INFOMAT

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Augustnummeret er i stor del viet til første halvdel av Raussen og Skau's interview med årets Abelprisvinner, men vi kan også by på et innlegg fra Kristian Ranestad om matematikk i skolen (og Sudoku). Videre er det en stor nyhet at Snorre Christiansen er den første nordmann (uansett fagfelt) som er tildelt EURYI-stipend. INFOMAT gratulerer!

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Snorre Christiansen tildelt EURY-pris

I konkurranse med de 622 forskerne som nådde fram til finalen vant Snorre Harald Christiansen (CMA, UiO) et av de 25 European Young Investigators (EURY) Awards som ble utdelt i år. Christiansen er med dette den første forskeren fra Norge som tildeles dette prestisjetunge stipendet. Han får 10 millioner norske kroner fordelt over fem år. I en kommentar gjenngitt av `www.forskningsradet.no` sier Chrisitansen

> Dette betyr at jeg kan satse på en forskerkarriere for fullt, legge undervisning litt til side en tid og knytte til meg stipendiater og post.doc'er for å bygge opp et team rundt prosjektet.

(Foto fra Forskningsrådets web-side)

Prosjektet Christiansen vant frem med går ut på å lage gode simuleringsverktøy for en klasse likninger som beskriver krumning i romgeometri. INFOMAT gratulerer!

For videre presseomtaler, se matematisk institutt, UiO sin web-omtale.

Nytt fra instituttene

Innholdet baserer seg på innsendt informasjon fra enkeltmedlemmer og fra instituttene.

Matematisk institutt, UiO

Doktorgrader.

Tore Kro, *Involutions on* $\mathbf{S}[\Omega M]$, dr. scient, 10. juni.

Dag Biberg, *Mathematical models for two-phase stratified pipe flow*, dr. Philos, 24. juni

Sverre A. Lunøe-Nielsen, *The Segal conjecture for topological Hochschild homology of commutative S-algebras*, dr. scient, 18. august

George W. Johnson, *A Study of Stratified Gas-liquid Pipe Flow* dr. scient, 22. august

Johannes Kleppe, *Additive Splittings of Homogeneous Polynomials*, dr. scient, 29. august

Notiser

Kina vant matematikkolympiaden Den internasjonale matematikkolympiaden ble avholdt mellom 4. og 18 juli i Merida, Mexico. Fra resultatlisten fra konkurransen ser vi at Kina vant (med 235 poeng). På de neste plassene kom USA (213), Russland (212), Iran (201) og på femteplass Korea (200 poeng). Norge fikk 38 poeng.

Primtallstvilling-formodningen mot en løsning? The American Institute of Mathematics (AIM) annonserte i mai et bevis for at avstanden mellom påfølgende primtall "is sometimes very much smaller than the average spacing". Personene bak den åttesidede artikkelen er Dan Goldston, Janos Pintz og Cem Yildirim.

I følge `http://aimath.org/primegaps/` er det "a belief among some number theorists that a psychological barrier has been broken and that a proof of the twin prime conjecture may not be far away".

Arrangementer

Modern Foundations for Stable Homotopy Theory

Oberwolfach (Germany), October 2-8, 2005

The next "Arbeitsgemeinschaft" (working group) at Oberwolfach has the title "Modern Foundations for Stable Homotopy Theory" and will be organized by John Rognes and Stefan Schwede. We study the foundations for and applications of structured ring spectra und discuss the rigidity theorem for the stable homotopy category.

The "Arbeitsgemeinschaft" is not an ordinary conference. The idea is to learn by giving a lecture about results which have been found recently by other researchers. The AG is intended for non-experts, and we particularly invite non-topologists to participate.

The number of participants is limited. The deadline for application is rather soon on **August 15, 2005**.

The program for the AG and further details can be found at
`http://www.mfo.de/cgi-bin/tagungsdb?type=21&tnr=0540` or
`http://www.math.uni-bonn.de/people/schwede/`
NB: Talk 12 replaces talk 10, and is in turn replaced by a talk on algebras over the complex cobordism spectrum.

Interview with

Martin Raussen, Aalborg University, Denmark

Peter D. Lax

Christian Skau, NTNU, Trondheim

Sammen med EMS Newsletter trykker INFOMAT intervjuet av Peter D. Lax som Martin Raussen og Christian Skau gjorde i Oslo 23. mai 2005.

Her kommer første del. Den andre halvdelen trykkes i septemberutgaven.

On behalf of the Norwegian and Danish Mathematical Societies we would like to congratulate you on winning the Abel Prize for 2005. You came to the U.S. in 1941 as a 15 year old kid from Hungary. Only three years later, in 1944, you were drafted into the U.S army. Instead of being shipped overseas to the war front, you were sent to Los Alamos in 1945 to participate in the Manhattan project, building the first atomic bomb. It must have been awesome as a young man to come to Los Alamos taking part in such a momentous endeavour, and to meet so many legendary famous scientists: Fermi, Bethe, Szilard, Wigner, Teller, Feynman, to name some of the physicists, and von Neumann and Ulam, to name some of the mathematicians. How did this experience shape your view of mathematics and influence your choice of research field within mathematics?

In fact, I returned to Los Alamos after I got my Ph.D. in 1949 for a year's stay and then spent many summers as a consultant. The first time I spent in Los Alamos, and especially the later exposure, shaped my mathematical thinking. First of all it was the experience of being part of a scientific team, not just of mathematicians, people with different outlooks, and the aim being not a theorem, but a product. One can not learn that from books, one must be a participant, and for that reason I urge my students to spend at least a summer as a visitor at Los Alamos. Los Alamos has a very active visitor's program. Secondly, it was there - that was in the 50's - that I became imbued with the utter importance of computing for science and mathematics. Los Alamos, under the influence of von Neumann, was for a while in the 50's and the early 60's the undisputed leader in computational science.

Research Contributions

May we come back to computers later? First some questions about some of your main research contributions to mathematics: You have made outstanding contributions to the theory of non-linear partial differential equations. For the theory and numerical solutions of hyperbolic systems *of conservation laws your contribution has been decisive, not to mention your contribution to the understanding of the propagation of discontinuities, so called shocks. Could you describe in a few words how you were able to overcome the formidable obstacles and difficulties this area of mathematics presented?*

Well, when I started to work on it I was very much influenced by two papers. One was Eberhard Hopf's on the viscous limit of Burgers' equation, and the other was the von Neumann - Richtmyer paper on artificial viscosity. And looking at these examples I was able to see what the general theory might look like.

The astonishing discovery by Kruskal and Zabusky in the 1960's of the role of solitons for solutions of the Korteweg - de Vries (KdV) equation, and the no less astonishing subsequent explanation given by several people that the KdV equation is completely integrable, represented a revolutionary development within the theory of non-linear partial differential equations. You entered this field with an ingenious original point of view, introducing the so-called Lax-pair, which gave an understanding of how the inverse scattering transform applies to equations like the KdV, and also to other non-linear equations which are central in mathematical physics, like the sine-Gordon and the non-linear Schrödinger equation. Could you give us some thoughts on how important you think this theory is for mathematical physics and for applications, and how do you view the future of this field?

Perhaps I start by pointing out that the astonishing phenomenon of the interaction of solitons was discovered by numerical calculations, as was predicted by von Neumann some years before, namely that calculations will reveal extremely interesting phenomena. Since I was a good friend of Kruskal I learned early about his discoveries, and that started me thinking. It was quite clear that there are infinitely many conserved quantities, and so I asked myself: How can you generate all at once an infinity of conserved quantities. I thought if you had a transformation that preserved the spectrum of an operator then that would be such a transformation, and that turned out to be a very fruitful idea applicable quite widely. Now you ask how important is it? I think it is pretty important. After all, from the point of view of technology for the transmission of signals, signalling by solitons is very important and a promising future technology in transoceanic transmission. This was developed by Linn Mollenauer, a brilliant engineer at Bell Labs. It has not yet been put into practice, but it will some day. The interesting thing about it is that classical signal theory is entirely linear, and the main point of soliton signal transmission is that the equations are non-linear. That's one aspect of the practical importance of it. As for the theoretic importance: the KdV equation is completely integrable, and then an astonishing number of other completely integrable systems were discovered. Completely integrable systems can really be solved in the sense that the general population uses the word solved. When a mathematician says he has solved the problem he means he knows the solution exists, that it's unique, but very often not much more. Now the question is: Are completely integrable systems exceptions to the behavior of solutions of non-integrable systems, or is it that other systems have similar behaviour, only we are unable to analyse it? And here our guide might well be the Kolmogorov-Arnold-Moser theorem which says that a system near a completely integrable system behaves as if it were completely integrable. Now, what near means is one thing when you prove theorems, another when you do experiments. It's another aspect of numerical experimentation revealing things. So I do think that studying completely integrable systems will give a clue to the behaviour of more general systems as well. Who could have guessed in 1965 that completely integrable systems would become so important?

The next question is about your seminal paper "Asymptotic solutions of oscillating initial value problems" from 1957. This paper is by many people considered to be the genesis of Fourier Integral Operators. What was the new viewpoint in the paper that proved to be so fruitful?

It is a micro-local description of what is going on. It combines looking at the problem in the large and in the small. It combines both aspects and that gives it its strengths. The numerical implementation of the micro- local point of view is by wavelets and similar approaches, which are very powerful numerically.

May we touch upon your collaboration with Ralph Phillips - on and off over a span of more that 30 years - on scattering theory, applying it in a number of settings. Could you comment on this collaboration, and what do you consider to be the most important results you obtained?

That was one of the great pleasures of my life! Ralph Phillips is one of the great analysts of our time and we formed a very close friendship. We had a new way of viewing the scattering process with incoming and outgoing subspaces. We were, so to say, carving a semi-group out of the unitary group, whose infinitesimal generator contained almost all the information about the scattering process. So we applied that to classical scattering of sound waves and electromagnetic waves by potensials and obstacles. Following a very interesting discovery of Faddeev and Pavlov, we studied the spectral theory of automorphic functions. We elaborated it further, and we had a brand new approach to Eisenstein series for instance, getting at spectral representation via translation representation. And we were even able to contemplate - following Faddeev and Pavlov - the Riemann hypothesis peeking around the corner.

That must have been exciting!

Yes! Whether this approach will lead to the proof of the Riemann hypothesis, stating it, as one can, purely in terms of decaying signals by cutting out all standing waves, is unlikely. The Riemann hypothesis is a very elusive thing. You may remember in Peer Gynt there is a mystical character, the Boyg, which bars Peer Gynt's way wherever he goes. The Riemann hypothesis resembles the Boyg!

Which particular areas or questions are you most interested in today?

I have some ideas about the zero dispersion limit.

(Foto: Knut Falch/Scanpix)

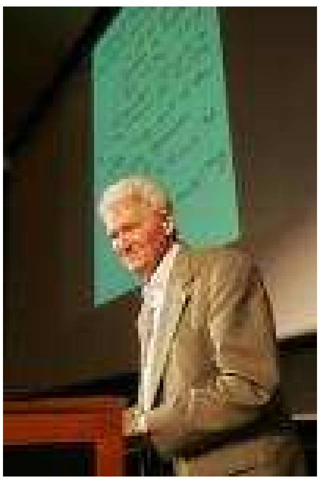
Pure and applied mathematics

May we raise a perhaps contentious issue with you: pure mathematics versus applied mathematics. Occasionally one can hear within the mathematical community statements that the theory of non-linear partial differential equations, though profound and often very important for applications, is fraught with ugly theorems and awkward arguments. In pure mathematics, on the other hand, beauty and aesthetics rule. The

English mathematician G.H. Hardy is an extreme example of such an attitude, but it can be encountered also today. How do you respond to this? Does it make you angry?

I don't get angry very easily. I got angry once at a dean we had, terrible son of a bitch, destructive liar, and I got very angry at the mob that occupied the Courant Institute and tried to burn down our computer. Scientific disagreements do not arouse my anger. But I think this oppinion is definitely wrong. I think Paul Halmos once claimed that applied mathematics was, if not bad mathematics, at least ugly mathematics, but I think I can point to those citations of the Abel Committee dwelling on the elegance of my works! Now about Hardy: When Hardy wrote "Apology of a Mathematician" he was at the end of his life, he was old, I think he had suffered a debilitating heart-attack, he was very depressed. So that should be taken into account. About the book itself: There was a very harsh criticism by the chemist Frederick Soddy, who was one of the co-discoverers of the isotopes - he shared the Nobel Prize with Rutherford. He looked at the pride that Hardy took in the uselessness of his mathematics and wrote: "From such cloistral clowning the world sickens". It was very harsh because Hardy was a very nice person. My friend Joe Keller, a most distinguished applied mathematician, was once asked to define applied mathematics and he came up with this: "Pure mathematics is a branch of applied mathematics". Which is true if you think a bit about it. Mathematics originally, say after Newton, was designed to solve very concrete problems that arose in physics. Later on these subjects developed on their own and became branches of pure mathematics, but they all came from applied background. As von Neumann pointed out, after a while these pure branches that develop on their own need invigoration by new empirical material, like some scientific questions, experimental facts and, in particular, some numerical evidence.

In the history of mathematics, Abel and Galois may have been the first great mathematicians that one may describe as "pure mathematicians", not being interested in any "applied" mathematics as such. However, Abel did solve an integral equation, later called "Abel's integral equation", and Abel gave an explicit solution, which incidentally may have been the first time in the history of mathematics that an integral equation had been formulated and solved. Interestingly, by a simple reformulation one can show that the Abel integral equation and its solution are equivalent to the Radon Transform, the mathematical foundation on which modern medical tomography is based. Examples of such totally unexpected practical applications of pure mathematical results and theorems abound in the history of mathematics - group theory that evolved from Galois' work is another striking example. What are your thoughts on this phenomenon? Is it true that deep and important theories and theorems in mathematics will eventually find practical applications, for example in the physical sciences?


(Foto: Terje Bendiksby /Scanpix)

Well, as you pointed out this has very often happened: Take for example Eugene Wigner's use of group theory in quantum mechanics. And this has happened too often to be just a coincidence. Although, one might perhaps say that other theories and theorems which did not find applications were forgotten. It might be interesting for a historian of mathematics to look into that phenomenon. But I do believe that mathematics has a mysterious unity which really connects seemingly distinct parts, which is one of the glories of mathematics.

You have said that Los Alamos was the birthplace of computational dynamics, and I guess it is safe to say that the U.S. war effort in the 1940's advanced and accelerated this development. In what way has the emergence of the high-speed computer altered the way mathematics is done? Which role will high-speed computers play within mathematics in the future?

It has played several roles. One is what we saw in Kruskal's and Zabusky's discovery of solitons, which would not have been discovered without computational evidence. Likewise the Fermi-Pasta-Ulam phenomenon of recurrence was also a very striking thing which may or may not have been discovered without the computer. That is one aspect. But another is this: in the old days, to get numerical results you had to make enormously drastic simplifications if your computations were done by hand, or by simple computing machines. And the talent of what drastic simplifications to make was a special talent that did not appeal to most mathematicians. Today you are in an entirely different situation. You don't have to put the problem on a Procrustean bed and mutilate it before you attack it numerically. And I think that has attracted a much larger group of people to numerical problems of applications - you could really use the full theory. It invigorated the subject of linear algebra, which as a research subject died in the 1920's. Suddenly the actual algorithms for carrying out these operations became important. It was full of surprises, like fast matrix multiplication. In the new edition of my linear algebra book I will add a chapter on the numerical calculation of the eigenvalues of symmetric matrices. You know it's a truism that due to increased speed of computers, a problem that took a month 40 years ago can be done in minutes, if not seconds today. Most of the speed-up is attributed, at least by the general public, to increased speed of computers. But if you look at it, actually only half of the speed-up is due to this increased speed. The other half is due to clever algorithms, and it takes mathematicians to invent clever algorithms. So it is very important to get mathematicians involved, and they are involved now.

(Foto: Knut Falch/Scanpix)

Could you give us personal examples of how questions and methods from applied points of view have triggered "pure" mathematical research and results? And conversely, are there examples where your theory of non-linear partial differential equations, especially your explanation of how discontinuities propagate, have had commercial interests? In particular, concerning oil exploration, so important for Norway!

Yes, oil exploration uses signals generated by detonations that are propagated through the earth and through the oil reservoir and are recorded at distant stations. It's a so-called inverse problem. If you know the distribution of the densities of materials and the associated waves' speeds, then you can calculate how signals propagate. The inverse problem is that if you know how signals propagate, then you want to deduce from it the distribution of the materials. Since the signals are discontinuities, you need the theory of propagation of discontinuities. Otherwise it's somewhat similar to the medical imaging problem, also an inverse problem. Here the signals do not go through the earth but through the human body, but there is a similarity in the problems. But there is no doubt that you have to understand the direct problem very well before you can tackle the inverse problem.

Hungarian mathematics

Now to some questions related to your personal history. The first one is about your interest in, and great aptitude for, solving problems of a type that you call "Mathematics Light" yourself. To mention just a few, already as a 17 year old boy you gave an elegant solution to a problem that was posed by Erdős and is related to a certain inequality for polynomials, which was earlier proved by Bernstein. Much later in your career you studied the so-called Polya function which maps the unit interval continuously onto a right-angled triangle, and you discovered its amazing differentiability properties. Was problem solving specifically encouraged in your early mathematical education in your native Hungary, and what effect has this had on your career later on?

Yes, problem solving was regarded as a royal road to stimulate talented youngsters, and I was very pleased to learn that here in Norway they have a successful high-school contest, where the winners were honoured this morning. But after a while one shouldn't stick to problem solving, one should broaden out. I return ever once in a while to it, though. Back to the differentiability of the Polya function: I knew Polya quite well having taken a summer course with him in '46. The differentiability question came about this way: I was teaching a course on real variables and I presented Polya's example of an area-filling curve, and I gave as homework to the students to prove that it's nowhere differentiable. Nobody did the homework, so then I sat down and I found out that the situation was more complicated. There was a tradition in Hungary to look for the simplest proof. You may be familiar with Erdős' concept of The Book. That's The Book kept by the Lord of all theorems and the best proofs. The highest praise that Erdős had for a proof was that it was out of The Book. One can overdo that, but shortly after I had got my Ph.D., I learned about the Hahn-Banach theorem, and I thought that it could be used to prove the existence of Green's function. It's a very simple argument - I believe it's the simplest - so it's out of The Book. And I think I have a proof of Brouwer's Fixed Point Theorem, using calculus and just change of variables. It is probably the simplest proof and is again out of The Book. I think all this is part of the Hungarian tradition. But one must not overdo it.

There is an impressive list of great Hungarian physicists and mathematicians of Jewish background that had to flee to the US after the rise of fascism, Nazism and anti-Semitism in Europe. How do you explain this extraordinary culture of excellence in Hungary that produced people like de Hevesy, Szilard, Wigner, Teller, von Neumann, von Karman, Erdős, Szegő, Polya, yourself, to name some of the most prominent ones?

There is a very interesting book written by John Lukacs with the title "Budapest 1900: A Historical Portrait of a City and its Culture", and it chronicles the rise of the middle class, rise of commerce, rise of industry, rise of science, rise of literature. It was fuelled by many things: a long period of peace, the influx of mostly Jewish population from the East eager to rise, an intellectual tradition. You know in mathematics, Bolyai was a culture hero to Hungarians, and that's why mathematics was particularly looked upon as a glorious profession.

But who nurtured this fantastic flourish-

ing of talent, which is so remarkable?

Perhaps much credit should be given to Julius König, whose name is probably not known to you. He was a student of Kronecker, I believe, but he also learned Cantor's set theory and made some basic contribution to it. I think he was influential in nurturing mathematics. His son was a very distinguished mathematician, Denes König, really the father of modern graph theory. And then there arose extraordinary people. Leopold Fejér, for instance, had enormous influence. There were too many to fill positions in a small country like Hungary, so that's why they had to go abroad. Part of it was also anti-Semitism. There is a charming story about the appointment of Leopold Fejér, who was the first Jew proposed for a professorship at Budapest University. There was opposition to it. At that time there was a very distinguished theologian, Ignatius Fejér, in the Faculty of Theology. Fejér's original name was Weiss. So one of the opponents, who knew full well that Fejér's original name had been Weiss, said pointedly: "This professor Leopold Fejér that you are proposing, is he related to our distinguished colleague Father Ignatius Fejér?" And Eötvös, the great physicist who was pushing the appointment, replied without batting an eyelash: "Illegitimate son". That put an end to it.

And he got the job?

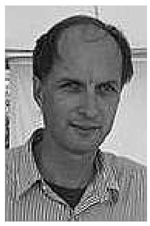
He got the job.

Siste del av interviewet kommer i septembernummeret

Meninger

Matematikk i skolen

Kristian Ranestad. Matematisk institutt, UiO



Sudoku har rast over landet som en farsått i sommer. Familier kopierer avisens daglige oppgave, en til hver, slik at alle får prøvd seg. Selv om en ikke trenger å bruke de fire regningsartene, vil jeg ikke nøle med å kalle dette matematikk. De systematiske og logiske ressonnementer er forekommer ofte i matematikk, og spillet kan helt sikkert egne seg som eksempel i matematikkundervisningen på ulike nivå etter den enkelte lærers skjønn. Det vil imidlertid være helt galt å ta inn Sudoku i læreplaner og lærebøker, for dermed å gjøre det til en viktig del av matematikkfaget i skolen.

Dette eksempelet illustrerer et par sentrale tema i diskusjonen rundt matematikkfaget og nye læreplaner det siste halve året.

Kathrine Aspaas retter i sin kommentar *Matematikk i våre hjerter*, Aftenposten den 6. Juli 2005, en anklage til landets "realfagsprodusenter". De er ikke i stand til å lage et produkt som er relevant for kundene, i stedet bidrar de på ulike måter til inntrykket av fag i krise. Nå er ikke realfagene i krise, men rekrutteringen, ikke minst til realfagslærerutdanningen er i krise. Dette er en stor utfordring. Det blir imidlertid galt når Aspaas først og fremst etterlyser en tilpasning av faget som produkt etter hva som er aktuelt og populært. Da kan en fort ende med Sudoku eller andre interessevekkere som viktig innhold i fagene.

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

I disse dager legger departementet siste hånd på nye læreplaner for grunnskolen (se `www.skolenettet.no/lp`). Fram til for førti år siden fokuserte læreplaner og lærebøker i matematikk i stor grad på sentrale regneteknikker bygd på de fire regningsartene. Siden den gang har ulike bruksområder fått mer og mer plass. Det er naturlig at undervisningen i matematikk kombinerer innlæring av grunnleggende teknikker med anvendelser som viser relevans utover faget selv. Men denne tendensen har gått for langt når gangetabellens plass i læreplanen står i fare. Sammen med brøkregning og parantesregning representerer den grunnleggende teknikker som en ikke kan ta bort uten å ta bort faget.

Diskusjonen omkring gangetabellen har blitt overraskende stor. Både blant matematikklærere, i lærerutdanningen og blant politikere. Noe av diskusjonen har dreid seg om hvor detaljert planen skal være, men like mye har diskusjonen dreid seg om hvor langt en skal gå i ferdighetstrening i tallregning og prealgebra i grunnskolen. For meg ble etterhvert disse tingene så viktige punkt i læreplanen, at de fleste andre invendinger mot planen ble underordnet.

Arbeidet med nye læreplaner for fordypningsfagene (programfagene) i matematikk i videregående skole er igang. Læreplangruppa, som jeg har ledet, har sendt sitt forslag til utdanningsdirektoratet. Vi har lagt vekt på færre emner enn tidligere, med mer tid til fordypning og ferdighetstrening både i algebraisk manipulasjon og i argumentasjon/bevis. Forslaget vil etter planen bli lagt ut til høring i høst. Jeg ser fram til høringen og diskusjonen omkring den, og håper på bredt engasjement.

Læreplanene er imidlertid bare en liten brikke i det løftet for faget i skolen som vi trenger for å sikre rekruttering. Viktigere enn læreplanene er selvsagt lærerne.

I Lamis (Landslaget for matematikk i skolen, www.lamis.no) har vi i løpet av de siste årene fått en forening for matematikklærere fra barnetrinnet til høgskoler og universiteter med over 3000 medlemmer. Lamis har nå lokallag over hele landet og er en møteplassen for alle som er interessert i matematikkundervisningen i skolen. Det er viktige at alle matematikkmiljøene ser den muligheten som Lamis representerer til å nå fram til de som underviser i faget i skolen, og på den måten være med på å ta et felles løft for faget.

(Red. anm: lesere som er ukjent med spillet "Sudoku" som refereres til i artikkelen kan slå det opp i f.eks. Wikipedia.)