WASC 1925

June 1968
Radio script,
'Science in Action'
Talk on 'whiskers'

AS BROADCAST

Recorded: 20.6.68.
Tape No.: 8R/41E398G
Duration: 28'37"

Producer: Peter Beer
834 CB Bush PABX 2710
Direction: H.O.T.F.

Radio Programmes

'SCIENCE IN ACTION' - No. 38

A weekly review of Science, Technology and Medicine
(Any item used after six onths, should first be checked with the Producer)

TRANSMISSIONS:			
	WS:	Thursday, 20th June 1968	2045 GMT
	WS:	Friday, 21st June 1968	1615 GMT
	WS:	Saturday, 22nd June 1968	0215 GMT
	WS:	Monday, 24th June 1968	1130 GMT

Linking narration written and read by Arthur Garratt

Sig. tune: 'Newsprint' (Papworth) - International Studio Group, Directed by Hugo de Groot (DW/LP2921)

1. DELICATE NEEDLEWORK 8R/41E720G rec.23.4.68. Dur: 06'03"

   The plastic surgeon has to carry out some very fine sewing in order to rejoin the finer blood-vessels. Pauline Hillman recently visited Queen Victoria Hospital, East Grinstead, and talked to the plastic surgeon who was responsible for successfully rejoining an entirely severed finger.

2. X-RAYS FROM THE SUN 8R/41E572G rec.20.5.68. Dur: 05'11"

   Professor Sir Harrie Massey, F.R.S., of University College, London, describes the objects of rocket and satellite studies of solar x-ray emission to Aubrey Wilson.

3. SCIENCE NEWSLETTER * 8R/41E719G rec.20.6.68. Dur: 03'32"

   Presented this week by Bryan Silcock, whose subjects are aluminium-reinforced fibres; rapid cleaning of ships plates; lens grinding techniques; and an ear defender for noisy situations.

4. SAFETY IN THE AIR 8R/41E717G rec.19.6.68. Dur: 02'48"

   John Bentley, of "FLIGHT" magazine, has just returned from the Beirut conference on air safety, and reports on some of the developments discussed.

5. SAFETY FOR THE FISHERMAN 8R/41E721G rec.22.5.68. Dur: 03'16"

   Tragic accidents earlier this year underlined the risks of distant-wanter trawling. One great danger is the icing-up of masts and rigging, and Palmer Aero Products has deveised an inflatable rubber sleeve to prevent this. Robin Burton talks to Mr. Campbell Thomas, the firm's Product Supervisor, about it.

6. DATING ANCIENT POTS 8R/41E255G rec.13.3.68. Dur: 03'52"

   The well-established radioactive-carbon method of dating rocks and archealogical specimens fails where carbon is not present - for instance in bricks or pottery. A method being developed by the Oxford University Department of Archaeology uses the phenomenon of thermoluminescence, as Mr. Brian Aldred of the Department explains to Paul Vaughan.

TAPE: Signature tune.

ANNOUNCER: 'SCIENCE IN ACTION'

TAPE: Signature tune.

GARRATT: Hello - SCIENCE IN ACTION, Arthur Garratt here. The subjects we have for you today include: x-rays from the sun, air safety, and safety for fishermen.

First I have to tell you that Britain's heart transplant patient has died 46 days after the operation. Apparently he contracted an infection which he could not resist. There will be more details, of course, when the results of the autopsy are published.

Bad news - but we have something much more encouraging to follow - on the subject of plastic surgery. To report - Pauline Hillman.

HILLMAN: I'm at the Queen Victoria Hospital, East Grinstead and I've just been looking at what looks like a human hair but it isn't:it's a very thin thread that's being used in some of the most advanced plastic surgery operations. And two weeks ago, at this hospital, the totally severed fingers of a patient were rejoined and with me is the surgeon who did the operation. Is this the first time this operation has been done in this country?

SURGEON: To my knowledge it is the first time it's been done in this country, and of course it is too early to tell whether the operation will be a total success. It has certainly been done in Japan and in the United States.

HILLMAN: How exactly do you go about it?

SURGEON: Well it is necessary not just to join the skin and the bone but particularly the small blood vessels carrying blood to and from the amputated part.

HILLMAN: What order of size are these blood vessels?

SURGEON: These are about the size of a pencil lead, the lead in an ordinary wooden pencil, not the propelling-pencil type which is usually smaller.

HILLMAN: So obviously you need some sort of magnification for this.

SURGEON: Yes we do.

HILLMAN: What exactly do you use?

SURGEON: We ourselves find it best to use some sort of operative microscope. The new one we have, in fact, is two operating microscopes built into one machine, so that two surgeons can work at once - one helping the other. The blood vessels have to be joined by stitching the edges together - this is like stitching the ends of two tubes together except the tubes are very small and so we have to use this fine stitch material you were talking about.

HILLMAN: How long have you been working on this technique?

SURGEON: Well we've been working in the experimental field on this technique for nearly four years though in fact other surgeons in the United States started this small vessel surgery about ten or twelve years ago.

HILLMAN: What's the smallest vessel you've been able to join using this technique?

SURGEON: About .7 of a millimetre in external diameter.

HILLMAN: That's fantastically small, it seems almost impossible to think you can stitch anything so small.

SURGEON: I think it's going to be impossible every time I see one.

HILLMAN: How is this technique going to help you in your work with tissue grafting?

SURGEON: Well basically I think I have to tell you a little bit about how a tissue is transferred from one part of the body to another before we can go into the real details of how this new technique will help. There are three basic methods - one is to cut a free graft, a thin graft, of probably skin and put it on a raw surface somewhere else. This will, in the course of time, gradually gain a new blood supply from the part where it is put down. There are certain sites where this cannot be used as the blood supply to the site where the graft is put is inadequate to support the life of the graft, examples of this are bare bone or bare tendon. When one wishes to place transfer tissue on such a site it is necessary to use what we call a pedicle graft.

HILLMAN: And what's this?

SURGEON: Well for example if one had a skin defect on the back of the hand that one wished to fill and for some reason one could not use a free graft, perhaps there was exposed bare tendon or bare bone on the back of the hand following an accident, it would be necessary to cut what we call a plaque - let us say of abdominal skin - one would cut three sides of a square and lift up this square rather like a trap door hinge along one side, and through this hinge would be the blood vessels taking the blood to and taking the blood away again from this flap of tissue.

HILLMAN: What happens to the underneath of the flap? Isn't it bleeding profusely?

SURGEON: Well one can stop the bleeding fairly easily and this raw underneath of the flap will then be placed on the raw surface on the hand. So that the hand is attached to the abdomen and the patient has to sit like this for about three weeks before a new blood supply has grown satisfactorily between the hand and this flap of tissue.

HILLMAN: Is the hand encased in plaster of Paris to stop them moving away?

SURGEON: Well in this particular instance some form of strapping, adhesive strapping is usually adequate, a little bit of movement is permissable. At the end of three weeks one can divide the hinge and the flap of skin that you have transferred will live on the new blood vessels that have grown into it from the hand. This is the second method of transfer.

The third method is not at present in use in plastic surgery and the best example of it that I can give you is in a kidney transplantation where the kidney is taken from a donor and put into the recipient. And when this is done the blood vessels are joined up so the kidney, which has been transplanted, has an immediate blood supply to and fro.

HILLMAN: Now why isn't this in use at the moment?

SURGEON: This isn't in use in plastic surgery because the blood vessels concerned in feeding such a piece of skin are smaller than one has been used to joining up.

HILLMAN: How big are the vessels in a kidney for example?

SURGEON: Well the vessels in the human kidney are perhaps the size of a pencil; whereas the vessels concerned in a small piece of skin that one might be transferring might be something again the size of a pencil lead or even a little bit smaller.

HILLMAN: So obviously this is where the new technique comes in?

SURGEON: This is where the new technique comes in. This operation has not been done in the human; it has been done successfully with an experimental animal and various surgeons around the world are waiting for a suitable case to do this operation on.

HILLMAN: Which will obviously come up in the near future you say?

SURGEON: Well we all hope so.

HILLMAN: May I wish you the best of luck when that time comes along. Thank you very much for talking to us.

SURGEON: Thank you.

GARRATT: Fascinating isn't it, and that was Pauline Hillman talking to a plastic surgeon.

Astronomers have suspected for many years that the sun and stars radiate in the infra-red, ultra-violet and X-ray regions - but our atmosphere, fortunately for us, totally absorbs these. It wasn't until the coming of rockets and satellites that we could put instruments up high enough to detect this radiation. The first detection of X-rays from the sun was by rocket in 1958. Since then many satellites - such as the ESRO TWO - have been fitted with detectors and we have pieced together a great deal of information of obvious interest to astrophysicists. Aubrey Wilson went to see one of the leading men in this field, Sir Harrie Massey, and asked him first what interested him about the results:

MASSEY: Well a great number of different features - we're interested in practically all of them. In the first Anglo-American satellite we had equipment to study in detail the hardness of these X-rays, that is to say, what was the intensity of comparatively soft and less penetrating X-rays, as compared to the more penetrating ones. We got very satisfactory and interesting results from these experiements, but we want to go on ahead in very much more detail, because the sun, which you all know is a very variable star at times when it is very spotty and so on - and the variability is associated very closely with its emmission of X-rays. And what we want to do is to track down this association in much more detail. Comparing the emission of X-rays with the emission of other radiations from the sun and this envolves continuous observation of the X-rays from a space vehicle.

WILSON: Which particular satellite contains your equipment for information?

MASSEY: This was ARIEL ONE, since then we've had other equipment up - we have some operating now in an American orbiting solar observatory and we are preparing other equipment - some of it is launched in rockets at Woomera and some will be launched in future satellites.

WILSON: Talking about equipment in satellites, have you got any equipment in ESRO TWO which was put up the other day?

MASSEY: Oh yes certainly, we have equipment which is concerned with this very matter of X-ray emission from the sun. ESRO TWO has a very suitable orbit to study these matters because it's related to the orbit which is polar and it also provides us with the oportunity of comparing the X-ray radiation with actual particle radiations which can only be observed in the poles. Other people are carrying out the observations on these particles and we will be able to compare our X-ray results with theirs.

WILSON: What specific information are you looking for from ESRO TWO?

MASSEY: Well examining the quality of the X-rays from the sun - that's to say the intensity of the X-rays in, which are hard X-rays, the inensity of soft X-rays and so on, in some detail, rather more numerical detail than just hard and soft, considerably more. But it is this sort of information we want to get.

WILSON: How do the satellites actually transmit the information to you?

MASSEY: Well on board the satellite there is a radio transmitting system and the signal which it transmits is modified by the information which is accumulated about the X-rays. So that these modifications are sent down to us in the form of a signal which changes depending on the nature of the observations. We can interpret this and get the results we want.

WILSON: Yes, I was just going to ask you that, who interprets it? But how do you interpret it, that's rather more important?

MASSEY: Well this involves, of course, the use of high speed computers because there is an enormous amount of information comes down, really colossal amount and the computer does the first job for us in getting it into a form so that we can then think about it. The one thing, of course, which we can't avoid doing is thinking this is not possible to automate!

WILSON: But what I'm not still not quite clear about is what shape is the information in, when it comes to you?

MASSEY: The information as it comes to us is in numerical form. It actually gives in many instances the numbers we want to work on.

WILSON: So once you get these numbers, what's the next stage?

MASSEY: Well then we have to see what the signifcance of this is in relation to other information about the state of the sun - there is a great deal of information being accumulated in solar observatories and so on - which refer to radiations which reach the ground. We can compare with such observations and in that way try to find out what are the underlying factors which are determining the variability as expressed through the

MASSEY: (Cont.) emission of X-rays and the other radiations.

WILSON: So when you've got this information, you've got it tabulated and analysed and so, what use can you put it to?

MASSEY: Well one thing - actually this is not very far from being useful already - is that now that aircraft are flying very much higher, particularly the Concorde aircraft will fly at quite a high altitude, then there is the question of making sure that there is no danger from radiation, penetrating radiations from the sun. Such radiations are only emitted during disturbed conditions of the sun and we would like very much to be able to predict when the sun is going to be disturbed and what will be the extent of the disturbance.

WILSON: And what's the answer? I'm in a Concorde, am I likely to be affected?

MASSEY: Well if you know in advance whether it's likely or not, well, of course, you could avoid, actually avoid flying that high and if of course there was an actual outburst from the sun - the thing to do is to record this as quickly as possible so that you can then fly down to lower altitudes to avoid any serious consequences.

GARRATT: Sir Harrie Massey was talking to Aubrey Wilson at University College, London. Incidentally, Sir Harrie mentioned safety in the air and later in the programme we have something else on this subject.

But first, our regular science newsletter. As we told you last week, Denny Desoutter is on holiday and this week's edition is presented by Bryan Silcock:

SILCOCK: Ever since the end of the war a government laboratory just outside London called the Explosives Research and Development Establishment has been busy devising bigger and better bangs - or so everyone thought, but when it opened its doors to the press for the first time last week it turned out that only about 20% of its programme actually involved explosives.

My first two items come from the non-banging activities of the Explosives Research Establishment. In fact one of them is for keeping bangs out. It's called the Erdefender - a pun that's almost impossible to explain on the radio. Anyway it's a combination of ear muffs and headphones. You can hear ordinary conversation through the head phones, but they're set so that they don't transmit really loud noises, and of course the muffs stop sounds reaching the ears in the ordinary way - in fact it's just the thing if you want to carry on a quiet conversation during an artillery barrage.

SILCOCK:
(Cont.)

The Establishment is also very interested in materials, and it's devised a new form of reinforced aluminium that could have a big future in the aircraft industry. It might, for example, make it possible to raise the speed of the Concorde supersonic airliner, at present limited by the ability of aluminium to withstand high temperatures.

Fibreglass has made everyone familiar with the strength of composit materials. Well the new aluminium is also a composite. It's reinforced with whiskers of silicon carbide - that's the carborundum we use to sharpen knives. Whiskers are minute hair like crystals that grow spontaneously on some materials and they are quite amazingly strong - many many times stronger than the bulk material. Well, these whiskers incorporated in aluminium make it very much stronger - in fact as strong as titanium, but weighing only half as much. Titanium is of course the costly metal the Americans have chosen for their supersonic airliner.

My other two items are concerned with blasting, they're very different. One is a machine for cleaning ships, the other for polishing lenses.

I'll take the ships first. Modern paints can make a ships hull so smooth that the reduced friction can lead to an extra knot or so on the speed and fuel costs slashed by as much as 30%. Even so it may not be economic to take a ship like a giant tanker out of service for repainting unless it can be done very quickly. Well, at their Merseyside shipyard Cammell Laird have just installed a new £200,000 machine for cleaning ships in record time. It's a gigantic grit blaster as big as a dockside crane and controlled by only one man. The operator can move it up and down, and from one end of the ship to the other to strip its paint faster than by any other method.

Cammell Laird's machine will take the place of men on scaffolding scrubbing away with wire brushes.

My final item is also a new approach to another traditional activity: lens polishing, which is usually still done by hand with jewellers rouge. At the Scientific Instrument Research Association they are experimenting with the use of beams of ions (particles of atomic size) to do the same job. If it works it will be quicker, and produce a better finish, than the usual method. Several laboratories are involved in the project and there is hope that eventually it might be possible to do more than the final polishing with ion beams. If they could also be used to erod away glass in quantity they could replace mechanical grinding as well as polishing. Complicated lens profiles which take man years to grind and polish could be completed in a fraction of the time.

BENTLEY: (Cont.) remedial action to be taken can be read out after the warning has been given so that the pilot has an aural prompt while he performs the vital actions to ensure safe operations. In this way air safety will eventually feel the benefits of automation.

GARRATT: John Bentley. Now to safety at sea, with a background of air safety. One of the reasons for trawler disasters is icing-up. Surprising, but if the superstructure - the masts and rigging - get badly iced, the extra weight may be enough to unbalance the ship so that it capsizes.

The problem has been tackled by Palmer Aero Products Ltd., a firm experienced in aircraft de-icing. Robin Burton went along to talk to the firm's Product Supervisor, Mr. Campbell Thomas, and he asked him how the new system works:

THOMAS: The method consists of a rubber glove which we attach to the mast of the vessel and contained within this rubber glove is a series of tubes which are inflated numatically. On inflation this cracks the ice and dislodges it from the mast.

BURTON: The rubber glove then has to cover the whole length of the mast presumably?

THOMAS: It has, it must cover the whole effective area of the mast.

BURTON: What provides the pulsation?

THOMAS: On most trawlers there is a supply of compressed air, and we tap off the existing supply through the necessary regulator valves and control valves with which we operate the system.

BURTON: What about the rigging?

THOMAS: This is a problem and on most modern trawler designs they try to reduce the rigging to a minimum - although some still exist - but this we are investigating at the present time.

BURTON: Of course many modern trawlers have these quadrant masts don't they?

THOMAS: Yes they do. In replace of a single mast with wire supports they have multiple masts and this eliminates the necessity of having the wire stays.

BURTON: Do you think it's likely or feasible that you could in fact rig up the same arrangement on rigging?

THOMAS: This is feasible, yes, but we have not fully investigated this at this stage.

BURTON: Presumably then, rubber never freezes solid or rigid rather?

THOMAS: Not within the temperature range which we are considering for marine applications. On aircraft our over shoes operate down to minus 46°C, but of course, this would not be experienced at sea.

BURTON: You mean this is much too cold to actual be at sea?

THOMAS: Yes, at minus 46 they are at about 25,000 feet.

BURTON: What is the most dangerous period, as far as this freezing up is concerned?

THOMAS: The most dangerous period would be between zero degrees centigrade and say to minus 20.

BURTON: One would think that the colder it became the more dangerous it would become as well. Why is it that it doesn't below about 20°?

THOMAS: Well below about minus 20°C we are in the hail storm configeration rather than water droplets.

BURTON: So in fact you don't get any more freezing up after that point?

THOMAS: Exactly, yes.

BURTON: I suppose the mast is the most dangerous point as far as the actual build up of weight is concerned, isn't it?

THOMAS: Yes, on the top of the mast, you have your maximum height above the centre of bouyancy of the vessel and this is critical particularly in rolling conditions.

BURTON: What about the hull, the bridge and any other superstructure such as the gallows or something like that, the trawl gallows?

THOMAS: Well the bridge can be de-iced and in fact we shall shortly be fitting such a system onto the trawler Boston Phantom.

BURTON: So you think it's quite feasible then to coat the whole of the super-structure with some sort of a covering?

THOMAS: Yes, exactly.

BURTON: On how many ships have you tried it out so far?

THOMAS: To date we have only fitted one overshoe onto the mast of the Boston Phantom, and this has been tested at sea in icing conditions and has proved entirely satisfactory. In fact tests on the Boston Phantom and also tests carried out in a climatic chamber have proved the effectivness of this system.

BURTON: Mr. Thomas, thank you very much.

GARRATT: Campbell Thomas was talking to Robin Burton. By the way, let me remind you that we like to hear from you and we like comments about the programme. If you'd like to write, the address is: SCIENCE IN ACTION, BBC, Bush House, London, W.C.2.

And to end this edition we're going to hear how thermoluminescence helps the archaeologist. Paul Vaughan talks to a scientists at the Oxford University Department of Archaeology, Brian Aldred:

VAUGHAN: Mr. Aldred, what exactly is thermoluminescence?

ALDRED: This is a physical phenomenon exhibited by a number of crystalined materials, of being able to have a permanent record of the total radiation dose that they've received from nuclear radiation. And this is a form of stored energy which upon subsequent heating or warming, is released in the form of light and the amount of light is proportional to the total radiation dose.

VAUGHAN: How does this help you in archaeology?

ALDRED: Well all forms of soil and clay are naturally radioactive, very weakly so of course, and this means that if you have some clay which contains a few crystals of say quartz, which it usually does, the quartz will indeed monitor the natural radioactivity of the normal clay. However, if this is ever heated this record is immediately erased with the emission of light of course. So that means that when the ancient potter took his clay from the clay pit it contained crystals of quartz which had a memory of all the radiation it had received since geological times; when he fired it into a pot he erased that - subsequently the record has been steadly building up over the years, monitoring the natural radioactivity of the clay - and when we get the pot again; when we heat it a second time, again it emits light. We measure the amount of light, we merely have to calibrate, using a known amount of radioactivity - you see we can give it a radiation dose equivalent to a thousand years of natural radio- activity in perhaps a matter of a minute, and we measure the light that that gives and we then measure it's radioactivity and by multiplying the two together and dividing by the third we get the age.

VAUGHAN: How accurate is this?

ALDRED: The present technique, which we've only just re-developed, appears to be certainly 10%, good to 10% of the age and possibly better.

VAUGHAN: Does this mean you can get within, what, a hundred years or so of the objects original firing?

ALDRED: A hundred years in a thousand basically, if it's a thousand years old, then we might be anything up to a hundred years out.

VAUGHAN: What sort of sites has this been used on so far?

ALDRED: We've been collecting shards from all over the world actually to test our programmes. The latests set of shards were mainly Gallo-Roman and Romano-British, mainly because these were shards which archaeologists could give us and also quote the correct date fairly accurately to us so that we could use this to test the method.

VAUGHAN: There is something called carbon 14 dating isn't there, which is already a pretty sophisticated method of dating archaelogical objects?

ALDRED: Yes, carbon 14 of course does apply essentially to carbon, which limits its use, mainly to remains of wood, say charcoal or perhaps bones or some form of material like that. And effectively what carbon 14 does for wood so thermoluminescence does for pottery.

VAUGHAN: I wonder whether you could give me an example of the kind of thing that you've tried this technique on.

ALDRED: At the moment, it's mainly been a test programme, the only special thing we did recently was to use it as a way of rapidly detecting possible fakes in pottery of quite high value for example, pottery from the Tang dynasty in China, which was about 600 to 900 A.D., roughly speaking, and we have had in our laboratory recently a small number of horses, this is a very popular form of statue, some of which were definately genuine, some of which were definately fakes and some of which were unknown - And there we were able to show very rapidly and very conclusively which were gen uine and which were fakes.

VAUGHAN: Mr. Aldred, thank you very much indeed.

GARRATT: Brian Aldred talking to Paul Vaughan, brings us to the end of this edition of SCIENCE IN ACTION. Back next week at the same time, and same place on your dial - goodbye. SIGNATURE TUNE:

Addresses for Newsletter: Reinforced aluminium and Ear defenders - Explosives Research & Development Establishment, Waltham Abbey; - - Cleaning ships plates - Cammell Laird, Birkenhead; - lens grinding - Scientific Industrial Research Association, Chislehurst.