Jeremy

The Official Journal of The University of Sydney Physics Society

Volume 5 Number 5 November 1989

Editorial

We said we'd do it and, by George, we did it. Against the advice of our friends, we have struggled through endless hours of late night typing to bring you a fifth issue of *Jeremy* for the year. This editorial is again being composed only hours before press time. Crazy, you say? Yes, we answer.

Well, we guess we'd better tell you what's in this issue. Most of the stuff has, for once, been written by people other than us. We have a serious (shock, horror!) article about the very latest developments in particle physics and string theories, kindly written for us by Dr Jan Govaerts of the Katholieke Universiteit Leuven in Belgium. Someone else has submitted a less serious story about the life of a quote collector, but is too afraid to own up to it. Whoever you are, thank you. Bodie returns with more *Physics Forum* and we have the last of this year's entries for the *Kit Kat Quotes Competition*. Several cartoons have been submitted and appear within these hallowed pages. All in all, we must say that we are pleased with the fact that we haven't had to write this whole issue by ourselves. It's given us the few spare minutes we need to do things like our assignments and projects.

But really, we've had a lot of fun editing this journal for you, even if it did mean writing most of it for the first few issues, staying up until all hours of the night finishing off issues before the printing deadline, hefting boxes containing eight thousand sheets of paper, battling with the collating machine and Murphy's Law at the same time, distributing *Jeremy* to lecture classes under the eyes of a lecturer who knows he's not going to get any sort of attentiveness out of his class for the next hour, and being told by everyone that we were mad for taking on such a job. Well, we think we enjoyed it, anyway. We're too tired at the moment to remember.

And now, we have to say good-bye for this year. We wish everyone the best for the exams and hope that you all have a well-earned rest over the summer. Everyone coming back, we'll see you again next March, and for those of you who will not be doing physics next year, good luck in the future.

That's about it. Have fun and take care.

The Editors: David Mar (Physics IV, Astrophysics)
Kim Lester (Physics IV, High Energy Physics)

J

Alien Ninja Bigfoot Tribe Found Near Loch Ness!!!

Well, we really put our foot in it this time. We said last issue that the Society was planning to have undergraduate past-year's exam papers with worked solutions for sale by about now. Unfortunately, we are still in the planning stage. We just didn't realise how much work would have to go into such a thing before we could get it off the ground. So we have to swallow our words and apologise for the inconvenience.

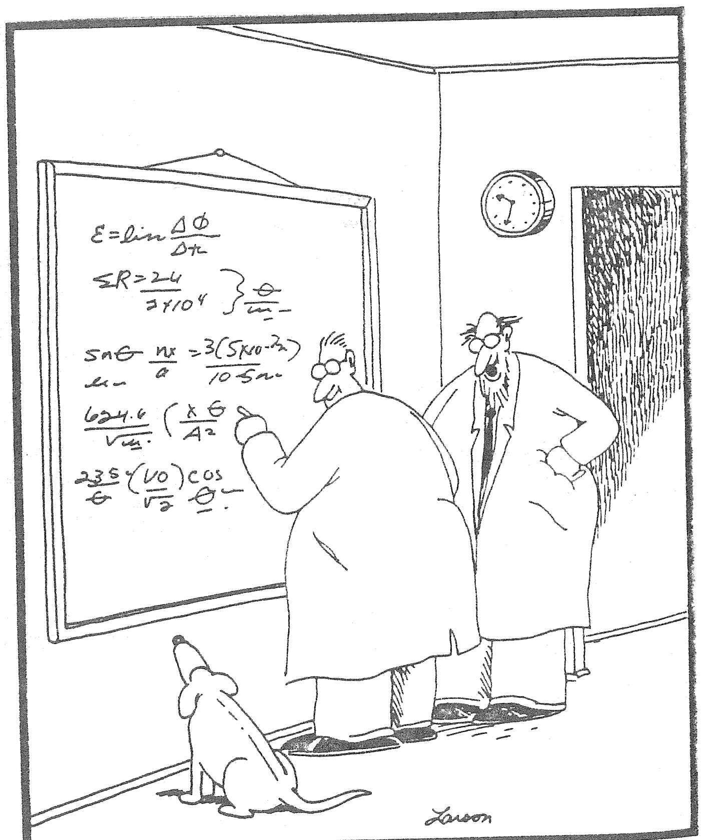
But we have managed to do a few other things since the last issue of *Jeremy* came out. There have been two informal discussion groups, at the normal fortnightly intervals. On the 12th of October, Prof. Jan Oitmaa of The University of New South Wales came all the way across town with a canister of liquid nitrogen and a Ph.D. student to help him demonstrate the amazing properties of *Superconductors*. Our very own Prof. Don Melrose gave an informative talk on one of his favourite topics, *Solar Flares*, on the 26th of October.

We must also tell of something which we neglected to mention in the last issue. These were the well attended, "almost exclusive", "almost live" video showings of *Images of Neptune*, direct from *Voyager 2* (well, via Parkes, JPL, Black Mountain, OTC and Telecom House), on the 24th and 25th of August (right about the time of closest encounter). These images were recorded for us by Telecom, to whom we are eternally grateful, only hours before being shown to the hordes of interested students and staff. Okay, so maybe a few were attracted by the prospect of free Jaffas.

There are also a couple of things which the Society does not have concrete plans for as this is being written, but which will hopefully come to pass by the time you read this. A Physoc lunchtime lecture on *Careers in Physics* is tentatively planned for the 1st of November. The huge, end of year Physoc party, at which the *Quotes Competition* winners will be decided, has yet to be given a firm date. Finally, the Society is hoping to organise a group expedition to Macquarie University for the Astronomical Open Night to be held there on the 4th of November.

That's about it for this year, really. The next thing to look out for is the Physoc stall during O-Week next year! See you there!

J



"Ohhhhhhh ... Look at that, Schuster ... Dogs are so cute when they try to comprehend quantum mechanics."

Physics Forum

Bodie Seneta

Virtual Kit-Kats

I'm going to start this column on a somewhat sour note, I'm afraid, but I'd rather do that than finish it that way.

As you will recall, as an incentive to all the budding authors out there, I have started offering Kit-Kats (donated to the Physics Society by Rowntree - Hoadley) as prizes for reasonable-sounding answers to the questions I pose here. This time round, as there was a fair amount of feedback, I chose to award two Kit-Kats; one to Kevin Moore for a solution to the glow-in-the-dark-stuff problem and one to John Morgan for an answer - at last - to the water droplet question.

Having established winners I went the fridge where they are kept - and discovered only an empty box! Subsequent queries to David and Kim, your editors, revealed that the previous week the carton had contained some twenty Kit-Kats, so I can only conclude that some incredibly selfish person has ripped off the Physics Society's donation. This seems to me to be a ridiculously petty thing to do, given that they could have bought something down at the sports centre for a trivial amount of cash. All I can do is award "virtual" Kit-Kats that have a pseudo existence until energy is expended on them in the form of another generous donation from Rowntree - Hoadley.

Where will the thief strike next? Stealing jaffas before they get a chance to get down the aisle? What about hijacking chocolate shipments, or armed holdups at the local Darrel Lea? Or will (hint, hint) the thief relent and re-stock the fridge with twenty Kit-Kats, no questions asked? Only time will tell if this criminal's conscience is stronger than their stomach.

Of T-Shirts and Stimulated Emission

Kevin Moore (again) barged into my office when volume five, number four of *Jeremy* was published and said, "About your T-Shirt problem... have you considered stimulated emission?" After a moment of stunned silence I worked out that he was referring to my *Jeremy* article and I stopped trying to escape out the window.

The solution, as you may have already guessed, is actually very simple. As I explained the time before last, a phosphor glows for some time after it has been excited because it is difficult for the atoms to make a spontaneous transition to the ground state and they only gradually drop back. What I hadn't thought of - and should have - is that this does not mean that they can't de-excite by *stimulated* emission. If I shine red light photons on them, the photons cause them to de-excite via emission of more photons; in fact, exactly what happens in a laser. The resulting phosphor glows more dimly. Because the phosphor is in the solid state, there is a wide range of wavelengths for which this is true.

I am not, unfortunately, able to do laser physics with my T-Shirt, because none of the phosphors are enclosed in a resonant cavity. One could imagine, though, a laser where the phosphor has mirrors on either side and is excited (pumped) by some means. Unfortunately, it's already been thought of. Dye lasers use a phosphorescent liquid dye to achieve their lasing action.

Kevin wins, as promised, the Drover's Mate flick knife and a virtual Kit-Kat for his trouble.

The Frisbee Effect

As I expected, Tim Bedding of Astrophysics has shed light on the things frisbees do when they are thrown vertically. If you throw a frisbee this way (a bit like throwing a flick knife) it rotates in the air until it is flying upside down. I wondered why. What Tim did was to throw it with *opposite spin* in the same direction (a sort of underarm throw) - and it rotated until it was flying the right way up.

This makes the solution pretty obvious, particularly to those of you that are doing first year physics. It must be some kind of precession effect.

As far as I can figure out, the explanation is almost identical to that for a gyroscope. You've all seen the demonstration - a gyroscope slowly rotating horizontally about a pivot point because a force is being exerted in the vertical direction on the other end. With the frisbee the force is horizontal, pushing against the frisbee's rim and causing a rotation about the line of travel. Use a vector diagram to work it out, if you like.

But what causes the force on the frisbee? It can only be aerodynamic. You have to throw a frisbee pretty hard to get it to turn over, and you would expect there to be some sort of effect due to the asymmetry of a frisbee about its horizontal axis.

I can now propose a new experiment to back up this claim. If you throw a frisbee vertically with the top to your left, it should flip one way; if the top is to your right it should rotate the other way. If it doesn't do this then I'm wrong.

The Great Stagnating Water Droplet Problem

I have a solution, at last, to the question about why water droplets sometimes skitter about on the surface of a pool. It was submitted by John Morgan, a chemistry student, who gets a virtual Kit-Kat for his efforts. Those physicists who find the awarding of a prize to an outsider objectionable should be reminded that you have had since August to submit something and you have not done so, so I don't see what you have to complain about.

John's submission was exemplary. I reproduce it below:

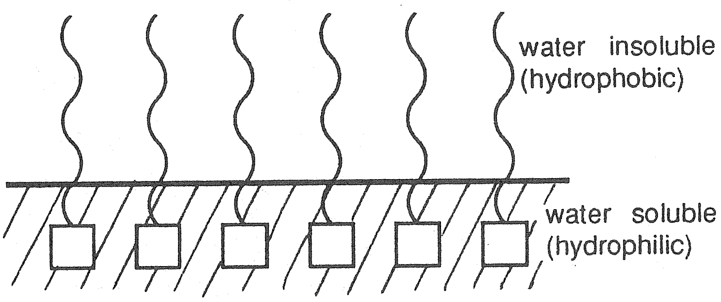


Figure 1: Soap molecules at an air-water interface.

Dear Bodie,

Being shocked by the revelation that no one had responded to your water drop problem I decided to shake myself from my apathy and venture a solution. That the sight of small droplets skittering across a surface of water invariably occurs when washing up suggests an answer. That it has taken another issue of *Jeremy* to reply is probably testimony to my skill in avoiding this task.

Washing-up water is full of soap

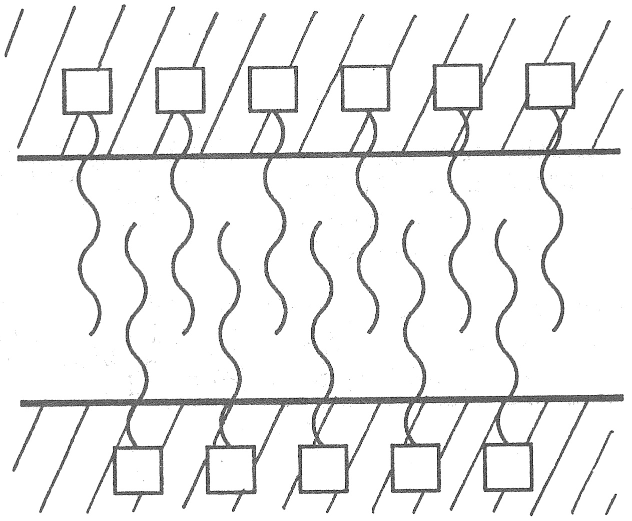


Figure 2: Soap molecules at the interface of two droplets.

molecules which have the property that a part of them is soluble in water and part of them isn't, so they tend to aggregate at surfaces [figure 1].

Further, the water soluble bits are usually charged and so repel each other while the water insoluble bits experience a slight dispersion attraction. Thus when two soapy surfaces meet something of a bilayer is formed which prevents mixing, which would explain the droplets sitting on the surface [figure 2].

To test the idea I rolled up my sleeves, took the week's washing from the sink, cleaned out the gunge and filled it with water. From the one clean spoon I dropped water from a height of about a centimetre onto the surface. No drops formed. However, when I added a small amount of detergent to the water in the sink droplets sat on the surface briefly. As more detergent was added droplets became larger and longer-lived, presumably because of the greater concentration of detergent at the surface.

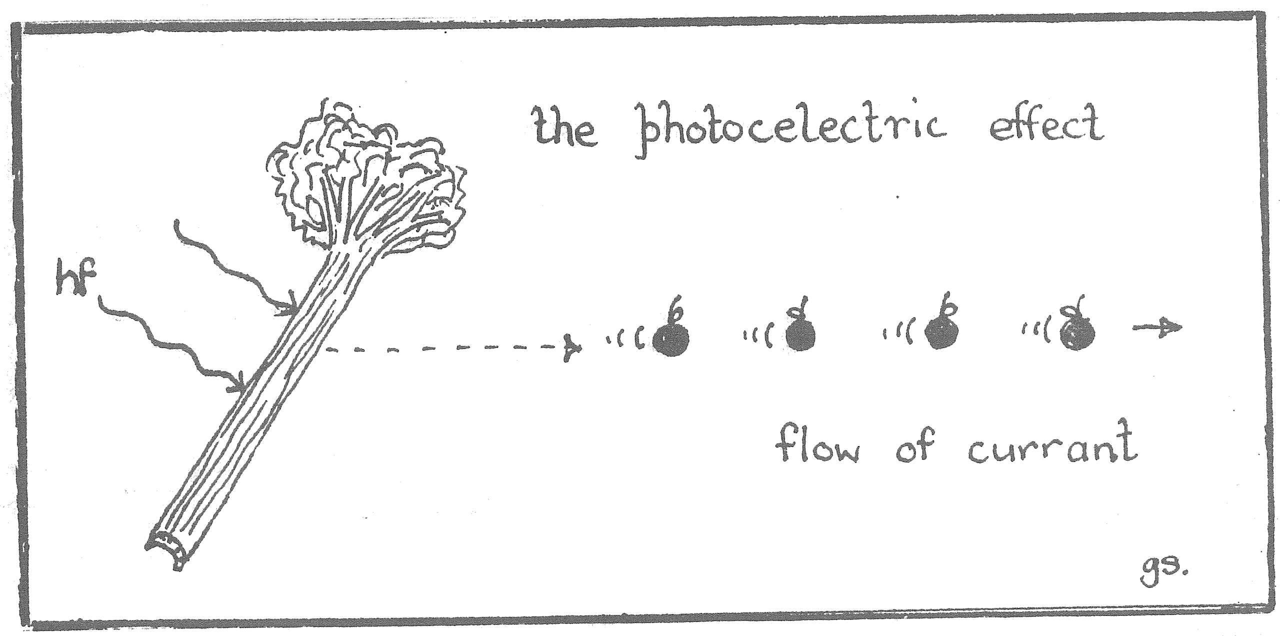
I think I have seen this phenomenon in the absence of large amounts of detergent. This need not be too surprising since unless one goes to great trouble water is rarely entirely without some surface active species.

John Morgan
Theoretical Chemistry IV

Well, there you have it. Having done a molecular biophysics course, I should have been able to work that out.

As this is the last issue of *Jeremy* for the year, I'm not posing any new problems; I wouldn't want to ruin your holidays by making you think about physics. I will, however, suggest an experiment for you. If you find yourself in a dark room that's illuminated only by ultraviolet ("black") light (currently very much the fad in nightclubs) take out your credit and debit cards and look at them. You'll be surprised by what you see.

I have enjoyed writing this column; I hope you've got something out of it too. My special thanks to all those who have contributed, and I'll see you all next year. **J**



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J

Are Elementary Particles Really . . . Particles?

by Dr Jan Govaerts,
Katholieke Universiteit Leuven (Belgium).

LEP and The Standard Model.

When driving from Cointrin airport, Geneva, through the village of Meyrin, just before crossing the Franco-Swiss border, one passes the main entrance of a rather strange looking place. About the size of a small village, with more than seven hundred people working there every day, the place bears little in common with a village. Indeed, it resembles more some important factory, with its many offices, long corridors, hundreds of control rooms and people from all over the world working at any hour of the day and night.

Oddly enough, the place does not (directly) produce goods of any commercial value. The men and women working there pursue a dream thousands of years old: understanding the Universe and all that it contains.

These rather ordinary men and women are particle physicists, trying to unravel one of the many secrets of the Universe: the structure of matter. The place is CERN, the European Centre for Nuclear Research, with its important complex of accelerators; necessary tools for particle physics. It is only one among a handful of other such laboratories in the world, where the quest for the structure of matter can be pursued.

As always, the place is buzzing with activity, but these days (July-September, 1989), all this exploding activity is directed . . . underground. All over the world, physicists are eagerly watching and waiting for the first results.

Indeed, "down under" (. . . but not quite that far!), at about fifty to one hundred metres underground, under the French Jura and close to the Lake of Geneva, CERN has built a big circular tunnel and new accelerator, with a circumference of more than 27 kilometres: the Large Electron-Positron Collider, or LEP. In this machine, the biggest in the world, two beams, one of electrons and the other of positrons, will be circulating close to the speed of light but in opposite directions and will collide with each other at tremendous energies (100 GeV[1]) in four huge detectors built by more than one thousand physicists. Physicists the world over will be watching when that happens.

Indeed, LEP has been built specifically to test the cornerstone of our present understanding of the world of elementary particles: the Standard Model (SM). What should come out of these collisions at LEP is not only a better understanding and a detailed test of the SM, but it should also have important implications for cosmology and astrophysics and tell us how to go further in our quest for a fundamental unification.

With our present understanding, embodied in the SM, all of the matter in the Universe is made of a few fundamental or elementary particles (and their anti-particles): quarks and leptons, all of spin $^1/_2$ [2]. One of these leptons is rather familiar and is the first elementary particle ever discovered, about 100 years ago: the electron e^-. The other two charged leptons are like big brothers of the electron, being more massive but otherwise having the same properties: the muon μ^- and the tau τ^-. Each of these charged leptons comes with a neutral lepton, the associated neutrinos ν_e, ν_μ and ν_τ, very elusive and strange particles, easily escaping detection but playing an important role in cosmology.

Quarks are the fundamental constituents of hadrons, i.e. the particles having strong interactions and found in nuclei, such as the proton, neutron, pions, etc. Quarks are very peculiar; their interactions are so strong that none has ever been observed in isolation. They always come in combinations of quark-antiquark pairs or as three quarks, a property called "confinement" although not fully understood. Six types of quarks are known and are given rather curious names: up (u), down (d), strange (s), charm (c), bottom or beauty (b) and top or truth (t), in order of increasing

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[1] For first years: GeV = giga-electron-volt = 1.6×10^{-10} joules, which is enormous for a particle as small as an electron — Ed.

[2] Spin is a fundamental property of particles. If anything else turns up that you haven't heard of before, just wait until second year, or third, or fourth . . . — Ed.

mass. (To be precise, the neutrino ν_τ and the top quark have not yet been observed but there are all sorts of very good reasons as to why they must exist.) They carry fractional charges: $+2/3$ for u, c and t quarks and $-1/3$ for d, s and b quarks. For example, the proton is made of the three quarks (uud) and the pion π^+ of the quark-antiquark pair ($u\bar{d}$).

Generally, quarks and leptons are subject to the four known fundamental interactions, namely gravitational, weak, electromagnetic and strong. In the SM, gravitational interactions are described by Einstein's theory of General Relativity and the remaining three interactions by a non-abelian gauge theory based on the group SU(3)×SU(2)×U(1), which unifies the electromagnetic and weak interactions into electroweak interactions based on SU(2)×U(1), whereas the SU(3) sector is also called QCD for quantum chromodynamics. These interactions are mediated by the exchange of particles. For gravitational interactions, this particle is the graviton, of spin 2, yet to be found experimentally. The other three interactions are mediated by spin 1 gauge bosons: the photon γ for electromagnetic interactions, the weak bosons $W^\pm$ and Z° for weak interactions and the eight gluons for strong interactions. Actually, the interactions of gravitons, gluons, Z° and $W^\pm$ are such that they also interact with and amongst themselves.

All quarks and leptons take part in gravitational interactions by their mass and spin. Only charged quarks and leptons participate in electromagnetic interactions by exchanging photons, but all quarks and leptons interact weakly by exchanging W's and Z's. Finally, only quarks interact strongly, by exchanging gluons. Quarks carry a new kind of charge, coming in three varieties (as opposed to one variety for the electric charge), hence the curious names of "colour charge" and "quantum chromodynamics" for theory describing their interactions.

It is only six years ago that the last discovery of elementary particles was made. In January, 1983, with the use of another accelerator at CERN, the proton-antiproton collider, the weak bosons $W^\pm$ and Z° were discovered in two big experiments specifically built for the purpose. By the annihilation of a quark from the proton and an antiquark from the antiproton, a $W^\pm$ or a Z° could be produced and observed indirectly through its subsequent annihilation into a pair of leptons. For example

$$u + \bar{d} \to W^+ \to e^+ + \nu_e \qquad \text{or} \qquad u + \bar{u} \to Z^\circ \to \mu^- + \mu^+.$$

This was a fundamental and impressive confirmation of the SM.

Six years later, with LEP and four large experiments ready to run, physicists are about to start a detailed experimental test of the SM, especially in the electroweak sector (this is also happening to some extent at the Stanford Linear Collider in California, the Tevatron at Fermilab, Illinois and HERA in Hamburg), and hopefully bring us closer to the fulfillment of the physicist's ultimate dream: the understanding of our Universe.

The Ultimate Unification: Superstrings?

Although the SM was essentially completed in the mid-seventies, since then theoretical particle physicists, in spite of appearances, have not been sitting around . . . reading *Jeremy* (!) and waiting for their experimental colleagues to finish testing and checking all the bits and pieces of the SM.

In fact, particle physicists are very proud of "their" SM (and being common mortals, they tend to think rather highly of themselves at times!). Everyone realises, however, that the SM has all sorts of unsolved features.

On the one hand, there is our present inability to extract all physical consequences of the SM, especially in the strong interaction sector (the spectrum of hadrons, i.e. of bound states of quarks and gluons) and in the interplay between strong and electroweak effects (semi-leptonic decays). This leads to a large amount of research work on the "phenomenology of the SM", which requires a better understanding of the dynamics of the SM, an important but far from trivial task.

On the other hand, since the SM does not unify the gravitational, electroweak and strong interactions, since it actually contains more than twenty arbitrary parameters (such as the masses of the quarks and leptons), and since it involves some rather strange coincidences (such as the fact that the electric charge of the d quark is *exactly* one third that of the electron), one has the feeling that the SM is not the end of "the road to fundamental unification". Hence, over the last fifteen years, theoretical particle physicists have also been playing with many different new and not so new ideas for the unification of particle physics (such as grand unified theories, extended technicolour, composite models, supersymmetry and supergravity, Kaluza-Klein theories, etc). One after the other, these approaches went out of favour, either being not really compelling enough, or suffering from theoretical or phenomenological inconsistencies. All these ideas for unification were formulated in the context of quantum field theories, where the fundamental constituents of matter are thought of as being point-like particles.

But are elementary particles really . . . particles?

This is how, about five years ago, an old but nevertheless very "new" idea, ideally fit for this context, was revived, making the search for the unified theory of everything an even more speculative but fascinating research field. The idea is that particles are actually . . . relativistic strings; fundamental objects not like points but like lines, which, by being excited in different vibration modes, could lead to the existence of all known particles. The same string could thus be a quark, a lepton, a graviton, a photon, a gluon, a $W^{\pm}$ or a Z°, depending on its state of excitation. This is a wonderful idea; all of the Universe, its contents and its interactions would then be made of only one single type of object, a fundamental relativistic string, . . . or heaps of strings all in a good vibrating mood!

Not only is this idea very much in favour, but it is the best and only consistent proposal we have so far for the ultimate unification. The construction of these superstring theories ("super" stands for the existence of a space-time symmetry which exchanges bosons, of integer spin, and fermions, of half-integer spin) is very much contrived, but nevertheless, and surprisingly, very large numbers of such theories may be constructed, all leading to a consistent quantum unification of gravity with the other interactions and of all particles.

Much however, remains to be done before being able to relate superstring theories to the SM. On the theoretical side, we are missing a profound and thorough understanding of these theories. We know which "building blocks" we have to use, and how to put them together to construct such theories, but we have no hint whatsoever as to why these "building blocks" actually "fit each other" so well, and in so many different ways. Moreover, the same "building blocks" also appear in completely different fields of physics and mathematics. They are fundamental in the study of two-dimensional statistical systems at and off criticality, and have led to important developments in that field in recent years. These "building blocks" also "unify" what seem to be completely unrelated old, as well as very recent, fields in pure mathematics, such as number theory, modular forms and Riemann surfaces, quantum groups, braid groups, the classification of three and four dimensional manifolds, the theory of knots and links, etc. In themselves, these are truly fascinating subjects!

On the phenomenological side, superstring theories have a natural scale of the order of the Planck scale, namely 10^{19} GeV. This is the energy scale at which quantum gravitational effects overwhelm all other interactions. Having a consistent theory describing physics at such scales is essential in coming to grips with the very first moments in the creation of the Universe! The Planck mass is 17 orders of magnitude above the natural scale of the SM, namely 100 GeV. One of the biggest unsolved mysteries of particle physics is to know what lies "between here and there". If superstring theory is indeed the ultimate unification, then the day we have a thorough understanding of its dynamics, the theory should tell us how this puzzle can be solved. At worst, we would then have to pick among the very large number of of possible theories, the only one (or the very few?) leading to the SM at 100 GeV, with no explanation as to why this theory rather than any other is realised in our Universe. At best, we would have only one superstring theory, leading precisely to the SM!

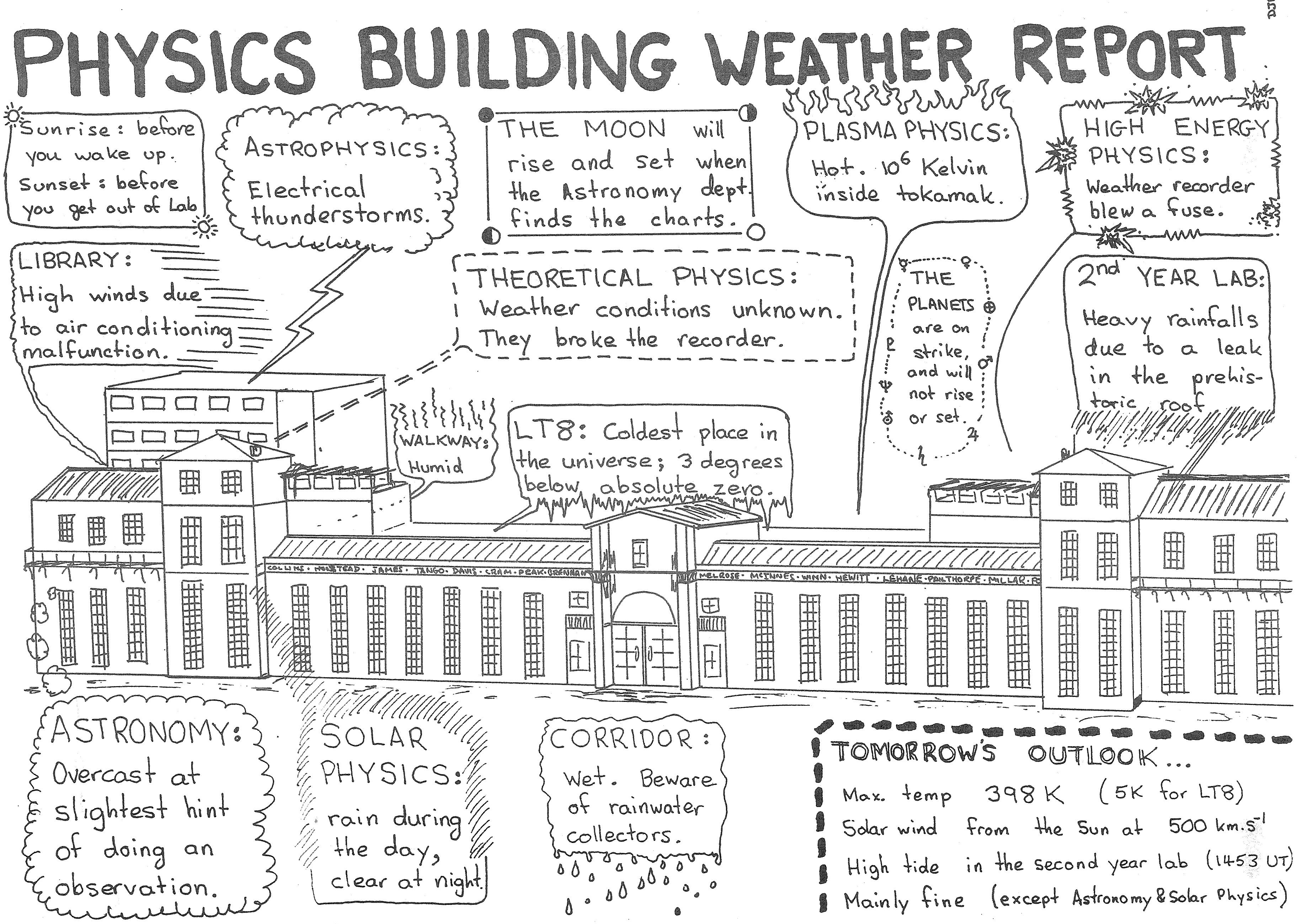
Of course, it could well be that superstrings have nothing to do with our Universe. But then, God obviously went to a whole lot of trouble putting together all of this beautiful mathematics, which find such a natural place in string theories. Unless of course, He has something even more beautiful in store for us?!

Clearly, with new and powerful accelerators becoming operational, and further understanding of superstring theories and related mathematical aspects, we should be witnessing very exciting and fascinating developments in particle physics in the coming years. Let us not miss the rendezvous!

Postscript:

It just happened! On August 14, LEP has produced its first Z°, by running at 45.5 GeV per beam. It is just beginning!!

J


PHYSICS BUILDING WEATHER REPORT
Sunrise: before you wake up. Sunset: before you get out of Lab
ASTROPHYSICS: Electrical thunderstorms.
THE MOON will rise and set when the Astronomy dept. finds the charts.
PLASMA PHYSICS: Hot. 10⁶ Kelvin inside tokamak.
HIGH ENERGY PHYSICS: Weather recorder blew a fuse.
LIBRARY: High winds due to air conditioning malfunction.
THEORETICAL PHYSICS: Weather conditions unknown. They broke the recorder.
THE PLANETS are on strike, and will not rise or set.
2nd YEAR LAB: Heavy rainfalls due to a leak in the prehis-toric roof
WALKWAY: Humid
LT8: Coldest place in the universe; 3 degrees below absolute zero.
ASTRONOMY: Overcast at slightest hint of doing an observation.
SOLAR PHYSICS: rain during the day, clear at night.
CORRIDOR: Wet. Beware of rainwater collectors.
TOMORROW'S OUTLOOK...
Max. temp 398 K (5K for LT8)
Solar wind from the Sun at 500 km.s⁻¹
High tide in the second year lab (1453 UT)
Mainly fine (except Astronomy & Solar Physics)

The KitKat Quotes Competition

Here it is: this year's final set of entries for the *Kit Kat Quotes Competition*. Unfortunately, we don't know what the winning quote is yet, because the voting is taking place after this issue of *Jeremy* goes to the printers. But rest assured that the rightful winner will be semi-publically humiliated by having the Quote of the Year trophy, suitably engraved, presented to him (or her) at morning tea, in front of the rest of the staff. The submitter will be subjected to similar treatment in front of one of his or her lectures. Full details will be published in next year's first edition of *Jeremy*.

And now folks; you knew they were moronic, we knew they were moronic, but they had to go and prove it all over again — here come the quotes!

Ross McPhedran:

"Let me have a go at abusing myself."

"This class is highly infectious."

"A friend of mine once made a rather exaggerated remark: that chemistry was 'a little branch of physics that I solved in 1929'. He actually said chemistry was 'interesting', but I think he was wrong about that."

". . . in that way, you severely underestimate your own ignorance."

"And from now on we degenerate from quantum physics into chemistry."

"From your intensive study of diffraction theory . . ."

"That's one of the amazing things about this equation, all the particular details about it are gone!"

"I'm sure you'll agree that that's enough equations for one lecture."

"One day quantum physics became quantum mechanics, and we've been suffering the consequences ever since."

"One of my friends considers quantum mechanics to be a branch of physics based on mathematical theories which are untrue."

"It only took them ten years to go from $p=h/\lambda$ to $\lambda=h/p$."

"These sorts of problems are dealt with in subjects like chemistry, about which I don't want to say too much more."

"Equation 33 hasn't come back from holidays yet, quite obviously."

"Physicists don't believe anything that radical unless they can subject it to all the tests they can think of."

Lawrence Cram:

"Astrophysicists just look up the formulae in books."

"I'm trying to be gentle."

"We've so far seen this volume in one dimension."

"I don't know how to draw imaginary curves on real paper."

"I know the first line and I know the last line; I just can't work out the bit in between."

"I don't know why we should assume this, except that nature behaves nicely."

"I'm going to fill up the board with algebra and at the end we'll have the result we want."

"There's another explanation in French & Taylor, but I don't understand it."

"I'm doing this on the board because of the nasty things said in *Jeremy* about my algebra."

Laurie Peak:

"Playing with mesons is much more satisfying than playing with baryons."

"This reaction will go if you tilt your head a bit, say by 90°."

"You mustn't forget to have lunch."

"The most disturbing thing in any book is 'it can be shown'."

"Today is going to be all theoretical. I'm sorry about that, but that's life."

"As we increase the energy — and there you can see the energy increasing in zaps . . ."

"You've got to make a little bit of a fudge here . . . or a big fudge, depending on how you look at it."

Cathy Foley:

"We do this so you can get a nice feeling inside, not because it's examinable."

Dick Collins:
"Divergence measures . . . well, I can't think of a better word — it measures divergence."
"Your confusion shows good perception."
"There's no physics in that derivation — and it's not even magic."

Bill Tango:
"Unlike the Huygens construction, this construction is valid."

Neil Cramer:
"A hot body always cools down and a cool body always cools up."
"I suppose that's as clear as mud. Let's proceed."

Max Brennan:
"Hopefully I'll know what I'm talking about."
"Little particles don't *always* behave like golf balls, you know."
"They're just the ordinary type of fission reactors, which you can buy off the shelf today."

Don Melrose:
"When asked how the electrons separate from the positrons in the magnetosphere of a pulsar, you would go um . . . errr . . . aaah . . ." (*Waving hands around.*)

Dick Hunstead:
"Please excuse me if I seem a little confused. I've just finished a first year lecture course and I'm suffering from withdrawal."
"Of course, aficionados of *The Hitch Hiker's Guide To The Galaxy* will realise this straight away."
"Now I left you at a temperature of about 3000K last Tuesday, and cooling rapidly."
"Astronomers like to plot things on logarithmic scales because the errors are so huge and the trends so weak that you have to plot them on a log-log graph in order to get anyone to believe them."

Paul Walker:
"I'm not in the business of telling people the truth."
"The best advice you can ever get is never to take advice from anyone."

David Faiman:
"This generalisation is too general."
"Let's face it, 10^{17} is much bigger than 1."
"Probably the best approximation that you'll ever make is that $10^{17}+1$ is 10^{17}."
"The rest of this lecture is, I think, just words."

FØRƎIGN QUOTES:

John McMullen (Pure Maths):
"Number theory has been studied because of its incredible beauty."
"I would have thought a little more motor control over the mouth would have been required before doing maths."
"This is a mathematical problem that arises from mathematics."
"Not all of these functions work, whether you're in the real world, the world of mathematics, or somewhere else."
"This proof can be very, very messy if you use the 'discovery' method; or you can bring it all together and make it look like a trick. We'll use the trick."

Don Cartwright (Pure Maths):
"Get this into your fat heads!"
"The ultimate honour is when your name becomes an adjective."
"There must be an easier way to do this, but I don't know it."
"You learn this at school . . . well, you have the opportunity to learn it at school."
"I'm pulling the wool over your eyes."

T. C. Kuo (Pure Maths):
"Mathematics is theology . . . and the temple is the Pure Mathematics Department."

Robert Armstrong (Inorganic Chemistry):
"Who's bored witless?"

Leslie Field (Organic Chemistry):
"He looks like a reject from *Miami Vice*."
"If you've got hydrochloric acid in your lungs, well . . . exit, stage left!"
After switching off lights to show slides: "Engineers, please keep your hands on the table!!"

Steve Simpson (Electrical Engineering):
"I'd expect that it would be close enough to zero. If it's not zero it's, infinite."

J

Acknowledgements

The Physics Society and *Jeremy* (and us) never would have made it through this year without the help and support of many people and organisations.

Financially, we graciously acknowledge the funding made available to the Society for the organising of parties, free munchies at various events and the printing of *Jeremy* by the Student Union. Most of the things the Society has done this year would have been impossible without this funding. The Science Association also helped fund many of the Society activities this year. Beyond Limited made a substantial donation towards the cost of printing *Jeremy*. All members of the physics academic staff dug deeply into their pockets in order to help the cause. Finally, we thank all of the students who parted with some hard-earned cash and joined the Society this year.

Rowntree-Hoadley have, of course, sponsored the *Kit Kat Quotes Competition*, and their donation of the major prize of a whole box of Kit Kats is most appreciated.

We must thank all of the people who gave up their own time in order to give lunchtime lectures or speak at discussion groups.

We thank everyone who contributed anything to *Jeremy*, be it a series of articles or just an entry for the *Quotes Competition*.

On the production side, we thank Sean (we're not sure if that's the right spelling, but it's pronounced *Sharn*), the tireless woman who slaves over a hot printing press to bring you *Jeremy*, and Sergio, the guy who showed us how to nurse the automatic collating and stapling machine in Carslaw so that it doesn't mangle hundreds of copies of *Jeremy*. Kathryn Collins deserves mention as the most patient person in the Physics Building; throughout the year she has had to put up with almost everything imaginable as we rushed to type and print each successive issue of *Jeremy* on her computer.

Ian Johnston helped the Society to organise many of the events held this year. In fact, almost everything Physoc did was suggested to I.J. first, and acted upon with the help of his constructive suggestions. Elizabeth Hing almost requires a salary from us, after spending a substantial amount of time as Physoc's "unofficial secretary". Her help in getting many and varied things done for the Society has been invaluable.

On a more personal side: Dick Hunstead and Andrew Bakich, our project supervisors, have been patient with us on the occasions when we have spent time toiling over *Jeremy* instead of our projects; for this we owe them thanks.

Lastly, we thank you. Everyone who has read *Jeremy* and/or has been involved with any of the activities which the Society has organised and run this year deserves all of the thanks we can give. Without you, none of it would have been possible at all.

The Eds.

J

Did You Get That One Down?

(A day in the life of a quote collector.)

by A. Nonymous, Physics XVII.

The story you are about to read is true (well, sort of). The names have been changed to protect the innocent.

The Day: Monday, 32nd of September.
The Time: 9:25 am.
The Place: The Physics Building.

My name is Max. I'm a quote collector. It's a dirty job, but someone has to do it.

And this particular morning, my job was looking dirtier than ever.

I took a deep breath of the carbon monoxide tinged air and pushed open the the grey doors emblazoned with notices. The corridor stretched out before me. I walked in. The air was cold and lifeless. The heaters hadn't worked since 1953. It doesn't worry the staff. In the pursuit of science you have to make sacrifices to get the job done.

I strode down the corridor. I'd done this 674 times before. Up the stairs, around the corner, across the walkway and through a glass door. The library! I took a seat and began to browse through a *Sky & Telescope* magazine. I'm a sad case. These things happen.

At 9:50, as if on cue, my assistant sauntered in. Her name is Stella. She glanced at the *Sky & Telescope* I was reading.

"You should give those up, you know. They're not good for your health."

I ignored her. She continued.

"I've got the list of suspects. For the PQ case, that is."

My mind was jerked back to reality. PQ's, or "Prepared Quotes", had been reported in *Jeremy*. Though not serious yet, we had been assigned to find the culprit before it got out of hand.

I took the piece of paper Stella was waving in front of me, looked at it for a second and got up. She handed me my coat as we moved out.

We traversed the walkway, making a mental note of which cars were in. Our first call was the First Year Office. We paused outside the door and I gave Stella the knowing look. We had done this many times before. I marched in and instantly my eyes spotted a lady standing behind a large desk, sorting mountains of paper.

"Looking for Life Science assignments?" she asked.

"No ma'am, we're from the P.I.A." (Physoc Intelligence Agency.) I turned to Stella, "Watch her carefully." I then strode through the second door, my pen and notepad at the ready.

"Freeze, McGuiness! One false move and you're on paper!"

Brain McGuiness looked up from a tub of soapy water with disinterested eyes.

"You're tracking down the PQ's, aren't you?" he said.

"You've used them," I stated.

"Ah! But I didn't create them. It was Dickens."

"D . . . D . . . Dickens?" I stammered.

"That's right," McGuiness turned back to his tub of soapy water.

Col Dickens. I might have known. I quietly left the room, collected Stella (yes, I can collect things other than quotes) and headed up to the Applied Physics Department.

Uncle Col had been nailed on PQ charges before. We ambushed him in a lecture. He didn't suspect a thing. It was not pretty. After that he came good, but it now appeared that he had reverted back to his old ways.

At last, we arrived outside his office. Both myself and Stella are quote collectors, but Stella is an undergraduate. Undergraduates are expendable. She knew what she had to do. It wasn't nice, but she understood the risks when she took the job. She burst into Professor Col Dickens' office, prepared for the worst.

The precautions were unnecessary. Uncle Col was tied to a chair, gagged. I pulled out a pair of pliers (all good physics personnel carry pliers) and began to cut the printer cable that was securing the professor to the chair. Stella undid the gag. Dickens began to speak.

"It was Ianston! He tried to silence me! It was Ianston, I tell you! Besides, if you take the double surface integral with respect to the . . ."

Stella redid the gag. We'd heard enough.

So, John Ianston, theoretician and quote mastermind, was behind it all. That also ruled out two other possible suspects: Professor Lawrence of Arabia/Astrophysics and Professor "Particle Accelerator" Leak. Stella crossed them off the list as we headed off for the second year laboratory.

For some unknown reason, this theoretician had been let within the three kilometre anti-theoretician buffer zone normally surrounding the second year lab. These buffer zones had been set up around all the labs in order to protect the equipment from breaking, as it always does according to Newton's Third Theoretician Proximity Law.

Actually, it probably doesn't matter because none of the experiments ever work anyway.

We found Ianston in a room on the upper level, alone. I burst into the room with Stella on my tail. Ianston gave us an icy stare.

"John Ianston," I began, "We're from the P.I.A. You're under arrest and have the right to remain silent according to . . ."

Ianston let off a prepared quote. It flew past me and narrowly missed Stella, who had ducked quickly at the last second. Then he said:

"You'll never take me, you ratbags! You can't prove anything. It's only my words against your paper."

We were prepared for this devastating blow. I signalled Stella, who handed me a mini cassette recorder with microphone. This combination of technology and miniaturisation had revolutionised quote collecting like the nuclear bomb had revolutionised world politics. Even to this day, thousands of staff would take to the streets in protest at the most ruthless quote recording implement since the semi-automatic fountain pen with belt-fed ink cartridges. I confidently switched on the recorder and smiled smugly at Ianston.

"If you think you'll get me that way, you're severely mistaken," said Ianston quietly, "You've forgotten the Third Proximity Law."

I stared down at the cassette recorder in my hands and my mouth opened in horror. By now the symptoms were well advanced; the buttons had jammed, the reels had mangled most of the cassette and the batteries were on the blink.

I looked at Stella. She shrugged and made for the door. I followed, dejected. Yet again we had failed in our quest to eliminate prepared quotes. And while these menaces are loose in our lecture theatres, nobody is safe. Next time, perhaps.

J

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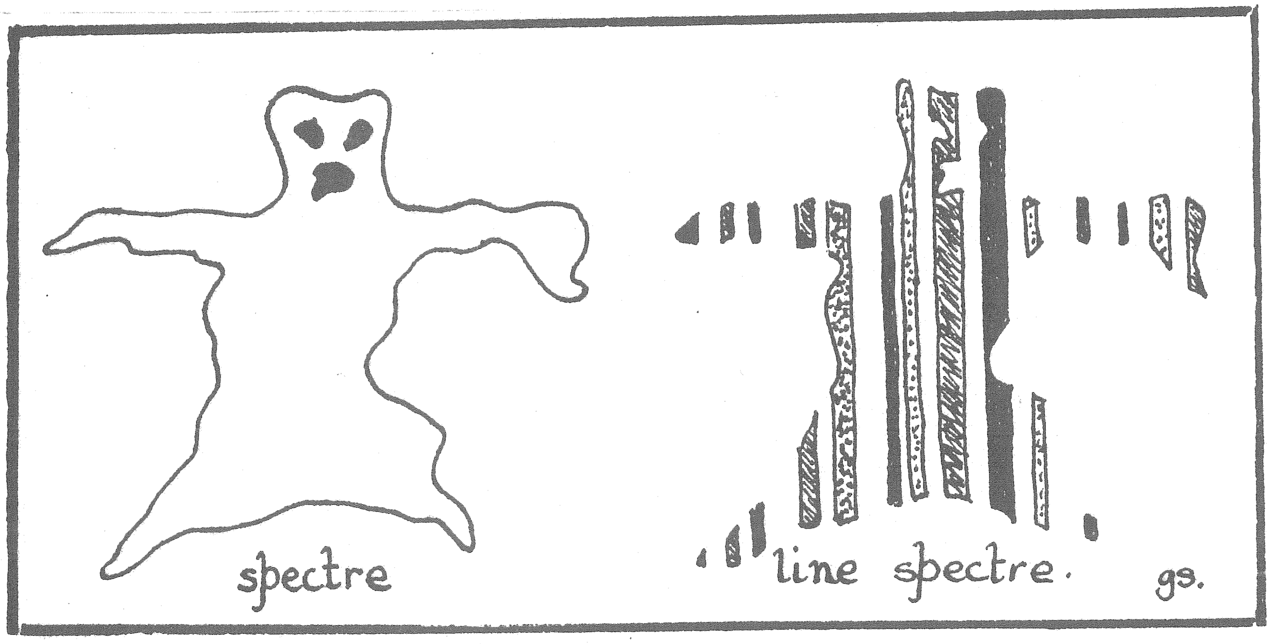
line spectre

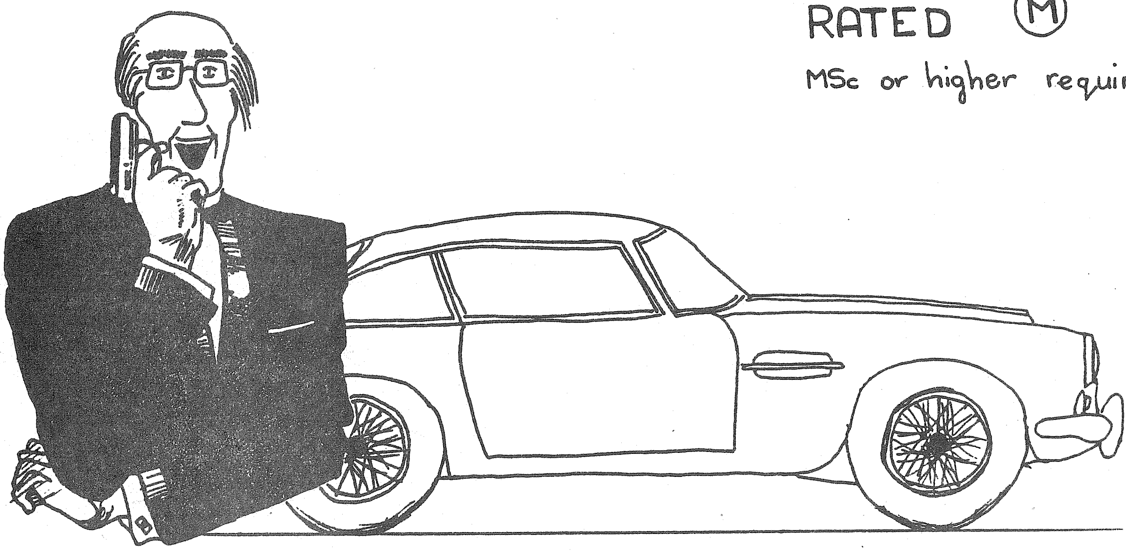


DICK COLLINS IS 007 IN...

LICENCE TO CHILL

RATED (M)

MSc or higher required.



Will 007 keep his cool, and uncover a cryogenic plot in a "Physics is Fun" lecture? Does dunking rubber balls into liquid nitrogen prove anything, or are we all being left cold? Find out in this chilling adventure... (I think we had better put a freeze on these pathetic puns).

STARRING Dick Collins (007); Max Brennan (M); Chief Lab Technician (Q); Paul Walker (Felix Leiter); Members of the Chem. Dept. (The Bad Guys).

NOW SHOWING AT A LECTURE THEATRE NEAR YOU