Paris. Scenes of glamour and gaiety come to our minds and we are sorry we were not present during those glorious times.
YM : Had we been we might have been dying from cholera miserably stacked away somewhere out of sight to be forgotten by history.
UP : Much as I sympathize with the environmental movement I cannot deny that there is a strong proto-fascist streak in it. It is basically a quest for purity, or at least this is its ideological edge. This does not mean that you have to discard it...
YM : ...the alternative are worse, I admit...
UP : ...but simply that you have to live with it and be aware of it. It is not the case as in mathematics that true things reinforce one another, in real life good things are often at odds with each other. As Isaiah Berlin observed. Liberal values often contradict each other. I referred to the threat of a nuclear war earlier, this fear has now been replaced by the threat of global warming. I see it as a way of focusing a general environmental Angst concerned with the human impact on our world,

YM : I have consulted the G.I.C. I think that they take a very fair view of the issue, which I think has been turned too quickly into a political one.
UP : Some of my colleagues are very concerned about it, others take a more skeptical attitude, I guess you are somewhere in the middle. There seems to be a large consensus as to its urgency, but it is based on conservative thinking in the sense that if it is true, actions have to be taken before it becomes confirmed. When confirmed it will by definition be too late. As a theorem the 'proof' contains many gaps, a very crucial one pertaining to models for cloud formations. Pure Mathematics is in a very real sense timeless, we can always wait for theorems to be proved. In real life we seem not to have this luxury.
YM : We have come a long way from mathematics.
UP : But we can always go back to it. You have had some ties with Swedish mathematics?
YM : Swedish mathematics has a very strong tradition in analysis. PDE of course, but perhaps even stronger in harmonic analysis...
UP : ..which is closer to your main interests?
YM : You can say that. But as you should understand by now I feel quite at home in much of analysis. In fact I was invited to be an opponent at a doctoral defense in Lund once. In Sweden they have the tradition that the opponent gives a long survey on the work of the candidate before getting down to asking questions.
UP : I think it is an excellent tradition. It is particularly very good to the candidate, it must be gratifying indeed to have had somebody reading through your work carefully and seriously, and then, by virtue of greater experience present it from a higher point of view, to paraphrase Felix Klein. The candidate can learn a lot from it.
YM : But it is tough on the opponent. In my case it was even tougher because Hörmander was in the audience.
UP : That must have been very intimidating. He is like Serre intolerant of any mistake, and he is sure not to miss anyone.
YM : He is very impressive.
UP : I recall my one meeting with Andreotti. It was at the famed AMS Summer school of Algebraic geometry at Arcata in 1974. I found myself with the Italian and a young fellow student taking a walk in the woods. When you ask Hörmander something, Andreotti told us, you pay very careful attention to what he answers. I remember I was very impressed at the time. Andreotti was a hot-shot in geometry and he presented himself as almost a child in the presence of Hörmander.
YM : Yes, Hörmander has this effect on you. A most impressive mathematician.
UP : But there are surely other Swedish mathematicians you would care to comment on?
YM : Of course. Lennart Carleson. I am a simple human being and Lennart is God. Lennart Carleson is, without any doubt, the deepest living analyst. He solved three of the most difficult problems in mathematics, paving the road to crowds of followers (I am one of those). These three problems are (a) The Corona problem whose solution led Carleson to introduce a new concept which is named "Carleson measures" by everyone. (b) The almost-everywhere convergence of Fourier series of square integrable functions. This problem has been for analysts what is climbing the Everest for alpinists. Carleson solved the problem and his attack is so deep that his work has received a considerable attention in mathematical

physics. G.Gallavotti understood that Carleson's proof could be rewritten in the language of phase-space analysis which is seminal in quantum mechanics. Gallavotti's program was completed by Raphy Coifman and his team. Raphy Coifman unveiled the "time-frequency atoms" which were implicit in Carleson's proof. (c) Understanding the Hénon map. This beautiful piece of mathematics answers some of the most important and difficult questions about dynamical systems, chaos, strange attractors,... What is amazing in Carleson's work is the fact that his work is always so far ahead from the crowd. He is only interested by the most difficult and deep problems. Once solved, he is letting other people invade the kingdom he has discovered and, in a superb loneliness he is moving to even wilder and more remote countries in Science.

UP : Those formulations strike me as very familar.

YM : There is a good reason for that, but let us not dwell on it. Lennart Carleson brought a lot of goods to mathematics in Sweden and all around the world. He ran the Mittag-Leffler Institute in a marvelous way. Talking to Lennart is always pleasant, inspiring and fruitful. These remarks about Carleson lead me to Sweden, a country I loved visiting. Many of my visits happened when a ruthless Pinochet was ruling Chile. Many Chilean opponents found a new home in Sweden. I was staying at the Mittag-Leffler Institute but sometimes I was taking the little train to Stockholm. I was overwhelmed with the beauty of the city. Among other things I was happy to buy a bottle of wine at Systembolaget. And sometimes I could meet a Chilean refugee there. Sweden was and remains a model of what is named Social Democracy, a model which was despised by the French communists, a model I admire so much.

Abel Prize 2017 to Yves Meyer

Jan-Olov Strömberg

1 Introduction

The Norwegian Abel Prize Committee has decided to give the 2017 year Abel Price to Professor Yves Meyer. First I want to give my warmest gratulation to Professor Meyer, but also to the whole mathematical field Harmonic Analysis. There are many mathematicians in the 1980'th and the 1970'th and even earlier and later who have contributed to the development in this field of mathematics leading to the wavelet theory, nobody mentioned, nobody forgotten, included myself. Also several persons with the background from signal processing have contributed to this. But in all of this Yves Meyer has been a central figure, with key collaborators both inside and outside the mathematic sphere of pure mathematic. He formulated the right concept at right time. Meyer has developed a solid wavelet theory and made to it the big success, especially in signal and image processing.

The year was 1985, or maybe the year before, when Meyer formulated the concept of the *mother wavelet* $\psi(x)$ with the property that its set of *siblings wavelets* $\{\psi_{kj}\}_{k\in\mathbb{Z},j\in\mathbb{Z}}$ is an *orthonormal basis*

$$\psi_{kj}(t) = 2^{j/2}\psi(2^j t - k).$$

He also constructed an example of a smooth mother wavelet with this property. The concept of smooth orthonormal wavelets became a big success. The applications of the wavelet theory showed up in very many different areas and became a veritable boom. For instance the network magazine Wavelet Digest, with thousands of subscribers, were showing applications of all kinds and many different variations of wavelets were constructed.

Before continuing, the reader might consult the Appendix at the end of the article for some notations and definitions.

2 What are wavelets about

Given a function (or time signal) f, we may study it with respect to the space location (time), or also with respect to its frequency content using its Fourier transform, but often both time and and frequency at the same time. One way is to split the given function f into pieces, building block ψ_{kj}, where the indices k and j are time respectively frequency parameters. We then write $f = \sum_{kj} c_{kj}\psi_{kj}$. If, in addition, the set of all building blocks form an orthonormal basis, the the coefficients are easily computed by inner products: $c_{kj} = \langle f, \psi_{kj}\rangle$. In real applications there may be very many building blocks (literally thousands or millions), so we need a good structure in order to describe ψ_{kj} for all values of the indices k and j.

1. ψ_{kj} have good localization in time parametrized by the integer k parameter.
2. ψ_{kj} have good localization in frequency parametrized by the integer j parameter.
3. the set of all $\{\psi_{kj}\}_{k,j\in\mathbb{Z}}$ forms an orthonormal basis.
4. there is an easy structure describing ψ_{jk} for all integer values k and j.

3 Can this be accomplished - and how?

Compromises are needed. If we just look at point 1 och point 2 we know that the best localization both in time and frequency are given by Gaussian function $g(t) = \mathrm{e}^{-\pi a t^2}$ with Fourier transform $\hat{g}(\xi) = e^{-\pi\xi^2/a}$, for any positive constant a . Imposing a structure on this we get the Gabor basis $g_{kj}(t) = e^{i\pi at}g(t - bk), k, j \in \mathbb{Z}$, for suitable positive constants a and b. However, this is not an orthonormal basis.

I think the wavelet structure wave motivated by the Calderon's identity for functions on the real line. But let us first go back to the Hardy spaces with harmonic and more general extension $f_\varphi(t, y)$ of functions on the real line to the upper half space. Let φ be a smooth function on the real line, $\int \varphi(x)dx = 1$ and $\varphi_s(x) = \varphi(x/s)/s, s > 0$ be the approximation of the identity and define the extension of the function f on the real line to the upper half-space by

$$f_\varphi(t, s) = \int_{\mathbb{R}} f(x)\varphi_s(x - t)dx \text{ for } t \in \mathbb{R}, s > 0.$$

The value of $f(t)$ can be obtained as the limit of $f_\varphi(t, s)$ as s goes to zero. Another half-space formula is the Calderon's identity. We now assume that $\int \psi(x)dx = 0$ and decaying fast enough at $\pm\infty$ and we use the L^2 - normalization and write $\psi_s(x) = \psi(x/s)/\sqrt{s}$ and define the continuous wavelet transform of f by

$$W_\psi f(a, b) = \int_{\mathbb{R}} f(x)\overline{\psi_b(x - a)}dx, a \in \mathbb{R}, b > 0.$$

Then the Calderon's identity says that

$$\int_{\mathbb{R}} f(t)\overline{g(t)}dt = C_\psi \iint_{a\in\mathbb{R},b>0} W_\psi f(a, b)\overline{W_\psi g(a, b}\,\frac{da\,db}{b^2},$$

where the constant $C_\psi = \int |\hat{\psi}(\xi)|^2/|\xi|\,d\xi$. This lead to the continuous wavelet representation of f:

$$f(t) = C_\psi \iint_{a\in\mathbb{R},b>0} W_\psi f(a, b)\psi_b(t - a)\frac{dadb}{b^2}$$

Note that here the Fourier transform is zero at the origin and goes to zero at infinity, so if we assume that the Fourier transform is mainly concentrated in a set $c\langle|\xi| < C$, then the parameter b will regulate the frequency content of ψ_b, and the parameter a will be a time space localization parameter.

Now we can discretize the double integral by approximating the measure by a double sum of Dirac's at points $\{(kab^j, b^j)\}_{kj}$ in the half space:

$$f(t) \approx C_{\psi,a,b} \sum_{k,j\in\mathbb{Z}} W_\psi f(kab^j, b^j)\psi_{b^j}(t - kab^j)$$

with constants $a > 0$, $b > 1$ and $C_{\psi,a,b}$. If the mother wavelet $\overline{\psi}$ is used as mother wavelet b and the in constants above are chosen $a = 1, b = 2$ the formula above reads

$$f(t) \approx C_{\psi,1,2} \sum_{k,j\in\mathbb{Z}} \langle f, \psi_{kj}\rangle \psi_{kj}(t),$$

where the wavelet siblings $\psi_{kj}(t) = 2^{j/2}\psi(2^j t - k)$. This motivates a wavelet structure with the mother wavelets and its siblings. If in addition the point 3 above holds, i.e. that the the set of all $\{\psi_{kj}\}_{k\in\mathbb{Z},j\in\mathbb{Z}}$ forms an orthonormal basis, then the approximation above is an equality with the constant $C_\psi = 1$

4 Examples of mother wavelets with orthonormal siblings

The question that Meyer raised was: *Does there exist smooth mother wavelet functions such that the set of its siblings* $\{\psi_{kj}\}$ *will be an orthonormal basis?* There are some trivial examples:

1. The most well-known orthonormal basis with wavelet structure in the field Harmonic Analysis is the Haar basis from 1910. It was originally defined on a bounded interval. But the basis can trivially be extended to an orthonormal basis to the real line. The mother wavelet is
$$\psi(t) = \begin{cases} -1 \text{ for } 0 < t < \frac{1}{2}, \\ 1 \text{ for } \frac{1}{2} < t < 1, \\ 0 \text{ otherwise.} \end{cases}$$
The Haar basis has a very good time localization, but it is not continuous. Its Fourier transform decays slowly: $|\hat{\psi}(\xi)] < c|\xi|^{-1}$.

2. In the Signal Processing field the Shannon low-pass band-filter S is well-kown and is defined on the Fourier transform $\hat{S}$ to be 1 on the interval $[-1, 1]$ and 0 otherwise. The related Shannon wavelets have their mother wavelet b defined by its Fourier transforms
$$\hat{\psi}(\xi) = \begin{cases} 1 \text{ for } \frac{1}{2} < |\xi] < 1, \\ 0 \text{ otherwise.} \end{cases}$$
Thus the Shannon mother wavelet has compactly supported Fourier transform, but very bad time space localization: $\psi(t) = c\sin(\pi t/2)\cos(3\pi t/2)/t$.

These two examples are the extremes in the compromise between good time versus good frequency localization. Before we go on with further examples, we will look at some negative result.

5 Some restrictions of what is possible

It is not difficult to show that if the mother wavelet b is C^∞ than it cannot decay too fast.

Assume that ψ is exponentially decaying at infinity, i.e $|\psi(t)| < C\mathrm{e}^{-\epsilon|t|}$ for some constants C and $\epsilon > 0$. Then the Fourier transform $\hat{\psi}$ can be extended analytic in a in a complex strip $|\mathrm{im} z| < \epsilon_1$ for some $\epsilon_1 > 0$. From this we conclude that $\hat{\psi}$ only can have a zero of finite order $0 \leq m < \infty$ at $\xi = 0$ and hence the m-th moment of b is non-zero, i.e $\int \psi(t)t^m\, dt \neq 0$.

But we can show the following:

If a mother wavelet ψ of an orthonormal wavelet system has an open interval I_{t_0} around a point t_0 where the m-th derivative $D^m\psi$ is continuous then either $D^m\psi$ is constant zero on that interval or the m-th moment of ψ is zero.

We give that as an exercise for the reader.

Hint: Expand $\psi(t)$ in an m-order Taylor series. Calculate the integral for the inner product $< \psi, \psi_{kj} >$ where ψ_{kj} is a sibling in very small scale focused at the I_{t_0}. With a careful estimate of the m-th order Taylor remainder term it is possible to show that the orthogonality condition is violated for unless both $D^m\psi(t_0)$ and the m-th moment of ψ are non-zero.

The conclusion is that only the following two cases of mother wavelets can occur:

1. The mother wavelet ψ decays at least exponentially and has at most m times continuous derivatives, for some $0 \leq m < \infty$, or ψ is discontinuous.

2. The mother wavelet ψ does not decay exponentially and has infinitely many or less continuous derivatives.

6 Examples of orthonormal spline wavelets

However, some other known not so trivial examples of orthonormal basis systems turned out to fulfill Meyer's concept generated by single mother wavelets:

For any positive integer m there is an orthogonal wavelet spline system on the real line of order m, consisting of functions which are piecewise polynomials of degree m and with has $m-1$ continuous derivatives on the whole real line.

These orthonormal spline bases were introduced by myself at a conference in Chicago 1981.

Let us look at the case when $m = 1$. Then the wavelet basis is a modification of the Franklin system of piecewise linear continuous functions on a bounded interval, from 1927. The box-splines of order 1 look like tents Λ, supported on two minimal subintervals. At the boundary the box-spine is only one half of such a tent. The the set of box-splines of all scales spans up a dense subspace of function in L^2 and for each scale of subintervals the set of box-splines will be a basis of a subspace of function, however not an orthonormal basis. Thus an process of normalization is needed to create an orthonormal basis in L^2. In the case of

the Franklin system on a bounded interval one uses the Graham-Schmidt orthogonalization process, increasing the subspaces piecewise linear function with one dimension at the time by splitting one of the largest subintervals into in the middle by adding an extra node - in order from right to left and and at each step orthogonalized the new tent supported on the new subintervals against the subspace of function as it was before this step.

This calculation looks rather messy. It was at a seminar at Stockholm University 1980 about the construction of the Franklin, system, that I observed that all calculations will be much simpler if the boundaries were removed. Then there will be no largest scale, were to start the Graham-Schmidt orthogonalization process, and at each scale there is no beginning nor an end. However, each step look exactly the same as the others. You can by changing the scale by 2^j and than translation by integer k get to the case when you split the sub interval $[0,1]$ into the two subintervals $[0,\frac{1}{2}]$ and $[\frac{1}{2},1]$. From this you can directly conclude that the orthogonalized elements have exactly the same shape following Meyer's concept of the mother wavelet and its siblings. To calculate the node values of is not more difficult than could be done in a first year for undergraduates. One will get an exact expression for the values of the mother wavelet of this modified Franklin system at all node points. The orthogonalization causes two oscillating tails going out from the new subinterval with geometrically decaying node-values. The geometric factor is $r = \sqrt{3} - 2 \approx -0.28$.

Mother wavelets of higher spline order can in principle be calculated in a similar way. In the m-th order spine wavelet system case the mother wavelet will be a linear combination of $2m$ oscillating tails with diffent the decay-factors r. Here r is the $2m$ roots of the $2m$ degree linear equation using as constants the $2m+1$ non-zero node-values of the $2m+1$ order box-spline.

7 The classical orthonormal spline systems as approximative wavelet systems

One can easily get back the classical Franklin systems on a bounded interval from the Franklin wavelets on the line, by introducing the boundaries again. The the decaying tail will be reflected back toward the new subinterval again. This perturbation is extremely small away from the boundary and the two linear equations that regulate the combination of the new tent and the tail will be perturbed but very little. Yet even in this case all node-values can be described with an exact description

The classical higher order orthonormal spline system can also be obtained in a similar way. However, the reflection at the boundary will be somewhat more complicated: probably into a linear combination of tails.

The relative size of the perturbation decays very fast so it can be neglected a few nodes away from be the boundary. In the case of the Franklin system we have the decay factor $r = \sqrt{3} - 2$. Moving away from the boundary, the reflected tail decays while the original tail increases with the same factor. Thus the relative error i.e the perturbed/unperturbed node-value decays with a factor $r^2 = 7 - 4\sqrt{(}3)t = 0.0717\ldots$. At the distance 6 nodes away from the boundary the relative perturbation is $1.369\cdots\times 10^{-7}$ i.e. less than the single floating

point precision. At the distance 14 nodes away from the boundaries the relative perturbation is $9.6709\cdots \times 10^{-17}$ i.e less than double floating point precision. There is also a relative perturbation error caused by the renormalization after the reflection and this is of magnitude less than r^{2l_0} where l_0 is the distance in nodes from the the boundaries.

Thus we cannot distinguish the classical orthonormal spine systems from a wavelet system with a mother wavelet ands its siblings in a computer, using normal floating point arithmetic, provided we stay at a few nodes distance from the boundaries.

8 Meyer's wavelet construction

Meyer used a different approach. He studied the mother wavelet and her orthonormal wavelet siblings on the Fourier transform side. Because of scale and translation invariance it is enough to consider the inner products $\langle \psi_k 0, \psi_0 j > k \in Z$ and j non-negative integers. Consider the sums $\sum_{l\in\mathbb{Z}} \hat{\psi}(\xi - l)\overline{\hat{\psi}(2^j(\xi - l)}$, for $j \geq 0$. Since those sums are periodic with period 1, we can find their values by looking at their Fourier series coefficients when $j \geq 0$

$$\int_0^1 \sum_{l\in\mathbb{Z}} \hat{\psi}(\xi - l)\overline{\hat{\psi}((\xi - l)/2^j)}\mathrm{e}^{-2\pi ik\xi}\, d\xi = 2^{j/2}\langle \psi_{0k}, \psi_{0,j}\rangle.$$

Thus the orthogonality conditions for the wavelets siblings can be written

$$\sum_{l\in\mathbb{Z}} \hat{\psi}(\xi - l)\overline{\hat{\psi}\left(\frac{\xi - l}{2^j}\right)} = \begin{cases} 1 \text{ for } j = 0, \\ 0 \text{ for } j > 0. \end{cases}$$

I will try to recapture from memory his construction from a seminar he gave at Courant Institute, New York, more than 30 years ago. First note that the Fourier transform of the Shannon mother wavelet satisfies this condition. Meyer's approach was to smooth out the discontinuities which appear at $\xi = -1, \frac{1}{2}, \frac{1}{2}$ and 1. But how could this be done without destroying the orthogonality? The crucial Meyer trick consists essentially of two parts.

1. A special smooth cutting of $\hat{S}$ the Fourier transforms of the Shannon filter S, and the Fourier transform of the Shannon mother wavelet. This gives orthogonal wavelet siblings within each scale.

2. Multiplication on the resulting Fourier Transform by the phase factor $\mathrm{e}^{i\pi\xi}$. This is in order to get orthogonality between wavelet siblings on different scales.

First we define the function ρ to be constant 1 for $\xi \leq -\frac{1}{4}$, to decay C^∞-smoothly from 1 to 0 in the interval $[-\frac{1}{4}, \frac{1}{4}]$ and to be constant 0 for $\xi \geq \frac{1}{4}$; and in addition ρ should satisfy $|\rho(\eta)|^2 + |\rho(-\eta)|^2 = 1$. Using the function ρ the following modifications are made:

$$\begin{array}{llll}
\text{near } \xi & = 1: & \text{in the interval } [\frac{3}{4}, \frac{5}{4}] set & |\hat{\psi}(1+\eta)| = \rho(\eta); \\
\text{near } \xi & = -1: & \text{in the interval } [-\frac{5}{4}, -\frac{3}{4}] set & |\hat{\psi}(-1+\eta)| = \rho(-\eta); \\
\text{near } \xi & = \frac{1}{2}: & \text{in the interval } [\frac{3}{8}, \frac{5}{8}] set & |\hat{\psi}(\frac{1}{2}+\eta)| = \rho(-2\eta); \\
\text{near } \xi & = -\frac{1}{2}: & \text{in the interval } [-\frac{5}{8}, -\frac{3}{8}] set & \hat{\psi}(-\frac{1}{2}+\eta)| = \rho(2\eta).
\end{array}$$

With these modifications the function $|\hat{\psi}|$ will be $C^\infty-$smooth and satisfy

$$\sum_{l\in} |\hat{\psi}(\xi+l)|^2 = 1 \text{ for all } \xi = \sum_{j\in} |\hat{\psi}(2^j\xi)|^2 = 1 \text{ for all } \xi \neq 0.$$

We also see that $|\hat{\psi}(\xi)||\hat{\psi}(\xi/2^j)| = 0$ for all ξ when $|j| \geq 2$.
Finally, we will se how Meyer handled the case $j = 1$, i.e the sum

$$\sum_{l\in\mathbb{Z}} \hat{\psi}(\xi-l)\overline{\hat{\psi}((\xi-l)/2)}.$$

The product $|\hat{\psi}(\xi)||\hat{\psi}(\xi/2)|$ is zero except for two symmetric bumps around $\xi = \pm 1$

$$|\hat{\psi}(-1+\eta)||\hat{\psi}((-1+\eta)/2)| = |\hat{\psi}(1+\eta)||\hat{\psi}((1+\eta)/2)| = \rho(\eta)\rho(-\eta).$$

Meyer chose a phase factor $\mathrm{e}^{i\pi\xi/2}$ that made the contribution from these bumps in the sum cancel each other. Thus, with the Meyer mother wavelet defined by

$$\hat{\psi}(\xi) = |\hat{\psi}(\xi)|\mathrm{e}^{i\pi\xi/2},$$

he got

$$\sum_{l\in\mathbb{Z}} \hat{\psi}(\xi-l)\overline{\hat{\psi}((\xi-l)/2)} = 0.$$

Meyer's mother wavelet is C^∞ differentiable and the Fourier transform has compact support. It has infinitely many derivatives. All its derivatives decay faster than any negative power $|t|^{-N}$ at infinity but from what we have seen earlier in this article this Meyer's mother wavelet does not decay exponentially.

However it is not difficult to show that Meyer's mother wavelet cannot decay exponentially. I will discuss that below.

9 Further developments of orthonormal wavelets

Meyer's wavelet constructions created a lot of enthusiasm by researchers around him both from the mathematics side and from the signal processing field. His methods and conditions on the Fouriertansform of the mother wavelet are very general and many different versions of wavelets were constructed. With Meyer as a central person the wavelet theory was developed and a lot of applications were found. Let me here only mention that the enthusiasm heated up even more when Ingrid Daubeshies, as far as I understand, inspired by Meyer's constructions found a way to construct mother wavelets with compact support. Her constructions are based concepts from signal processing, square mirror filters, for each of her wavelet system there is a low-pass filter and a high-pass filter of finite length defining the wavelets and the computation of the wavelet coefficients and the inverse synthizeation of the function are filter procedures which are very easy to implement and also run very fast on computers. Daubeshies wavelets can be constructed to have continuous k-derivative for any fixed integer $k \geq 0$; the higher k the longer high-pass and low-pass filters are needed.

10 Time - frequency compromises of orthonormal wavelet systems

We have seen that nowadays we know a large variety of orthonormal wavelets, starting with the Haar system where the mother wavelet has small support and is not continuous and with a Fourier transform bounded by $c|\xi|$ to the Shannon wavelets with compact supported Fourier transform but Daubeshies wavelets can gradually get the mother wavelets with higher and higher order and Foureier transform bounded but in time space very badly localized, bounded by $c|t|^{-1}$ at infinity. Between those two extremes there many ways to compromise between good localization in time space and good localization in frequency space. It seems that there a two groups of localization conditions in time space that relates to two groups of localization conditions in the frequency spaces:

- A. In time space
  - Group A1. From "compactly supported", to "exponentially decaying at infinity".
  - Group A2. From "decaying faster than any negative power" to "decaying as negative power one at infinity", (not satisfying Group A1 conditions).
- B. In frequency space
  - Group B1. From "compactly supported", to "decaying faster than any negative power at infinity"
  - Group B2. From "decaying as a negative power, for a fixed exponent" to "decaying at negative power one at infinity", (not satisfying Group B1 conditions).

Between the conditions in Group A1 and conditions in Group A2 there is a gray-zone.

The examples of wavelet bases satisfying different combinations of these groups of conditions:

- Examples from combination Group A1 · Group B2: Haar wavelet , Daubechies wavelets, spline wavelets.
- Examples form the combination A2 · Group B1: Shannon wavelet and Meyer wavelets.
- The combination Group A2 · Group B2 is the weakest combination of those conditions and and examples are not be difficult to find.
- The ombination Group A1 · Group B1 cannot be satisfied by any orthonormal wavelet system.

11 Some comparison between Spline, Meyer and Daubeshies wavelets

The Spline wavelets of order 1 on a bounded interval, the Franklin system in now about 90 years old, and follows essentially the mother wavelet structure with an extremely high

precision. The modified Franklin system from 1981 is given explicitly is exact values at the node point and is linear between neighboring node points. The Daubeshies wavelets are given by very special high-pass and low-pass filter of finite length. The actual value of the Daubeshies wavelet is obtained as an infinite fast converging algorithm using those filters, the cascade algorithm. The Meyer's wavelet is given in a more general form, depending on the choice of the smooth cutting function ρ.

The Meyer filters have been of the most theoretical value and corresponding impact. The mother wavelets and their Fourier transform are both in the Schwartz Class of test functions for tempered distribution. Meyer's method of wavelet constructions has inspired many other wavelet constructions.

The Daubeshies' compactly supported wavelets have become extremely popular and have been used in many applications, because they are very simple to implement once the high-pass and low-pass filters are calculated. I have seen tables of calculated Daubeshies high-pass and low-pass wavelet filters up to length 30. However, to be very pedantic, those filter procedures are operations between coefficients spaces and most often in applications the calculation is done with the assumption that the sampled data values are the coefficients on the finest scale.

The Spline wavelets are not much harder to implement. The corresponding high-pass and low-pass filter will in this case be rational filters. Also the spline wavelet coefficients can be calculated with very fast algorithms, and most applications where Daubeshies compactly supported wavelet have been use, could probably also be done with the orthonormal spline wavelet systems. The calculation of the Franklin wavelet transform has about the same complexity as the Daubeshies wavelet transform with filters of length 4.

12 Reference-Disclaim

This article is written on very short notice, direct out of memory with no reference text to wavelets available. The readers should not take the formulas in all their details for granted, but wheneever that is of importance I advise them to check them out in the literature.

13 Congratulation!

Let me end this article by bringing my warmest congratulation to Yves Meyer to the 2017 year Abel Prize.

14 Appendix

I will here give some definitions and other thing that hopefully be clarifying for the reader.

Inner product Vi use the notation $\langle f, g\rangle = \int_{\mathbb{R}} f(t)\overline{g(t)}\, dt$.

The Fourier Transform $\hat{f}$ of a function f on a real line is given by

$$\hat{f}(\xi) = \int_{\mathbb{R}} f(t)\, \mathrm{e}^{-i2\pi\xi t} dt.$$

Parseval's formula. With the definitions as above we get

$$\langle f, g\rangle = \langle \hat{f}, \hat{g}\rangle.$$

The Characterisic function χ_E of a set E is defined is defined by

$$\chi_E(t) = \begin{cases} 1 & t \in E, \\ 0 & t \notin E. \end{cases}$$

The Box spline $B^{(m)}$ **of order** m for non-negative integers m are define by successive convolutions of characteristic functions of an interval I

$$B^{(0)}(t) = \chi_I(t) \text{ and } B^{(m)}(t) = B^{(m-1)} * \chi_I(t) \text{ for } m = 1, 2, 3, \ldots$$

The box splines for the unit interval $[0, 1]$ can be written explicit

$$B^{(m)}(t) = \sum_{k=0}^{m} \begin{pmatrix} m \\ k \end{pmatrix} (-1)^k (t-k)_+^{m-1}.$$

The notation $t_+^k = t^k$ for t positive, 0 otherwise.

A finite filter represented by a formal polynom $a_0 + a_1 Z + a_2 Z^2 + \cdots + a_m Z^m$. Mapping $\{x_n\}$ to $\{y_n\}$ by assigning $y_n = a_0 x_n + a_1 x_{n-1} + a_2 x_{n-2} \cdots + a_m x_{n-m}$.

Recursive filter represented by

$$R(Z) = 1 + rZ + r^2 Z^2 + r3Z^3 + \cdots = \frac{1}{1 - rZ}, \text{ when } r < 1.$$

Mapping $\{x_n\}$ to $\{y_n\}$ by assigning $y_n = x_n + r y_{n-1}$.

A rational filter has the rational polynomial filter function $R(Z) = P(Z)/Q(Z)$, P, Q polynomials. This filter is a combination of finite filters and recursive filters.

.

The Schwartz Class of test functions is the space of functions on the real line such that

$$\sup_{t \in \mathbb{R}} |t^m D^n| < \infty, \text{ for any non-negative integers } m \text{ and } n.$$

D^m denotes the m - order derivative.

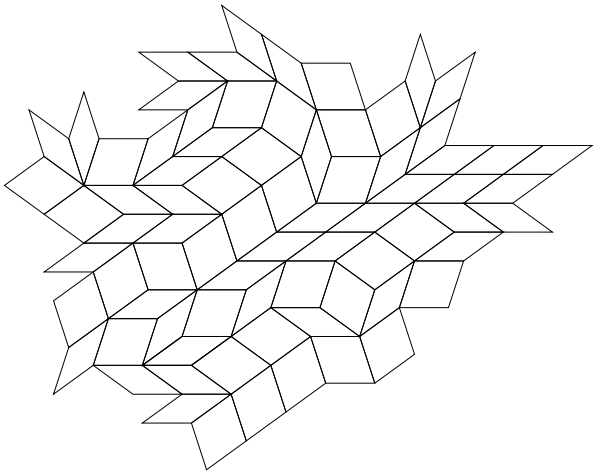
The scaling wavelets are generated by the *father wavelet* or *scaling function* in similar way as the mother wavelets generates its siblings. These sibling wavelets are orthonormal within the same scale, but not between different scales. They are also orthogonal against the mothers's wavelet siblings within the same scale. Together the mother wavelet siblings and the father's wavelet siblings in one scale span the same space as the span of father wavelet siblings in next finer scale.

Loosely speaking the scaling wavelets the contains the informations at the fixed scale, while the mother's wavelets contains the detail information, i.e. the difference information between spaces of neighbor scales.

The m-moment of a function f on $\mathbb{R}$ is given by $\int_{\mathbb{R}} f(t)t^m dt$.

Titelsidans illustration

Ulf Persson



Illustrationen visar början av en Penrose tesselation (kakling?), med hjälp av två romber med vinklarna $36, 144$ och $72, 180$ (och sidlängder normerade till 1) respektive. Det är lätt att inse att hörnen utgör en delmängd P av mängden X av talpar $(m_1+m_2A+m_3B, m_4C+m_5D)$ där $A = \cos(\frac{\pi}{5}), C = \sin(\frac{\pi}{5}), B = \cos(\frac{2\pi}{5}), D = \sin(\frac{2\pi}{5})$. (Notera att rombernas areor ges av C, D respektive). Betraktat som en graf, har varje hörn en valens mellan 3 och 10 och två punkter i P sammanbindes av en kant precis när avståndet är 1. Kanterna har fem olika lutningar. Relationerna till gyllene snittet bör vara uppenbara.

Man kan naivt tänka sig konstruera en tesselation genom att ha en oändlig mängd av romber till sitt förfogande och sedan systematiskt lägga pussel. Detta är lätt att göra lokalt, d.v.s. kring en fix punkt, men när man utvidgar arean och gör det slumpmässigt, hamnar man i återvändsgränder så småningom. För hand är det lätt att åtminstone i början undvika fällor, men kan man designa en algoritm som gör det automatiskt med slumpvisa val begränsade av den uppenbara lokala obstruktionen? Jag designade ett program, som ganska snart kraschade, resultatet av detta, samt punktvisa ingripanden för hand utgörs av bilden ovan. Detta om inget annat bör ge en indikation på att kaklingen av hela planet knappast är trivialt.

Man noterar att mängden X can beskrivas som mängden av all ortogonala projektioner av gittret $\mathbb{Z}^5 \subset \mathbb{R}^5$ på ett 2-dimensionellt underrum. Mängden P kan ges en naturlig tolkning. En introduktion ges av V.I.Arnold i den förtjusande lilla boken Huygens Barrow Newton Hooke (i engelsk översättning utgiven av Birkhäuser).

Wallenbergpriset 2017 till Maurice Duits

Milagros Izqueirdo

Maurice Duits, lektor i matematik vid KTH, tilldelas årets Wallenbergpris om 300 000 kronor. Priset har sedan 1983 delats ut av Svenska Matematikersamfundet till löftesrika unga svenska matematiker, och bekostas sedan 1987 med medel från Marianne och Marcus Wallenbergs stiftelse.

Maurice Duits får Wallenbergpriset för viktiga bidrag till analys av slumpmatriser och relaterade stokastiska modeller, speciellt för framsteg rörande skalningsgränser för egenvärden och centrala gränsvärdessatser för determinantprocesser.

Kort presentation av pristagaren:

Maurice Duits växte upp i Nederländerna och studerade tillämpad matematik vid Eindhoven University of Technology, där han tog examen 2004. Han avlade doktorsexamen i matematik 2008 vid KU Leuven i Belgien. Därefter var han Taussky-Todd instructor vid California Institute of Technology. År 2011 kom Duits till KTH, först som postdoktor, och sedan med stöd från ett VR Young Researcher grant. Han utnämndes till universitetslektor i matematik vid Stockholms universitet 2014 och återvände till matematikinstitutionen vid KTH 2015.

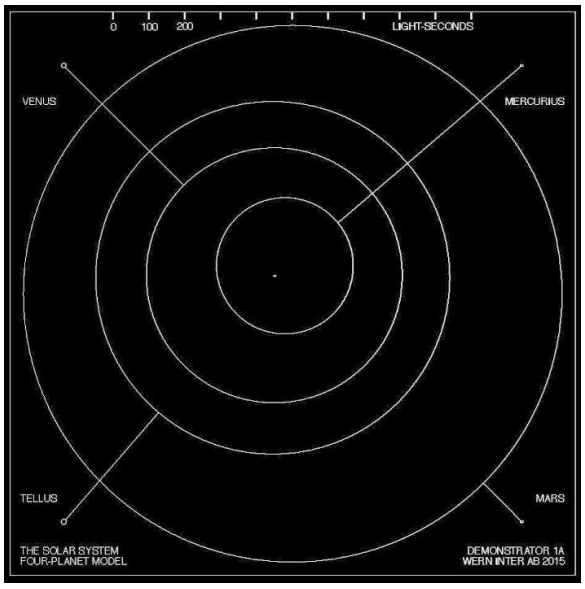
Maurice Duits beskriver sin forskning så här: Många komplexa system i matematik och teoretisk fysik är ofta svåra att studera i detalj. Men när dessa system är mycket stora uppvisar de ofta mönster som inte beror på modellens exakta karakteristiska drag utan bara på vissa faktorer. Samma mönster kan därför uppträda i modeller som kan verka ganska olika - ett fenomen som kallas universalitet. En bärande idé i mitt forskningsområde är att analysera förenklade matematiska modeller som förväntas uppvisa universella mönster som också finns i mer komplicerade system, som energinivåerna i tunga atomer eller nollställena till Riemanns zeta-funktion. Genom att använda moderna matematiska tekniker från (komplex) analys hoppas jag kunna rigoröst visa förväntade universalitetsrelationer, finna nya beteenden och mer allmänt få en djupare insikt i universalitetsfenomenet. Mycket av min tidigare forskning handlar om utveckling av Riemann-Hilbertmetoden, som är ett viktigt verktyg när det gäller att visa universalitet. I synnerhet har jag studerat Riemann-Hilbertproblem av större storlek som, till exempel, uppträder i tvåmatrismodeller, och där nya universalitetsklasser förväntas dyka upp. På senare tid har jag fokuserat på analys av makroskopiska och mesoskopiska fluktuationer i determinantpunktprocesser genom att använda linjära statistikor och utveckla en ny matrisbaserad metod.

Greppbara modeller av universum

Lars Wern

Astronomen Aristarchus tog för mer än tvåtusen år sedan fram den första kända modellen med jorden i ett kretslopp kring solen såsom centrum i det som då var känt utav universum. Hans beskrivning av verkligheten har under de senaste femhundra åren vidareutvecklats av Nicolaus Copernicus, Johannes Kepler, Isaac Newton, Albert Einstein och många andra. För människor med allmänbildning och för skolelever jorden runt är idag de inre proportionerna och strukturen i stort värda att veta hos solsystemet liksom hos Vintergatan. Här är solen endast en av mer än hundratusen miljoner stjärnor i en galax som själv är endast en av ett minst lika stort antal galaxer i universum. Värt allmän kännedom är även, såsom visat av intresset från massmedia, olika tolkningar av vad som kan ligga bakom indikationerna från observerade data om påverkan hos galaxerna från ett par oförklarade fenomen kallade mörk energi och mörk materia. Om deras natur har många hypoteser publicerats, men det finns ännu inga teorier som har blivit allmänt accepterade.

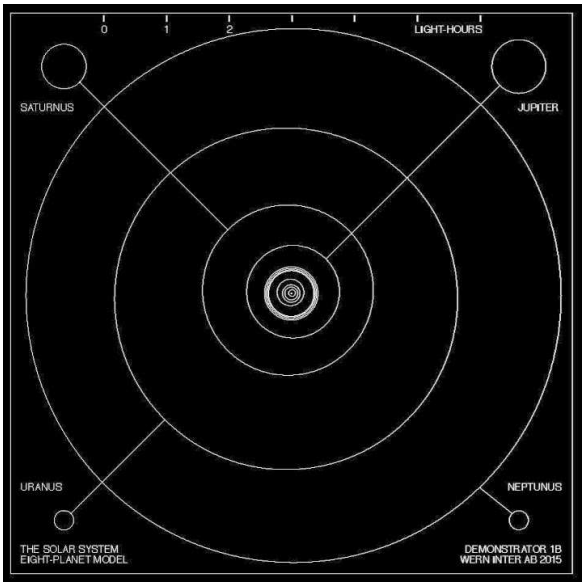
Följande rader beskriver fyra greppbara modeller av universum. Solsystemets och Vintergatans inre proportioner och struktur i stort är återgivna. Förklaringar ges på mörk energi och mörk materia. Modellerna har konstruerats att kunna fungera som interaktiva demonstratorer och är såvitt känt de första och enda i sitt slag. De avses nå en världsmarknad i form av delvis genomskinliga kvadratiska plattor försedda med ett interaktivt ljusbord. Elementär kunskap är tänkt att här inhämtas med hjälp av händerna. Det som är greppbart i bokstavlig såväl som bildlig mening blir enklare att begripa. Modellerna löser inom ramen av A4-formatet bland annat det sedan århundraden kända problemet att både visa planeterna på skalenliga avstånd i solsystemet och i rätt storleksskala relativt solen och varandra utan att de blir mikroskopiskt små.



Demonstrator 1A har en modell av solsystemets inre del med dess fyra planeter. På en framsida hos en kvadratisk platta finns fyra i stort koncentriska cirklar som återger planetbanorna. Merkurius, Venus, Tellus (Jorden) och Mars visas nära vart sitt hörn av plattan i rätt proportion till solens storlek såsom representerad av den yttersta cirkeln. Den cirkeln är även använd för att representera banan för planeten Mars. Skalan längs plattans övre kant visar exempelvis att det tar ljusvågor 500 sekunder att färdas från solen till jorden.

I proportion till storleken hos planetbanorna - ellipserna är approximerade av cirklar - framgår solens storlek liksom planetbanornas excentricitet. Den är lätt att

se för både Merkurius och Mars, medan cirklarna faktiskt är goda approximationer av deras respektive planetbanor.



På plattans baksida har Demonstrator 1B en modell med fyra i stort koncentriska cirklar för planetbanorna i den yttre delen av solsystemet. Nära vart sitt hörn av plattan visas Jupiter, Saturnus, Uranus och Neptunus i rätt proportion till solens storlek såsom representerad av den yttersta cirkeln. Denna cirkel har samma storlek som den yttersta cirkeln på framsidan och är också använd för att representera banan för planeten Neptunus. Skalan längs plattans övre kant visar exempelvis att det tar ljusvågor ca 4 timmar att färdas från solen till Neptunus.

I proportion till storleken hos planetbanorna framgår solens storlek liksom planetbanornas excentricitet. Den är noterbar. Ellipserna approximeras dock med god noggrannhet av cirklar. Asteroidbältet visas mellan planetbanorna för Jupiter i den yttre och för Mars i den inre delen av solsystemet varav den senare är i Demonstrator 1A förstorad 20 gånger.

Sett från jorden kan månen förefalla vara t o m större än solen fastän den är något mindre än Merkurius. I stort gäller samma proportion mellan distanserna till månen och solen som mellan deras diametrar. Distansen till månen är 30 gånger jordens diameter och för densamma gäller en anmärkningsvärt god överenstämmelse med summan av diametrarna för jordens sju följeslagare bland solsystemets planeter, dvs Jupiter, Saturn, Uranus, Neptunus, Mars, Venus och Merkurius skulle lagda bredvid varandra bilda en bro mellan månen och jorden.

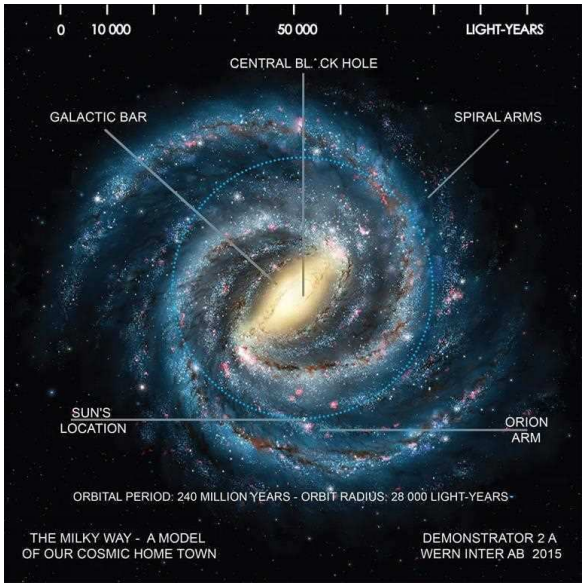
År 2006 bestämdes av The International Astronomical Union att solsystemet ska anses ha åtta planeter. Sedd tidigare som en nionde planet går Pluto i ett kretslopp som skulle hamna långt utanför vad som kan återges av Demonstrator 1B och kretsloppet delas med många andra kroppar. De har en större sammanlagd massa än Pluto som är en så kallad dvärgplanet[1]. Men sett i ett perspektiv som innefattar hela solsystemet liknar även de åtta planeterna pyttesmå dammpartiklar som cirkulerar i ett rum och reflekterar lampljus.

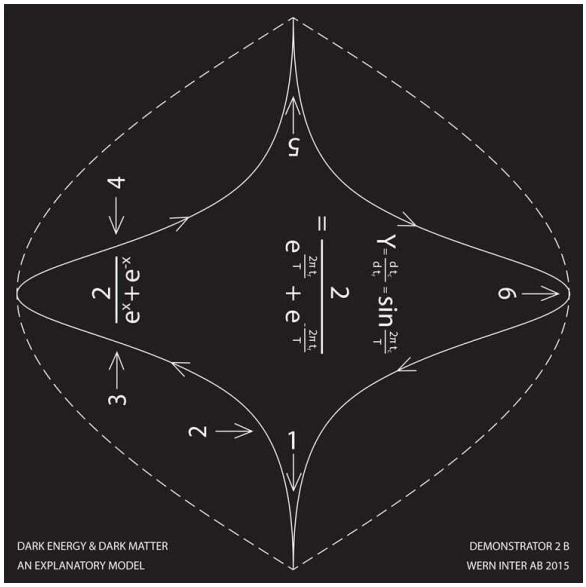
Demonstrator 2A har på en framsida hos en andra kvadratisk platta en bild av Vintergatan - galaxen som är vår hemstad i universum - i en konstnärlig och numera allmänt accepterad tolkning av observerade data (Källa: NASA). Universum uppskattas ha några hundra tusen

[1]Ceres var en kort tid en 8:e planet efter sin upptäckt 1/1 1801, och dess tack vare Gauss beräkningar återupptäckande något år senare. Sedan framkom ett antal andra småplaneter och Ceres (fortfarande den störste av dem) degraderades i smyg utan fanfarer. Pluto är mindre än Merkurius, rentav mindre än vår egen måne, men däremot större än Ceres och har dessutom fem månar, varav den största - Charon - faktiskt är större än Ceres likaså. Personligen finner jag den kvalificerad såsom planet, om inte annat än av tradition. (`red.anm.`)

miljoner galaxer i varierande form och storlek. Skalan längs plattans övre kant visar exempelvis att det tar ljusvågor ca 100 000 år att korsa Vintergatan. Vår galax har i sitt centrum ett svart hål, en galaktisk stav och en fåtal spiralarmar.

Vintergatan är en så kallad stavspiralgalax. Solsystemet är lokaliserat vid spiralarmen Orion och kretsar kring det centralt belägna svarta hålet med en omloppsperiod av drygt två hundra miljoner år och med en radie av ca trettio tusen ljusår. Observerade data indikerar att galaxen är insvept i en kokong av osynlig mörk materia som håller ihop den och åstadkommer att alla stjärnor rör sig i sina olika kretsbanor med i stort en och samma hastighet oavsett deras banradie, och att alla galaxer i universum påverkas av något som fått benämningen mörk energi och som orsakar en accelererad ökning av distanserna mellan dem.





På den andra kvadratiska plattans baksida har Demonstrator 2B en graf som utgör en förklaringsmodell för mörk energi och mörk materia. Modellen blev under Internationella Astronomiåret 2009 beskriven i min av SMS publicerade artikel om "Ett nytt kosmiskt perspektiv". Det är en allmänt godtagen uppfattning att universum är alltsedan nästan 14 miljarder år under expansion efter en begynnelse 1 kallad Stora Smällen, att expansionen hänger ihop med en variation i världsrymdens metrik och med en skapelse från ingenting, och att expansionen har en positiv acceleration vid vår nuvarande tidpunkt 2 såsom visat av grafen roterad 90 grader medurs. Somliga forskare spår ett förlängt tillstånd 3 av expansion med en positiv acceleration tills alla beståndsdelar hos universum bryts isär. Andra forskare tror att den positiva accelerationen kommer snart att upphöra och övergå i en negativ acceleration som resulterar i ett tillstånd 4 av kontraktion.

Tillstånden 3 och 4 av expansion respektive kontraktion är markerade med pilar mellan vilka det visas en matematisk modell. Den beskriver skiftet från positiv till negativ acceleration med hjälp av den inverterade summan av två exponentiella uttryck där den naturliga basen e har exponenterna x och -x. Kontraktionen resulterar i ett slut 5 såsom visat av grafen roterad ytterligare 90 grader medurs. En slutsats kunde vara att begynnelsen 1 av

expansionen innebär i enlighet med rådande uppfattning att universum föds för att utvecklas och sedan dö, och att slutet 5 blir ett förlopp som är omvänt till stora Smällen och är kallat Stora Krossen.

Faktum är dock att den i grafen visade matematiska modellen går att härleda från den mest fundamentala modellen för repetitiva fenomen, nämligen sinusvågmodellen. Med grafen roterad ytterligare 90 grader medurs framgår formen hos sinusvågen av en streckad yttre linje i grafen. Om variationen i världsrymdens metrik uttrycks som ett förhållande mellan ett variabelt mått dtc för kosmisk tid tc och ett mot det måttets maxvärde svarande mått dtr för referenstid tr där dtr är proportionellt mot tidsmåttet sekund såsom definierat av atombaserade referensklockor och dtc är proportionellt mot världsrymdens metrik per definition genom antagandet att ljushastigheten c är konstant så kommer ekvationen $dtc/dtr = \sin(2\pi tc/T)$ att göra x i grafens exponentiella utryck lika med $2\pi tr/T$ där T är sinusvågens repetitionsperiod.

I grafen följs slutet 5 av en ny begynnelse på ett tillstånd som är omvänt relativt tillståndet i begynnelsen 1, dvs skiftat 180 grader, och som innebär en andra expansion följt av ett tillstånd med en andra kontraktion. Ett maximum 6 är gemensamt för de två matematiska modellerna. Enligt den ovannämnda ekvationen måste måttet dtc vara växelvis positivt och negativt så den kosmiska tiden tc flyter i omkastade riktningar inom grafens streckade linje. Den bästa beskrivningen av gravitationen är krökt rumtid och den enklaste tolkningen av vad som ligger bakom krökningen är att beskriva den kosmiska tiden tc såsom ett ändlöst flöde i en sluten slinga. Dess repetitionsperiod T bestämmer vilomassan för gravitationens överallt närvarande elementarpartikel vilket resulterar i en tolkning av mörk materia. Med hjälp av de ovan beskrivna modellerna härleds den positiva accelerationen för världsrymdens expansion utan något antagande av fysisk existens för mörk energi bakom en repulsion som motverkar gravitationen. Det antagandet har blåst upp den största bubblan i vetenskapens historia vilket har skett utan respekt för Ockhams rakkniv.

Lika förenklat som i summeringen "Allt är relativt" av Einstein's välkända teorier kan det sägas att "Repetition är regel". Det mesta kretsar och roterar i såväl mikrokosmiska som makrokosmiska strukturer. Storleksförhållandet mellan repetitionsfrekvenserna hos ändlösa flöden i slutna slingor för referenstiden respektive den kosmiska tiden är den enkla förklaringen till styrkeförhållandet mellan den elektromagnetiska kraften och gravitationen liksom till förhållandet mellan vilomassorna hos elementarladdningen och hos gravitationens elementarpartikel.

Grafen visar två halvperioder för flödet av den kosmiska tiden. Vilken halvperiod nutid innebär är likgiltigt. Parallella universa i både lika och motsatta faser är en möjlighet. Mer intressant är att använda modellerna bakom grafen i en beskrivning av elektronen och positronen som motsatta faser hos flöden i slutna slingor för referenstiden som mäts i atombaserade referensklockor. Men förklaringsmodellen som erbjuds av Demonstrator 2B utmanar alla omskrivna och populära tolkningar av mörk energi och mörk materia så grafen och beskrivningstexten kan i läromedel komma att få en skyddsfolie med en text som varnar för att folien tas bort på egen risk...

Bokrecension av Mind Change

Lars Wern

Hjärnforskaren Susan Greenfield har skrivit den provokativa boken **Mind Change** (2015). Titeln valdes för att knyta an till Climate Change - läs "sinnesskifte" respektive "klimatskifte" - i hopp om att uppnå samma uppmärksamhet som dokumentärfilmen An Inconvenient Truth. Hon framför åsikten att klimatförändringar är inte den största utmaningen i vår tid utan det är på gott och ont den globala uppkopplingen till cyberspace.

Visst är det svårt att jämföra de största utmaningarna och göra det med sinne för proportioner. Ändå är det relativt lätt att ge henne rätt i Japan och Sydkorea där intresset för familjebildning är på väg ner mot katastrofala nivåer. I världens mest uppkopplade länder leker barn inte ute som förr och ungdomar lägger allt mindre tid på utveckling av känslomässiga kontakter. För många av dem är samlag inte längre fast förknippat till varken barn eller samliv eller ens till vad de kan uppleva som en aktivitet av övervägande positiv natur.

Greenfield har hunnit med att producera såväl böcker som många vetenskapliga artiklar. Mind Change ger information av allmänt intresse om hur hjärnan påverkas av hur den används. Ett exempel är att en sjöhästliknande hjärnregion kallad hippocampus har visat sig växa hos Londons taxiförare till följd av hårda krav på dem att memorisera gatunätet. Ett annat exempel är att tid till personliga möten för frågor och diskussioner sågs av den grekiske filosofen Sokrates som viktigt för att utveckla ett medvetande på djup nivå men tyvärr nedvärderat till förmån för läsning och färdiga svar.

I historiens ljus förefaller Sokrates överdrivet negativ mot läsning. Med idag färre toaletter än uppkopplade människor på jorden och med den tid som ägnas varje dygn åt personliga uppkopplingar så ser Greenfield dock goda skäl att varna för risken av försämrad förmåga att kunna hantera dagens hotbilder av alla slag, bland dem klimatskiftet. För henne är "sinnesskiftet" den största av alla utmaningar. I likhet med kända framtidsscenarior där robotar blir medvetna behöver proaktiva åtgärder övervägas mot uppkomst av medvetanden i cyberspace. Bevakning av attityder är en möjlighet. Ett bakterieskifte i tarmen kan få människor att ändra attityder men dessa är ojämförligt lättare att påverka via cyberspace.

I likhet med flera hjärnforskare fascineras Greenfield av fenomenet Facebook. "Syns du inte så finns du inte" är ordspråket som stämmer här och som får mig att tänka på Descartes och hans ord "Cogito, ergo sum" (I think, therefore I exist). Han dog i lunginflammation relativt ung efter att ha frusit i sina finkläder under några mycket tidiga morgonsamtal med drottning Kristina. "Role-based consciousness" är min enkla sammanfattning av personliga funderingar som börjat med orden ovan och som kommit in på funktionen hos medvetandet.

Boken ger en genomgång av hjärnans specialiserade regioner. Om medvetandet konstateras att en vetenskaplig förklaringsmodell saknas. På 48 sidor i 4 av totalt 20 kapitel med 271 sidor text plus 77 sidor referenser får läsaren dock en allmänbildande beskrivning av vad som är numera känt om hur hjärnan arbetar, genomgår förändringar och utvecklar medvetandet. Detta kan gå förlorat tillfälligt vid berusning eller permanent till följd av sjukdom, våld och ålder vilket diskuteras i kapitel 8 under rubriken "Out of your mind"! Övriga kapitel fokuserar bland annat på hur internet används för surfande och sociala nätverk. Videospel diskuteras på 49 sidor i 3 kapitel.

Medvetandet är alltså enligt Greenfield tills vidare oförklarat av vetenskapen, men hon är övertygad om att det är kopplat till synkrona signaleringsprocesser i hjärnregionerna. Där är vågor med karakteristiska repetitionsperioder kända under namnen Delta, Theta, Alpha, Beta och Gamma. Själv har jag länge haft en vågbaserad förklaringsmodell av medvetandet under utveckling i ett personligt forskningsprojekt med arbetsnamnet "Wave Theory of Consciousness", förkortat WTC.

Widgerson lectures

Avi Widgerson (IAS, Princeton) will give the 2017 Göran Gustafsson Lectures in Mathematics at KTH. The lectures will be held at 13.15 on May 19, 22 and 23. For locations, titles and abstracts please see below. A fourth lecture will be given in the combinatorics seminar on May 24, title + abstract can be found below.

For the latter lectures, please note that no prior knowledge from previous talks will be assumed.

19 maj, Friday, 13:15 - 14:15

Avi Wigderson: Randomness Plats: D1

Is the universe inherently deterministic or probabilistic? Perhaps more importantly - can we tell the difference between the two?

Humanity has pondered the meaning and utility of randomness for millennia. There is a remarkable variety of ways in which we utilize perfect coin tosses to our advantage: in statistics, cryptography, game theory, algorithms, gambling... Indeed, randomness seems indispensable! Which of these applications survive if the universe had no randomness in it at all? Which of them survive if only poor quality randomness is available, e.g. that arises from "unpredictable" phenomena like the weather or the stock market?

A computational theory of randomness, developed in the past three decades, reveals (perhaps counter-intuitively) that very little is lost in such deterministic or weakly random worlds. In the talk I'll discuss the main ideas and results of this theory, give a mathematical definition of pseudorandomness, and explain how both the Riemann Hypothesis and the P vs. NP question (among others) naturally fit in this framework.

The talk is aimed at a general scientific audience.

22 maj, Monday, 13:15 - 14:15

Avi Wigderson: Operator scaling - theory and applications Plats: E3

In this talk I will explain the "singularity problem" for symbolic matrices over non commuting variables, and describe its myriad origins and incarnations in commutative and non-commutative algebra, computational complexity, optimization, quantum information theory, Brascamp-Lieb inequalities and other areas. I will describe the "Operator scaling" algorithm, which efficiently solves all these related problems, and how its analysis combines ideas from these areas. This algorithm efficiently solves a large family of non-convex optimization problems, and will hopefully find other applications.

I will elaborate on algebraic and analytic aspects of this work (respectively) in the two following lectures on May 23 and May 24. Based on joint works with Ankit Garg, Leonid Gurvits and Rafael Olivera.

23 maj, Tuesday, 13:15 - 14:15

Avi Wigderson: Commutative and non-commutative rank of symbolic matrices
Plats: E3

Our object of study are matrices whose entries are linear forms in a given set of variables. We will be interested in their rank, both when variables commute and when they do not. I will discuss the importance of understanding these objects in arithmetic complexity, algebra and combinatorics, and present some structural and computational results and open problems about them.

No prior knowledge from previous talks will be assumed. Based on joint works with Ankit Garg, Leonid Gurvits and Rafael Olivera.

May 24: (Combinatorics seminar)

Avi Wigderson: Structural and computational aspects of Brascamp-Lieb inequalities

The celebrated Brascamp-Lieb (BL) inequalities are an important mathematical tool, unifying and generalizing numerous inequalities in analysis, convex geometry and information theory, with many used in computer science.

I will survey the well-understood structural theory of BL inequalities, and then discuss their computational aspects. Far less was known about computing their main parameters, and I will discuss new efficient algorithms (via operator scaling) for those, which also inform structural questions. In particular, these efficiently solve a large family of linear programs with exponentially many facets, potentially useful for combinatorial optimization. The analysis of this (very analytic) algorithm crucially uses modern results in invariant theory.

No prior knowledge from previous talks will be assumed. Joint work with Ankit Garg, Leonid Gurvits and Rafael Olivera

SVENSKA MATEMATIKERSAMFUNDETS STYRELSEBERÄTTELSE VERKSAMHETSÅRET 2016/2017

Milagros Izquierdo

Samfundet har 421 medlemmar, varav 535 ständiga medlemmar; därutöver tillkommer 16 institutionella medlemmar. Styrelsens nuvarande sammansätting är:

- Milagros Izquierdo Barrios (ordförande)
- Klas Markström (vice ordförande)
- Frank Wikström (skattmästare)
- Olof Svensson (sekreterare)
- Jana Madjarova (femte ledamot)

Denna styrelseberättelse avser verksamhetsperioden juni 2016 - juni 2017. Styrelsearbetet har till stor del bedrivits via epost, men även traditionella möten har förekommit. Samfundets höstmöte ägde rum i Lund den 18 november. Traditionsenligt var temat juniora matematiker. Förutom huvudtalaren Erik Wahlen, deltog sex juniora, och inte så juniora, talare från fyra olika lärosäten som presenterade sin forskning. Mötet var lyckat - presentationerna var överlag mycket bra, och det är viktigt för samfundet med detta återkommande juniortema. Under det gångna läsåret har Skolornas matematiktävling (SMT) arrangerats i vanlig ordning av tävlingskommittén som under 2016/2017 bestod av

- Mats Boij (KTH)
- Axel Hultman (Linköpings universitet)
- Thomas Kragh (Uppsala universitet)
- Peter Kumlin (Chalmers/GU)
- Jana Madjarova (Chalmers/GU, ordförande)
- Victor Ufnarovski (LTH)
- Paul Vaderlind (SU)
- Frank Wikström (LTH, sekreterare)
- Lars-Daniel Öhman (Umeå universitet)

Sverige skickade sex elever till den Internationella matematikolympiaden 2016 i Hong Kong. Det svenska laget placerade sig på plats 37 av 109 lag och var återigen bäst bland alla nordiska lag, och kom hem med tre silvermedaljer (David Wärn, Danderyds gymnasium, John Olof Hallman, Kitas gymnasium, Göteborg, och Joakim Blikstad, Danderyds gymnasium). Hugo Eberhard (Lars-Erik Larssongymnasiet, Lund) och Nicole Hedblom (Danderyds gymnasium,) fick hedersomnämnanden. Å Finalen 2016 genomfördes på Matematikcentrum, Lunds universitet, Lund, och vanns av David Wärn. På andra plats kom Arvid Lunnemark (Malmö Borgaskola) och på tredje Hugo Eberhard. Sverige gjorde mycket bra ifrån sig på den Nordiska matematiktävlingen, som gick den 3 april i år. Björn Magnusson (Katedralskolan, Lund) vann och svenska elever kom på de fem första platserna.

Två träningsläger har genomförts under den aktuella perioden, ett gemensamt nordiskt i Sorö, Danmark, strax före IMO 2016, i vilket det svenska laget deltog, och ett inför IMO 2017 för ett utvidgat lag i Stockholm i april 2017. Samarbetet mellan SMT och Brummer & Partners fortsätter. Den generösa sponsringen möjliggör genomförandet av tävlingen i allmänhet och de mycket nyttiga träningslägren i synnerhet.

Sedan 2016 är lagfinalen på skolornas matematiktävling *SMT Lagfinal "Pythagoras enigma"* som arrangeras under tävlingskommitténs och Malmö Borgarskolas samordnade regi. I år går den 1-2 juni.

Styrelsen vill tacka kommittén för det stora och viktiga arbetet med den svenska tävlingen och med träningen inför den internationella olympiaden. Baltic Way 2015, en lagtävling för

gymnasister från Danmark, Estland, Finland, Tyskland, Island, Lettland, Litauen, Norge, Polen, St. Petersburg samt Sverige, arrangerades av Finland 2016. Glädjande kom Sverige på tredje plats

Styrelsen har haft flera kontakter med styrelserna för de andra skandinaviska samfunden om framtiden för Nordisk Matematisk Tidskrift (NORMAT). Tyvärr ges NORMAT inte längre ut[1].

Sedan 2015 är Samfundet medlem i ICIAM (International Council for Industrial and Applied Mathematics). Samfundets representant är Åke Brännström, Umeå universitet. Styrelsen tackar Åke för hans engagemang.

Årets Wallenbergpris tilldelas Maurice Duits, KTH. Priskommittén bestod av Alexandru Aleman (ordf.), Pär Kurlbeg samt Jana Björn. Styrelsen vill tacka dem för deras noggranna arbete.

Samfundets årsmöte äger ger rum i Umeå den 12 juni i samband med *Joint Meeting of the Catalan, Royal Spanish and Swedish Mathematical Societies*. Mötet äger rum i Umeå, 12-15 juni 2017. Programkommittén består av Sandra di Rocco, KTH (ordförande); Mats Andersson, Chalmers/GU; Maria Ángeles Gil Univ. Oviedo; Gemma Huguet, Univ. Politècnica Catalunya; Ignasi Mundet, Univ. Barcelona; JoaquÃn Pérez, Univ. Granada; Xavier Tolsa, Univ. Atonoma Barcelona; Tatyana Turova, Lund och Juan Luis Vázquez, Univ. Autonoma Madrid.

Mötet består av tretton föredrag av inbjudna talare och elva *special sessions* som täcker ett brett matematiskt spektrum. Styrelsen vill tacka medlemmar i programkommittén och institutionen för matematik och matematisk statistik, Umeå universitet.

De inbjudna talarna är Tomás Alarcón (Barcelona), Yacin Ameur (Lund), Viviane Baladi (Paris), Fabrizio Catanese (Bayreuth), Rosa Donat (Valencia), Maria Esteban (Paris), Luis Guijarro (Madrid), Kathryn Hess (EPFL), Kurt Johansson (KTH), Jonatan Lenells (KTH), M. Teresa Lozano (Zaragoza), Joaquim Ortega Cerdà (Barcelona) och Marta Sanz-Solé (Barcelona). Kathryn Hess är *EMS Distinguished Speaker*.

Till sist vill styrelsen tacka lokalombuden för att de ger samfundet en snabb informationskanal till våra medlemmar och hela matematiska samhället inom högskolesektorn, samt att de förser SMS bulletinens redaktion med material.

Linköping 16 maj, å styrelsen vägnar

Milagros Izquierdo, ordförande

[1] Ett sista 'uppsamlingsnummer' $2-\infty$:2013 skall ges ut efter det att 1:2013 nyligen (äntligen efter år sedan färdigställande) trycktes. (`red.anm`)

Lokala Nyheter

Karlskrona

Blekinge Tekniska Högskola.
Befordran
Docent Johan Öinert: professor i matematik vid BTH.
Claes Jogréus: docent i medicinsk statistik.
Docentföreläsningen *Motionens betydelse för överlevnaden för äldre samt några aspekter på frailtymodeller* hölls 30/3.

Hannes Frenander (beräkningsmatematik): *High-order finite difference approximations for hyperbolicproblems: multiple penalties and non-reflecting boundary conditions*
Evgeniy Lokharu: *Small-amplitude steady water waves with vorticity*
Anna Orlof: *Quantum scattering and interaction in graphene structures*

Lund.

Doktorsavhandlingar
8/3, Tobias Palmér, *Computer Vision Based Analysis of Animal Behavior*
7/4, Mårten Wadenbäck, *Homography-Based Positioning and Planar Motion Recovery*
Nyanställningar
Tien Truong (doktorand)

Mälardalens Högskola.

Doktorsavhandlingar (5/5) Markus Jonsson *Processes on Integer Partitions and Their Limit Shapes*
Handledare: Kimmo Eriksson, Opponent: Johan Jonasson (Göteborg)

Umeå.

Konferens: Meeting of Catalan, Spanish and Swedish Mathematical Societies
`https://liu.se/mai/catspsw.math/?l=en&sc=true`
Strax därefter anordnas X-DMS 2017
`http://essenceofescience.se/event/x-dms-extended-discretization-methods/`

KALENDARIUM

(Till denna sida uppmanas alla, speciellt lokalombuden, att inlämna information)

Meeting of the Catalan, Spanish and Swedish Math Societies
Umeå Universitet
12/6-15/6 2017

ISAAC 2017
Linnéuniversitetet, Växjö
14/8 -18/8 2017

Författare i detta nummer

Yves Meyer Nestor inom waveletsteorin och Gaussmedaljör i Hyderabad 2010. Senaste Abelpristagare

Jan-Olov Strömberg Pionjär inom Wavelets.Under många år verksam uppe i Tromsö.Pensionerad fr° institutionen vid KTH.

Lars Wern Kosmologisktinriktad pensionerad patent-ingenjör. Flitig medarbetare i såvälsom i Bulletin.

Innehållsförteckning

Notiser