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# SIRIMLink

Driving innovation through technology and quality


## INNOVATION AHEAD

The most inventive community innovations in the country.

## IN THIS ISSUE:

### MICRO HYDRO HEROES

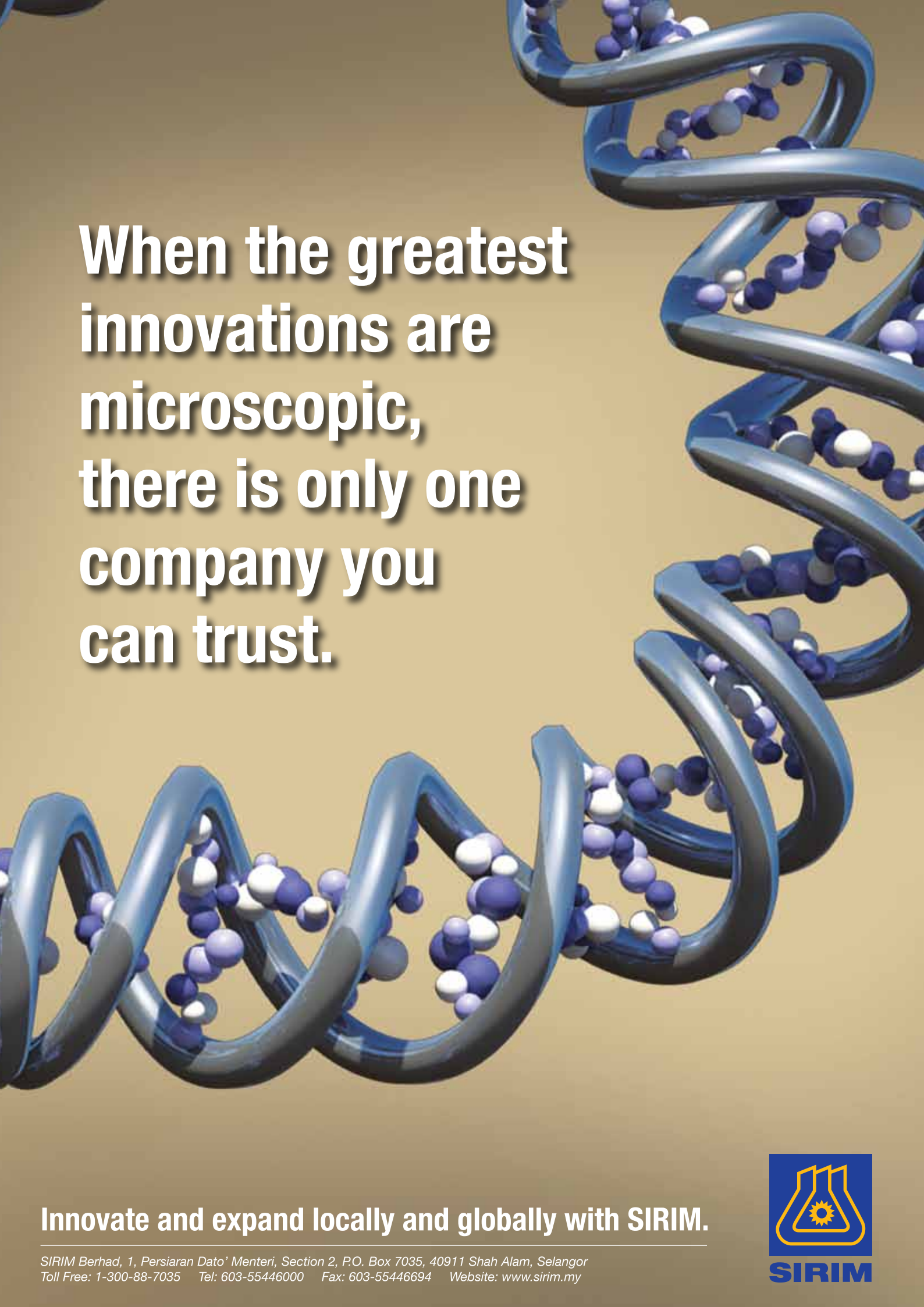

Turning on the lights at Kg. Sri Stamang 2

### MICROBIAL HERITAGE

Building Malaysia's first microbe data bank

### IN PURSUIT OF ENERGY

Innovative energy solutions for the electric vehicles industry




**Innovate and expand locally and globally with SIRIM.**

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# THE NEXT WAVE

SIRIM HAS ALWAYS BEEN A big fan of innovation. Naturally, when the idea for an inventors competition based on a TV reality show was first mooted, we were all very excited. Having seen more than our fair share of innovations first take seed and then grow up in our laboratories over the years, we were eager to see what grassroots innovators had to offer.

We were surprised at the depth and breadth of the entries the competition attracted, and were very encouraged by what we saw. Clearly, Malaysians are an innovative bunch. But innovation alone is not enough. History is full of great ideas that never happened, and of terrific concepts that failed because of a lack of support (or too much of it!).

While we hope that the winners of the IDEA Inventors' Challenge will successfully realise their dreams, they would do well to remember that technology evolves at an astonishing pace. Even the best ideas can fall victim to newer or better technology if one does not keep abreast of the rapid changes that these evolutions bring.

At SIRIM, we keep abreast of these changes as a matter of business so that we can help grassroots innovators when they need us. But as the country's leading R&D organisation, we also initiate change for the betterment of the country's future. We are committed to supporting the country and the community by making technology practical and commercially viable.

In this issue, we revisit some of our most successful and ambitious endeavours to date. These projects will pave the way forward for many of Malaysia's most promising industries, including electric vehicles, biotechnology, aquaculture and vinegar. They will also spur the next wave of innovation now and into the future.

Happy reading.

Nor Rashid Ismail
Vice President
Corporate Division


# CONTENTS

ISSUE 04/2010 "INNOVATION AHEAD"


## IN PURSUIT OF ENERGY

SIRIM is developing new batteries to be used in electric vehicles and stationary applications.


## MICRO HYDRO HEROES

For the small community of Kg. Sri Stamang 2, electricity is at last as easy as switch on, switch off.


## MICROBIAL HERITAGE

Dr Neelam Shahab and her team are building Malaysia's first microbe data bank.

Engineers at the Battery Laboratory in SIRIM Permatang Pauh checking the quality of the copper coating used for the anode electrodes in lithium-ion battery prototypes. The batteries will be used in Malaysia's rapidly growing electric vehicles industry. See page 8.


## SEA OF HOPE

Seaweed farmers in Semporna have new tools to help them earn their livelihood.


## VINAIGRE DE MALAYSIE

The Malaysian vinegar industry is about to take the leap from local to international.


## WHAT'S NEW AT SIRIM

The news and highlights of the past quarter at SIRIM Berhad.

# Malaysian Inventors' Challenge Grand Finals

IDEA invention competition culminates with winning concepts in automotive, home convenience, agriculture and electronics.

THE INAUGURAL SEASON OF Malaysia's first inventors' challenge reality TV show, IDEA: Malaysian Inventors' Challenge ended at a grand finale where the four finalists presented the finishing touches to their inventions to the panel of judges at SIRIM's headquarters in Shah Alam.

IDEA:Malaysian Inventors' Challenge was co-organised by MOSTI and SIRIM to discover the country's most innovative ideas and people at the grassroots level.

The weekly programme aired over TV3 was sponsored by Proton and partnered by the Malaysian Productivity Corporation. It attracted over 309 entries from around the country, including 68 from East Malaysia.

"There were many good ideas to choose from, and the judges' decisions were not always easy," said Datuk Hjh. Jamaliah Kamis, Chairman of SIRIM Berhad in her welcoming remarks at the grand finals held on 30 Oct. "We are very encouraged at the quality of entries we received, and look forward to seeing these inventors successfully commercialise their ideas.

Datuk Jamaliah added that the programme not only demonstrated the capacity of Malaysian innovation at the grassroots level, but also served to inspire young inventors among home viewing audiences. "IDEA:Malaysian Inventors' Challenge is a good example of how the government and private sectors can collaborate in supporting the government's efforts to create a more creative and innovative society," Datuk Jamaliah said.

## HIT SHOW

IDEA successfully garnered the interest and participation of people from all walks of life including primary and secondary school children, college students, nurses, blue collar workers, farmers and even pensioners.


**Tun Dr Mahathir Muhammad (centre) with the Grand Prize Winners. With him are (from left) Dato' Ir Hj. Yahaya Ahmad, President and Chief Executive of SIRIM; Datuk Hjh. Jamaliah Kamis, Chairman of SIRIM; Dato' Madinah Mohamad, Secretary General of MOSTI and Dato' Syed Zainal Abidin Syed Tahir, Managing Director of Proton Holdings Berhad.**


**INNOVATIVE MALAYSIANS:** The Grand Prize Winners with the "Hanger Dryer System". From left: Has Norsewake Hasim, Muhammad Nizam Saruman and Manap Ab Razak.

In the semifinals of the competition, 24 participants from all over the country were brought to SIRIM's headquarters in Shah Alam to vie for one of four places in the grand finals of the competition. The 24 semifinalists were selected from screening sessions held in Kuantan, Kota Kinabalu, Shah Alam and Kuching.

Upon being selected for the semifinals, each participant was given RM2,000 to further develop their inventions. In addition, all 24 contestants stand a chance to be considered for a grant from MOSTI to further develop their product.

The Grand Prize, RM 30,000 in cash, went to the Hanger Dryer System by Manap Ab Razak, Muhammad Nizam Saruman and Has Norsewake Hasim. Unlike other similar appliances in the market, their hanger dryer system dries clothes individually rather than all at the same time after they are spun dry in washing machines. Lighter articles of clothing are thus protected from "overdrying", a feature that current hanger dryer systems on the market lack.

"We are very pleased with our win, and hope to put our product on the market in a big way >>


**HOPEFULS: Second Prize Winner Lee Ka Let with the "Spare Tyre Pressure Early Warning System "; Third Prize Winner Zainuddin Ismail demonstrating the "Oil Palm Seed Collector"; and Syed Ahmad Tun Syed Nasir with the "World Clock".**

before the next season," says Manap, a lecturer at Institut Kemahiran MARA in Johor Bharu.

Retiree and part-time Elvis Presley impersonator Lee Ka Let says that he has already received enquiries from private investors who are interested in commercialising his Spare Tyre Pressure Early Warning System. He won second prize and RM15,000 in cash at the competition.

"My invention is already patented in Malaysia. Next, I intend to patent it in other countries around the world," says Lee.

The third prize (RM10,000) went to Zainuddin Ismail for his Oil Palm Seed Collector, while the fourth prize (RM5,000) went to Syed Ahmad Tun Syed Nasir for his World Clock.

The panel of jurors for IDEA was headed by University Sains Malaysia Vice Chancellor, Professor Tan Sri Dato' Dr. Dzulkifli Abdul Razak. Other jury members included SIRIM Vice President for Research and Technology Development Division Dr Zainal Abidin Mohd Yusof, SIRIM Vice President for Design and Engineering Division Ir. Dr. Mohd. Jamil Sulaiman as well as other experts, professionals and academicians in their respective fields.

Besides Datuk Jamaliah, the grand finals were also witnessed by Dato' Madinah Mohamad, the Secretary-General of MOSTI, Dato' Ir. Hj. Yahaya Ahmad, President and Chief Executive of SIRIM Berhad and guest of honour Tun Dr Mahathir Mohamad, who is also an advisor for Proton Holdings.

# Malaysian Technical Cooperation Programme (MTCP) 2010

## Technical cooperation programme strengthens bilateral ties among 20 developing countries

MALAYSIA'S LEADING research and development organisation SIRIM Berhad once again successfully organised and hosted the Malaysian Technical Cooperation Programme (MTCP). This is the eighth year in a row that the programme was hosted by SIRIM.

**Participants of the Malaysian Technical Cooperation Programme (MTCP) 2010 exploring SIRIM innovations in the gallery at SIRIM's headquarters.**

The objective of the MTCP is for members to share their knowledge and experiences in technology development among each other, thereby strengthening bilateral ties among member countries while promoting technical cooperation. This year, SIRIM conducted four training programmes for participating countries:

- Aspiring Leaders of Research Technology Organisations
- International Workshop on Standards and Quality
- International Training Programme on Metrology for Developing Countries; and
- Training on Powder Metallurgy Technology

Chairman of SIRIM Berhad, Datuk Hjh. Jamaliah Kamis said the MTCP was an important aspect of SIRIM's role as secretariat of the World Association of Industrial and Technological Research Organisations (WAITRO). WAITRO has played a significant part in international cooperation by sharing of the latest skills and expertise in technology and research.

"This programme is proof of the Malaysian government's and SIRIM's commitment towards promoting technical cooperation with developing countries," said Datuk Hjh. Jamaliah at the launch of MTCP 2010.

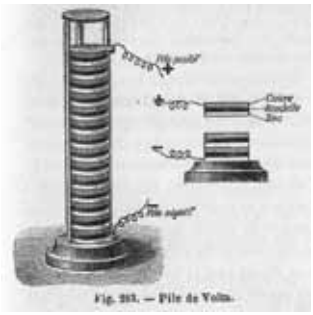
The five-day programme was officiated by Datuk Hjh Jamaliah and witnessed by Dr. Hj. Zainal Abidin Mohd Yusoff, Vice President of the Research and Technology Development Division of SIRIM Berhad. It was attended by more than 50 personnel from research organisations, government agencies and universities from developing countries such as Iran, Sudan, Ghana, Nigeria, Thailand, Sri Lanka, Vietnam and Indonesia.

The MTCP began in 2003 with the participation of 10 countries within ASEAN including Cambodia, Laos, Myanmar and Vietnam. Since then, the programme has grown increasingly more popular.

In hosting the MTCP over the years, SIRIM has forged technical cooperation and contributed to the technological development of over 460 participants from more than 60 developing countries.

# IN PURSUIT OF ENERGY

**Man has an unusual talent for consuming more energy than he creates, which is why energy efficiency has always been one of his greatest challenges. SIRIM is rising to the occasion for Malaysia, with innovations in energy generation, storage and savings.**

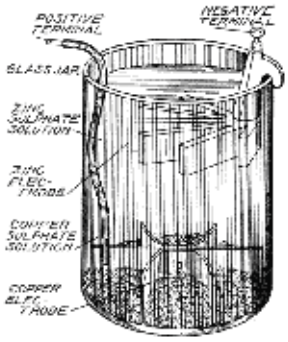


**1798**

**Italian physicist Alessandro Volta invents the "voltaic pile" – the world's first battery.**

**1859**

**Gaston Plante invents the lead-acid battery still used in automobiles today.**




**1860s**

**A French scientist named Callaud develops the gravity (Daniell) cell.**

GIVEN MAN'S PENCHANT FOR consuming energy, it is only natural that so many of the world's leading research and development institutions should devote so much time to finding new and better ways to manage it. At SIRIM, however, the challenge is multi-fold. Instead of merely pursuing innovations in energy generation, storage or savings, the company's researchers are exploring avenues in all three.

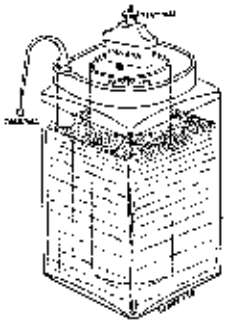
The pursuit of energy solutions at SIRIM is led by Dr Surani Buniran, an award-winning innovator and Head of the Electrochemical Materials Programme. He and his team are studying everything from organic solar cells to electrochromic glass in their quest to improve the availability of renewable energy solutions for Malaysians.

"We are looking at three of the biggest challenges facing modern society today and are developing the technologies we need to address them," says Dr Surani. "First, technology that can generate clean and renewable forms of energy; second, technology that will allow us to use and store our energy more efficiently; and third, energy-saving technology that can help eliminate the need for energy in specific applications altogether."

All three technologies will ultimately benefit the community, of course, whether directly or indirectly. Electrochromic glass, for example, will allow for the development of smart windows that can automatically darken or lighten depending on your needs. This will reduce energy demand for air-conditioners, which are responsible for a large chunk of urban society's carbon emissions. What makes them really special, however, is that they use natural rubber as an electrolyte.

**DR SURANI: "We are looking at three of the biggest challenges facing modern society today and are developing the technologies we need to address them."**

"We foresee electrochromic glass as being most useful in skyscraper windows and rear >>



**1868**

**Georges Leclanche invents the world's first "wet cell" battery, which will eventually become today's "dry cell" batteries.**

**1899**

**Waldmar Jungner of Sweden invents the nickel-cadmium battery.**


**1896**

**Columbia Batteries makes the first commercially available battery. It later became known as Eveready Battery Company, and then as the Energizer Battery Company.**

windshields," says Dr Surani. "The fact that they use rubber is good for Malaysia, because it will add value to our rubber industry, too."

Dr Surani is also exploring the possibility of using rubber as a separator in organic solar cells and supercapacitors, which are his pet projects. In fact, he is particularly pleased with the progress his team has made with lithium ion batteries for electric vehicles, a project that is already in the pre-commercialisation stage. SIRIM is also developing a stand-alone drying system for agriculture products that will use a combination of lithium ion batteries, supercapacitors and a flywheel system. The system will benefit farmers in remote and offshore locations where electricity is not available.

"We are also collaborating with an industry partner to manufacture a made-in-Malaysia lithium-ion battery for the up-and-coming electric vehicles industry, and I am happy to say that we have successfully developed a working prototype that should meet the industry's needs," says Dr Surani.

## A BATTERY OF WONDERS

The electric vehicle (EV) industry has grown by leaps and bounds over the past few years, especially since scientists finally found the right phosphate-based metals that are suitable for lithium-ion batteries. Previously, EV vehicles relied on lead-acid and then nickel metal hydride (NiMH) batteries, both of which fell short of the demands of the applications.

We all recognise lead-acid batteries as the kind of batteries used in conventional cars – they are bulky, heavy and don't give much bang for the buck. When used in EVs, they can take up as much as 50% of the vehicle's final mass, and with an energy density of a mere 30-40Wh/kg (Watt hours per kilogramme), the cars they powered could only travel about 100 km between charges.

Nickel metal hydride (NiMH) are better than lead-acid batteries by a whole order of magnitude. The best NiMH batteries offer energy densities of up to 100 Wh/kg, effectively double the range of similarly-heavy electric vehicles that use lead-acid batteries. But while that is impressive, it is not as good as the lithium-ion batteries which Dr Surani is most interested in.

"Lithium ion batteries can store as much as 200+Wh/kg of energy and also weigh much less than other batteries," says Dr Surani. "They also produce three times more voltage than other batteries, which makes them ideal for EV applications."

However, while all these batteries can supply a steady discharge of electricity to the vehicle's engine, none of them are good enough for acceleration. That is why Dr Surani is also researching supercapacitors: the energy source that EV vehicles rely on for acceleration boosts. >>

**1901**

**Thomas Edison perfects the nickel-iron (NiFe) storage battery.**


by 7-how-7, on Flikr.

**1950s**

**Eveready (previously known as Columbia Batteries) develops the first commercially available alkaline battery as well as the first watch cells, or "button" batteries.**

## SUPER, DUPER CAPACITORS

Supercapacitors are to electric vehicles what the turbocharger is to conventional cars. They provide the boost required for overtaking or for going up sharp slopes. Most EVs today are based on a combination of both batteries and supercapacitors, with the battery used for ordinary driving while the supercapacitors provide acceleration on demand.

Dr Surani's supercapacitors are rather different than most, however, since they use activated carbon with nanopores produced from rice husks: an innovation that has won his team several local and international awards.

"Activated carbon from rice husks has a high surface area and nano-sized pores, which makes them suitable for use in supercapacitors," explains Dr Surani. "These characteristics give them substantially more energy density than other supercapacitors."

The challenge for Dr Surani's team now is to devise an economically-attractive process for producing activated carbon from rice husks, which is currently either disposed of or used as a filler in construction applications. If Dr Surani succeeds, then farmers can look forward to having a new high-value revenue stream from what is right now essentially a waste produce – rice husk activated carbon is finding all sorts of applications around the world, particularly in exciting new fields of nanotechnology.

"All these technologies are geared towards the Malaysian government's Green Energy Initiative," explains Dr Surani. "An active electric vehicles industry would reduce our carbon emissions, supercapacitors made from rice husks would reclaim the lost energy of that waste and organic solar cells are practically green energy themselves. Best of all, these technologies are all almost 100% recycleable."

For all that to happen, however, the Malaysian electric vehicles industry must get a popular toehold in society so that these innovations may be commercially supported.

Although current technology is focused on two-wheeled vehicles and stationary appliances, the market is on the cusp of a full-blown EV revolution. SIRIM's battery laboratory at Kulim, Kedah and Permatang Pauh in Penang is producing lithium ion battery prototypes, while the Advanced Manufacturing Centre at Bukit Jalil is producing the electronic components and battery management systems required for electric vehicles. An industry collaborator is conducting field tests for the systems that SIRIM produces.

"We've already designed a charging infrastructure for lead-acid batteries, so all we need to do now is design something similar for lithium-ion batteries," says Dr Surani. "Then, we'll rope in the National Metrology Laboratory to help us calibrate these systems, and we'll be ready for a nationwide EV rollout."


**1960s**

**The nickel-cadmium (NiCd) rechargeable battery system developed by Waldmar Junger sixty years earlier finally takes off.**

**1991**

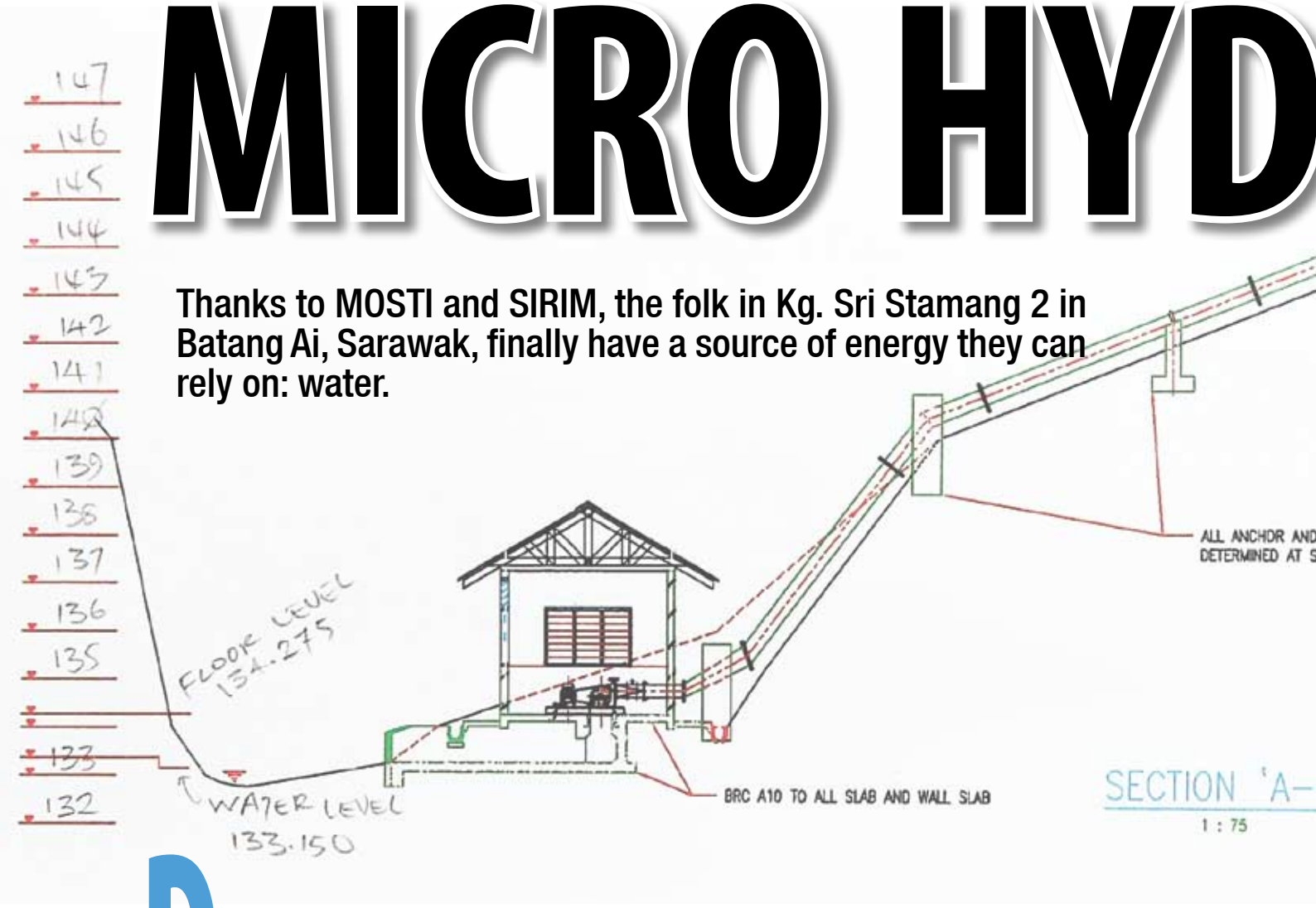
**Sony releases the world's first commercial lithium-ion (Li-ion) battery and revolutionises consumer electronics.**

**2000s**

**Super-efficient Nickel-Metal Hydride (NiMH) batteries become commercially available, paving the way forward for electric vehicles.**

# MICRO HYD

**Thanks to MOSTI and SIRIM, the folk in Kg. Sri Stamang 2 in Batang Ai, Sarawak, finally have a source of energy they can rely on: water.**




DIESEL GENERATORS ARE nothing new. In fact, they are considered a rather practical compromise to conventional energy grids in remote regions of the country. Trouble is, these generators need fuel, and if you're that deep in the jungle, then the chances are good that you won't see too many diesel delivery trucks passing by your front door.

In fact, you see none at all.

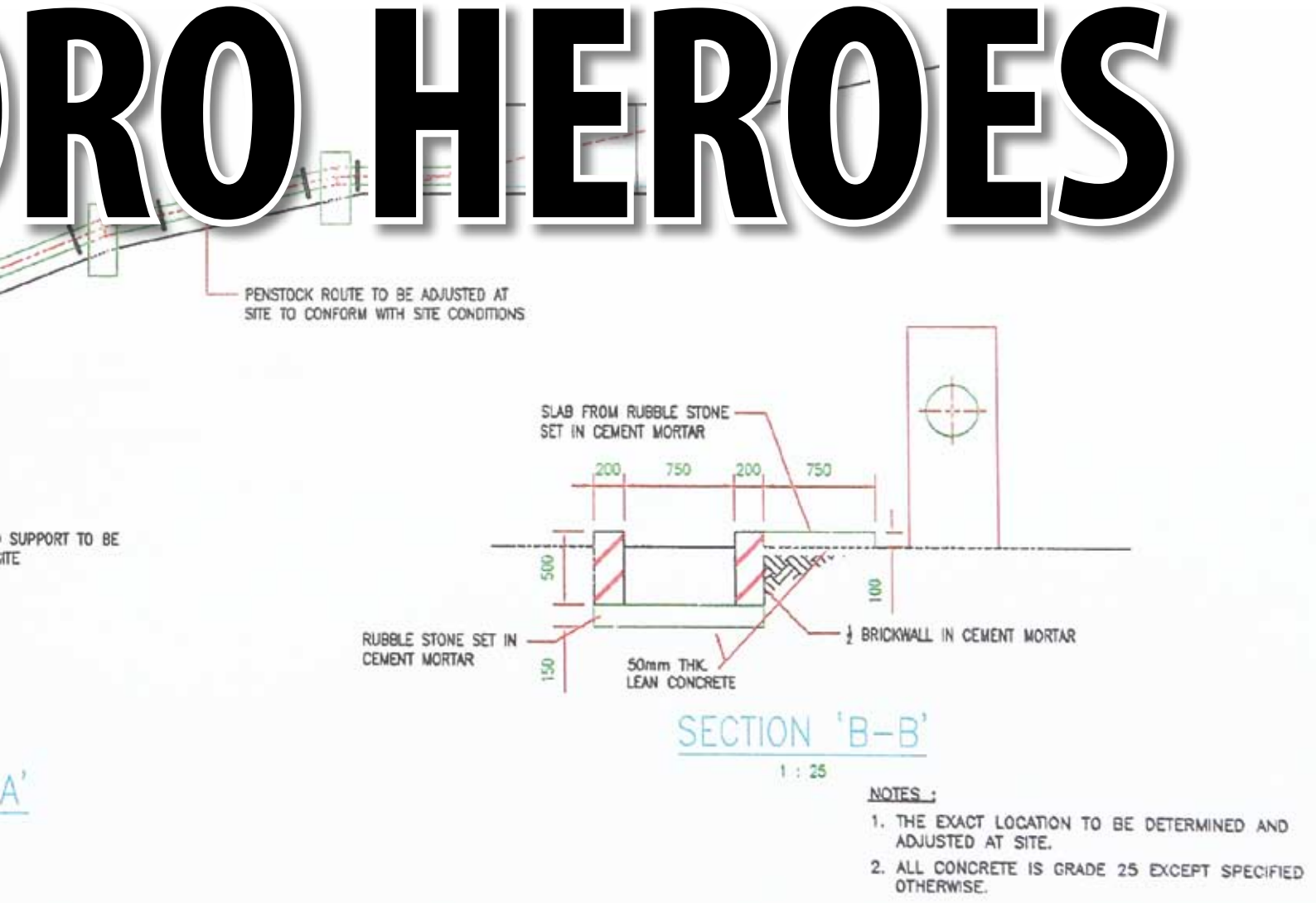
This was what life was like for the folk of Kg. Sri Stamang 2, a small village of some 200 residents located way off the beaten track, upstream of Engkari River in Batang Ai, Sarawak (see map, next page). Every couple of weeks or so, the village headman would round up the most able-bodied men in the longhouse and send them to the Batang Ai jetty over 23 km away to stock up on the diesel the settlement needed for its small diesel generator.

Now, 23 km might not sound too bad to someone used to travelling by car, but in Kg. Sri Stamang 2, the men transported their goods by *pancung* - a wooden boat powered by a single engine. The journey downstream took two hours and required the skill of the village's most experienced boatmen, occasionally negotiating small rapids. Coming back upstream loaded with fresh barrels of diesel, the going was anything but easy.

## A LITTLE HELP FROM THEIR FRIENDS

Seeing their predicament and admiring their verve, the Ministry of Science, Technology and Innovation (MOSTI) decided that the folk in

# RO HEROES




Kampung Sri Stamang 2 needed a break. It was an ideal opportunity to promote the use of green technology among rural folk and to demonstrate the government's commitment to go green. By adopting a renewable resource – water from a river that never dries – the community would be able to minimise its use of diesel and learn to rely on nature for its energy needs.

MOSTI thus wasted no time in commissioning SIRIM to evaluate the area's potential for renewable energy. Led by Azhar Ahmad, Head of Engineering & Machinery at SIRIM's Marketing & Sales Centre, the project team quickly got down to work and eventually decided that what Kg. Sri Stamang 2 needed was a micro-hydroelectric turbine generator.

"The system would supply the longhouse (consisting of 40 rooms) as well as the village clinic with 18.3kW of electricity, which under normal conditions will be enough for the community's normal needs – fans, lighting, refrigeration and so on," explains Azhar. "And, rather than let the current diesel generator go to waste, we would link it to the same grid so that it can be used as a back-up during schedule maintenance exercises or in the event of a system failure."

A plan so elegant in its simplicity, except for one thing: after a thorough survey of the area, the team discovered that the only place suitable for the system was on the bank of the Ubo River, about one kilometre away from the longhouse. This meant that the power plant itself would have to be installed quite a distance away from where the electricity would actually be used, which would require the energy to be channelled to a sub-station closer to the village before being distributed to both sides of the river. >>

# MICRO HYDRO IN KG. SRI STAMANG 2

**AZHAR AHMAD: "We want rural folk to know that they can rely on the government and SIRIM to help them out of tight spots, but that they have to do their bit, too."**

Such predicaments are not unusual for hydroelectric installations. However, there are few places on earth as remote as Kg. Sri Stamang 2. They were going to need pylons, transmission lines, cement and a whole lot of luck in transporting all that stuff up there by longboat. Indeed, the logistics of the whole exercise proved to be the team's biggest challenge.

## NO RIVER WIDE ENOUGH

The first thing SIRIM did was to get land surveyors to survey the contours of the area while the project's technology partner Cihanjuang Inti Technik from Indonesia proposed plans for the setting up of the system. The trouble was that the speed of the water in the river itself was not sufficient to turn the generator's turbine. As such, the only way the system could work would be if they built a small dam with conveyors – little drains – that would channel the water downhill and thus increase its head and velocity before it reached the turbine. They also had to build two small bridges across the Ubo River in order to join the jungle tracks for the transport of stones, cement and other stuff.

And so they began to build the dam. But, rather than build the dam themselves, the project team made sure that the community chipped in by collecting rocks and pebbles which they then mixed with cement and turned into the dam wall. The idea was that if the community participated in the building of the dam, the channel and helped erect the pylons, they would gain a sense of ownership and appreciation for the work they had done.

"We want rural folk to know that they can rely on the government and SIRIM to help them out of tight spots, but that they have to do their bit, too," says Azhar. "We don't mind investing time and money into a project, but we hope that they will reciprocate by taking care of the infrastructure so that it will last a long time."

The team have begun to identify suitable candidates among the 200-odd population of the longhouse who are young and intelligent enough to maintain the micro hydro system in SIRIM's absence.

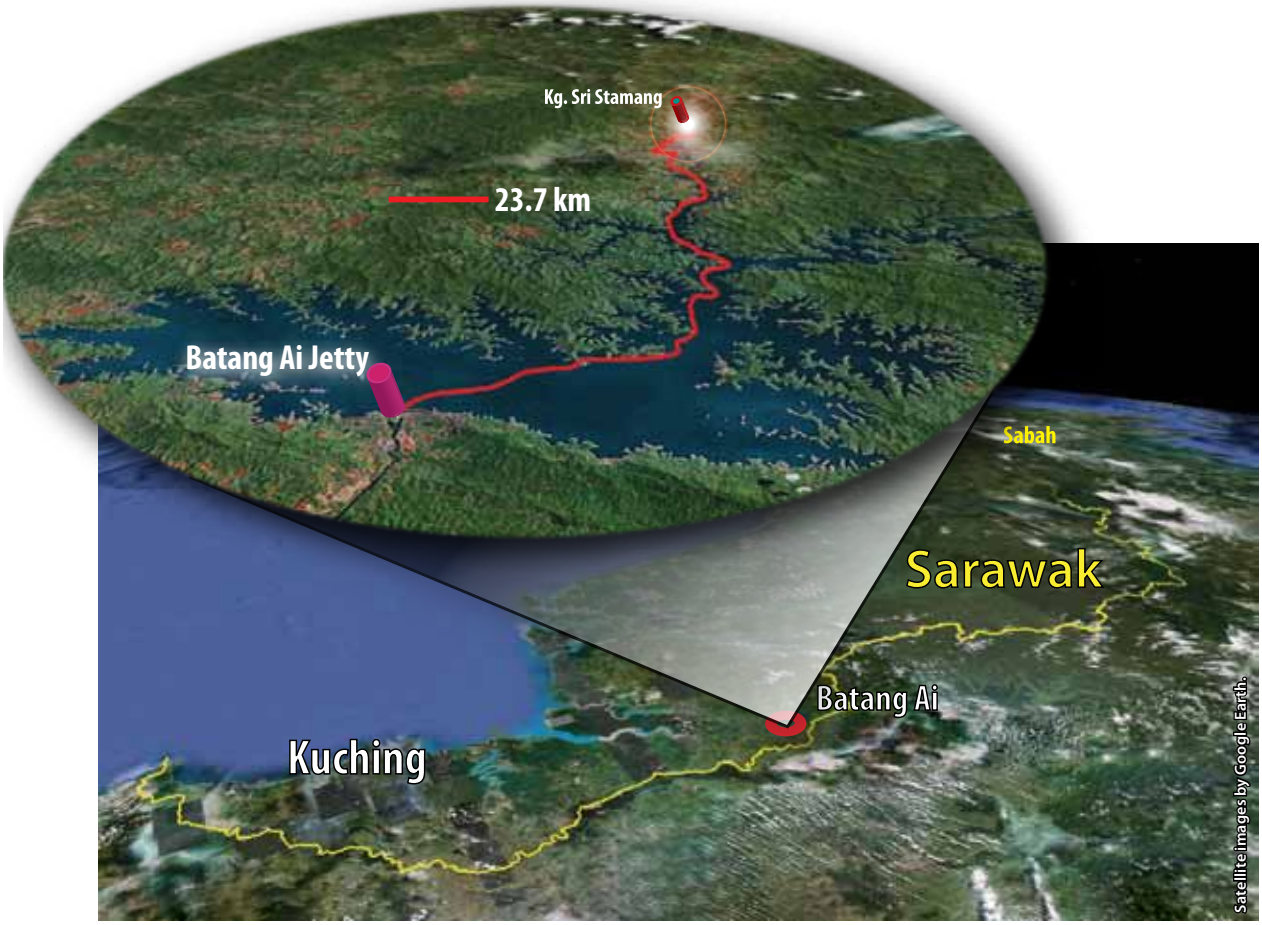
"The Sarawak state office in Kuching is six hours away from their village," says Azhar. "If the villagers have to wait for technicians from the state office every time they encounter a problem, then our purpose will be defeated – it would be much easier to just take a boat to Batang Ai to pick up a couple of barrels of diesel."

## MINIATURE WONDER

A micro-hydro turbine is exactly what it sounds like: a miniature turbine generator. The system the team is setting up in Kg. Sri Stamang 2 comes with a modest 30cm propeller that they have fine-tuned and optimised for the specific requirements of the terrain. On paper, a micro hydro is defined as a generator that produces an output of less than 100kW. Unfortunately, any power source that generates more than 5kW of electricity requires a license from the state government.

"We are trying to negotiate an exemption from this requirement with the Sarawak electricity board since this project is community-based and will not produce energy for sale," says Azhar. >>

# A LONG WAY TO GO FOR ELECTRICITY FUEL




**MILES AWAY: Before the micro hydro, Kg. Sri Stamang villagers had to take a boat down Engkari River to the Batang Ai Jetty to stock up on the diesel they needed to power their generator.**

The turbine system itself is not the bulk of the project's cost – at most, the bill for the hardware might come up to RM400,000. The real cost centre for this project is in the logistics – getting all those construction materials, pylons and cables onto the project site requires a lot of hard labour and skilled transportation.

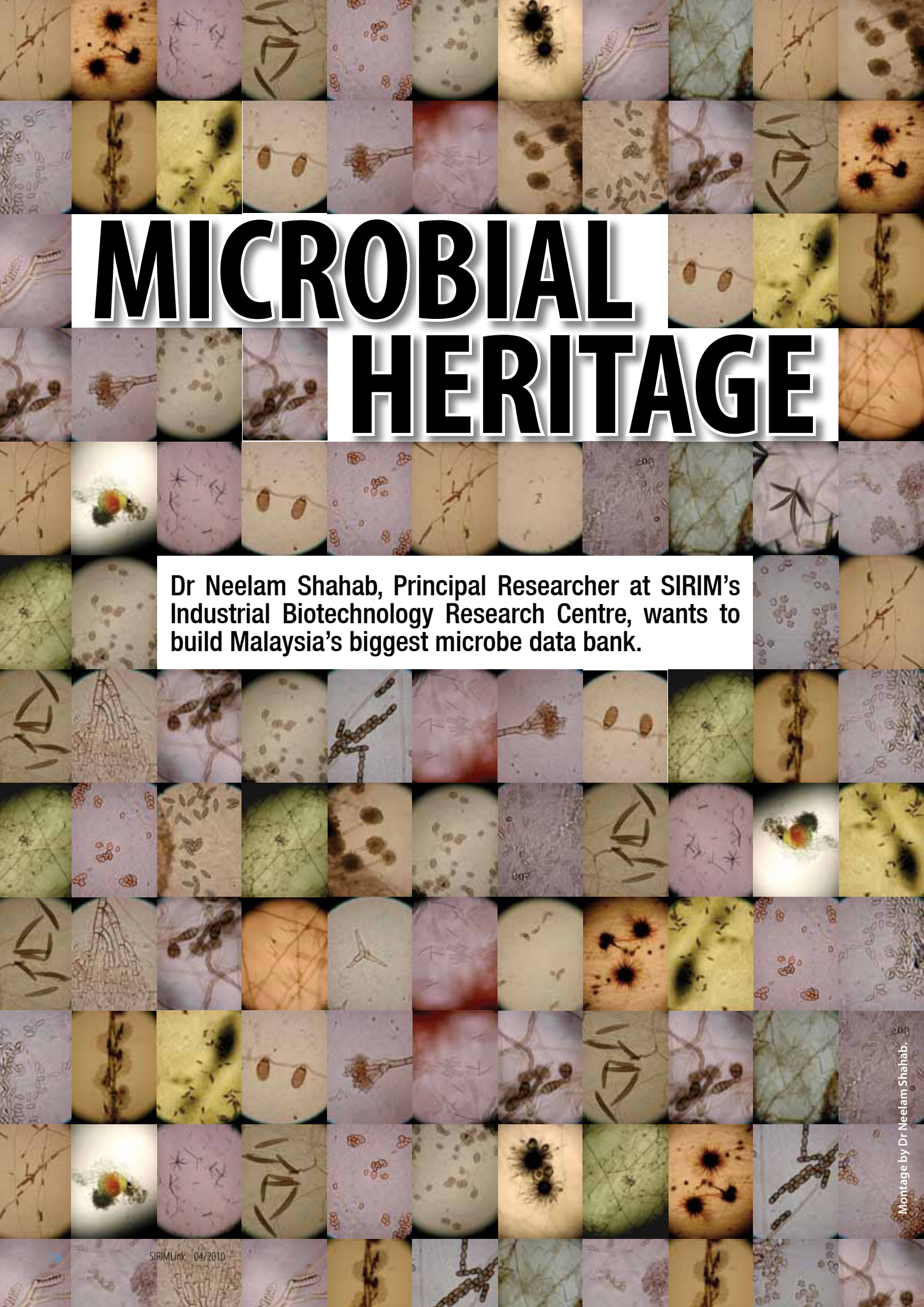
"The micro hydro is a more challenging form of green technology compared to solar energy or wind power because a hydroelectric solution cannot be implemented *in situ*," explains Azhar. "Besides the terrain, there are specific requirements that must be fulfilled in order for it to work – a steady flow of water all year round, enough head to provide the potential energy, favourable weather conditions and stable soil for constructing the dam and the waterwheel house. Once it is complete, however, it only requires simple maintenance and the occasional spare part."

The community of Kg. Sri Stamang can also look forward to less noise (from the generator) and pollution (from the diesel fumes) in their village. Ultimately, the new energy system will also allow the residents to concentrate their energies on their industrial activities and improve their quality of life.

"The system has some spare capacity, which may be used to power small machines or equipment," says Azhar. "With the right attitude and help, this community of farmers can revolutionise their industry and greatly improve their standards of living."

# MICROBIAL HERITAGE

**Dr Neelam Shahab, Principal Researcher at SIRIM's Industrial Biotechnology Research Centre, wants to build Malaysia's biggest microbe data bank.**



Montage by Dr Neelam Shahab.

NO ONE LIKES BUGS, ESPECIALLY when they are the microscopic kind that get under your skin and make you ill.

We're talking about pathogens, of course – those insidious microorganisms that have ruled the world ever since the Big Bang. Bacteria or virus, these are the true masters of the Earth, capable of wiping out entire populations in one, fell swoop.

Luckily, we humans have learned a few tricks of our own over the years, which is probably the only reason that we're still around.

Treating bacterial or viral infections in the old days typically involved ingesting some unpleasant mixture of plants-and-herbs, the recipe passed down through generations of medicine men. There was (usually) a sound basis to their remedies though, because while the natural world is full of nasty germs that can make you very sick, it is also full of wonderful bioactive compounds that can make you better. These microbes possess exceedingly useful pharmacological properties, and are the basis of modern antibiotic, antiviral and antifungal drugs.

The problem, as always, is a lack of resources. There are plenty of microbes out there in the world, any one of which might hold the cure for cancer, HIV/AIDS or any number of other incurable diseases. The trouble is, while our ability to collect these samples has improved through the years (thank you, refrigeration), the task of assaying these samples takes very much longer.

## LONG ROAD TO RECOVERY

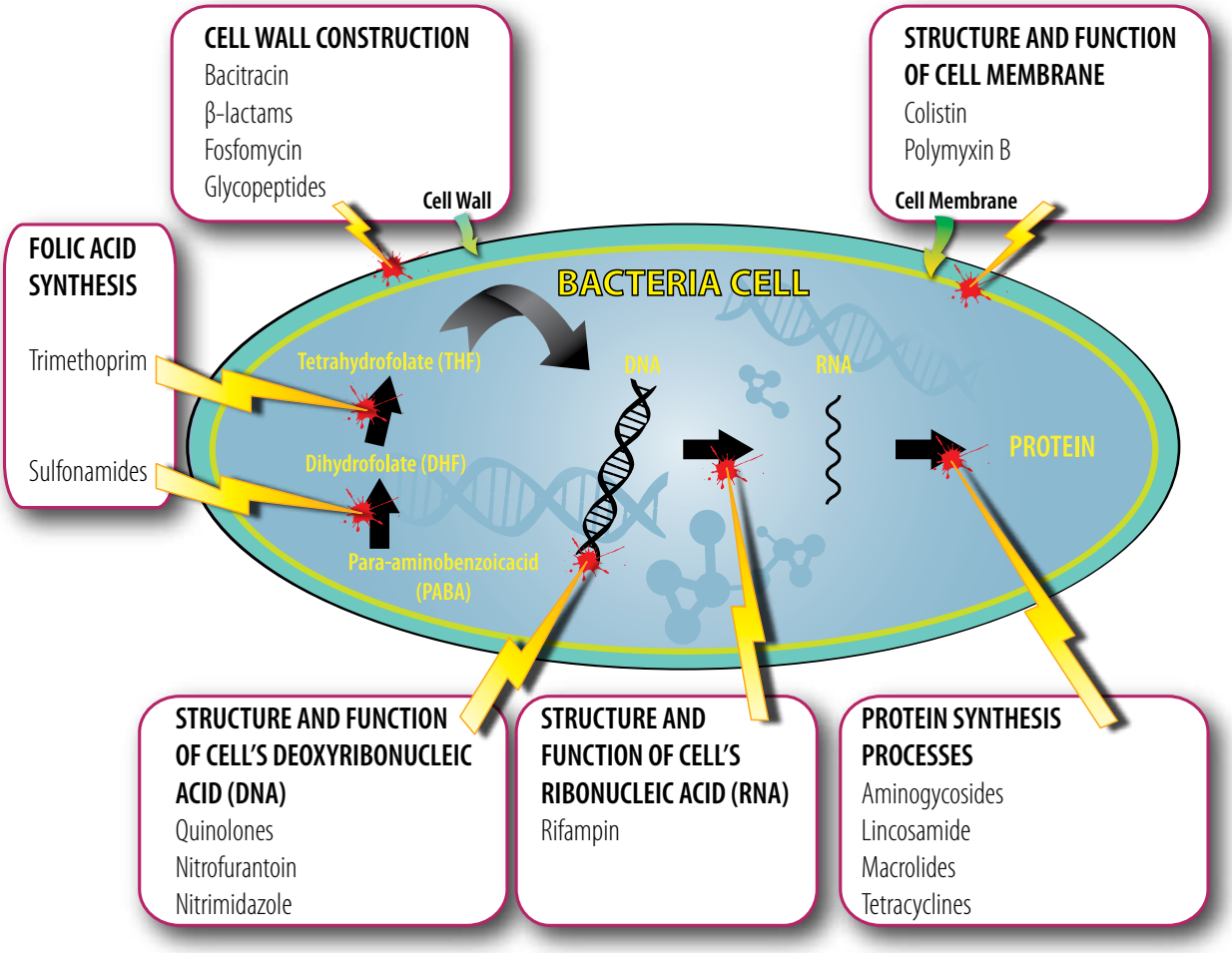
At SIRIM's Industrial Biotechnology Research Centre, for example, Dr Neelam Shahab and her brave team of biotechnologists have put together a culture collection of more than 11,700 fungi and 8,000 actinobacteria, of which less than 8% have actually been identified. They were collected over the course of ten years and 42 sampling expeditions in which Dr Neelam and her team trekked through Malaysia's virgin tropical rainforests picking up decaying leaves and soil samples from the forest floor.

"So far, we've identified about 1,500 strains via molecular means, and have about 20,000 fermentation broth samples derived from fungi and actinomycetes," says Dr Neelam. "Unfortunately, we are running out of the resources and the space we need to continue expanding our microbe data bank."

Dr Neelam's quest for microbes began over ten years ago when SIRIM entered into an agreement with Fujisawa Pharmaceutical Co. Ltd. (later known as Astellas Pharma Inc.) to isolate and screen Malaysian fungi and actinomycetes for pharmaceutically active compounds. This came after the revelation that Malaysia is among the world's top twelve biodiverse regions, which >>

**MICROBIAL REMEDIES: Dr Neelam Shahab and her team have identified about eight percent of the fungi and actinomycetes in SIRIM's culture collection.**

# HOW DO ANTIBIOTICS ATTACK BACTERIA?




**WHAT THE DOCTOR ORDERED: Different classes of antibiotics attack different parts of bacteria cells. Some act upon basic biological processes within the cell itself, while others attempt to destroy its protective lining. But if a bacteria adapts (i.e., becomes immune) to one particular class of antibiotics, (say, the class of drugs that attack the DNA of the bacteria cell), then doctors will not be able to use that plan of treatment against it and will have to explore other (possibly less effective) treatments. Adapted from "Antibiotics Actions", by Feerero and J Raghu. Licenced under the Creative Commons License 3.0.**

spurred research into all sorts of biotechnological areas.

"The samples are researched both in Malaysia and Japan, and is focused mainly on fungi and actinomycetes," says Dr Neelam. "Actinomycetes consist mostly of streptomycetes, which make up 60%-70% of pharmaceutically known compounds in the world."

Dr. Neelam had done research on antibiotic production in bioreactors utilising streptomycetes during her postgraduate studies and received training in fungal technology from Fujisawa Pharmaceutical Co. Ltd. for six months. Over a period of 10 years, nine SIRIM staff were sent to the pharmaceutical company based at Tsukuka, Japan for training in the areas of actinomycete technology, fermentation technology, assay techniques for anti-microbials and identification of compounds.

"Any discovery could lead to a pharmaceutical drug," says Dr Neelam. "However, the research cycle for each bioactive compound takes years to complete." >>

## THE QUEST FOR BACTERIA

The journey of an antibiotic compound from the forest floor to the final drug is an arduous one.

A bioactive compound as it occurs in nature is little more than a few microscopic spores on a dead leaf. In order to properly analyse its properties, it has to be first isolated and then fermented into quantities large enough to be useful to research. Along the way, scientists also have to ensure that they eliminate the compounds they have already found and select only the ones which they have not yet researched.

The fermentation process can take anywhere between a few days to several weeks, during which time more samples are arriving at the lab, ready to go through the same process. The result, of course, is a ghastly bottleneck… and they haven't even begun the actual pharmaceutical research yet.

*"The research cycle for each bioactive compound can take weeks or even years to complete."*

"While they wait their turn in the fermentation process, the samples have to be maintained so that they don't die," says Dr Neelam. "We store them in large fridges at -80°C and under the strictest sterile conditions. Otherwise, contamination can ruin the fermentation process."

The microorganisms are grown on up to six different types of media compositions at one time to ensure the production of multiple compounds, if present. The presence of any bioactive compounds is indicated through HPLC (High Pressure Liquid Chromatography) analysis. However, the HPLC profile itself will not positively identify the compounds present. This procedure merely indicates that they are there, and if they are, the broth sample is sent to the pharmaceutical company for assaying.

"We do some of this pharmaceutical research in Malaysia, but most of it is done in Japan," explains Dr Neelam. "They assay the samples for compounds with anti-tumour, anti-fungal, anti-bacterial and other properties, and then share the results with us."

## THE RISE OF THE SUPERBUG

The research of antibiotics was not always that straightforward though. In fact, we owe their discovery to a lucky twist of fate more than anything else – had Sir Alexander Fleming been more punctilious and tidied up the bacteria samples in his lab before he went on vacation, he would never have discovered penicillin upon his return. If not for Mr Fleming's disorderliness, we might all still be living in a world of Black Deaths and Great Plagues.

Still, although Fleming's propitious discovery of penicillin happened in 1929, it was not possible to produce the stuff at a large scale until the 1940s, and it took a further ten years of research before the chemical structure of the substance was isolated and synthetic antibiotics could be developed. Nonetheless, his breakthrough sparked a flurry of research into antibiotics throughout the 1940s and 1950s, most of which has revolved around the soil bacteria Streptomycetes. Over 60% of the medical world's antibiotic arsenal comes from the 550 species (and counting) of this single bacteria, including (among others) Cefoxitin, Daptomycin, Neomycin, Streptomycin and Vancomycin.

The golden age of antibiotic research in the mid-twentieth century enabled Man to treat some of the world's most terrible illnesses, including scarlet fever, pneumonia, meningitis and diphtheria. However, bacteria and viruses are nothing if not hardy (how else have they managed to survive 65 million years of evolution?) Their highly-developed instinct for survival allows them to mutate almost overnight, so much so that they gain a certain resistance against some antibiotics.

That's why doctors insist you finish your course of medicines – if you don't, you might only kill >>

**DR NEELAM SHAHAB: "While the samples wait their turn in the fermentation process, they have to be maintained so that they don't die."**

some of the bacteria in your body, while the rest mutates so that they don't meet the same fate. The next time you try the same drug, your body fails to respond to it.

In the heydays of the 1950s and 1960s, researchers discovered many new classes of antibiotics, which allowed medicine to stay ahead of bacteria mutations. By the mid-1970s, however, such inspired discoveries began to dry up, and antibiotic-resistant bacteria started to catch up with our spate of innovations. Since then, "new" antibiotic discoveries were really just synthetically-modified versions of older, naturally occurring ones. Throughout the 1980s and 1990s, there were no more "discoveries" of antibiotic classes, only improvements to existing classes.

Which brings us to the present day, where we have about 7,000 known antibiotics in the world, all of which are completely ineffective against certain mutated bacteria strains that medical circles have christened "superbugs". These new bacteria emerge every day in all corners of the world, challenging bacteriologists and doctors alike and making their victims very, very ill.

## THE BANK

The challenge of staying ahead of resistant superbugs has not gone unnoticed, of course. Drug companies everywhere are investing billions of dollars into research to find a superdrug capable of beating these resistant superbugs. So far, however, they have only managed to find variants of existing antibiotics, giving the world about 300 new drugs to try each year.

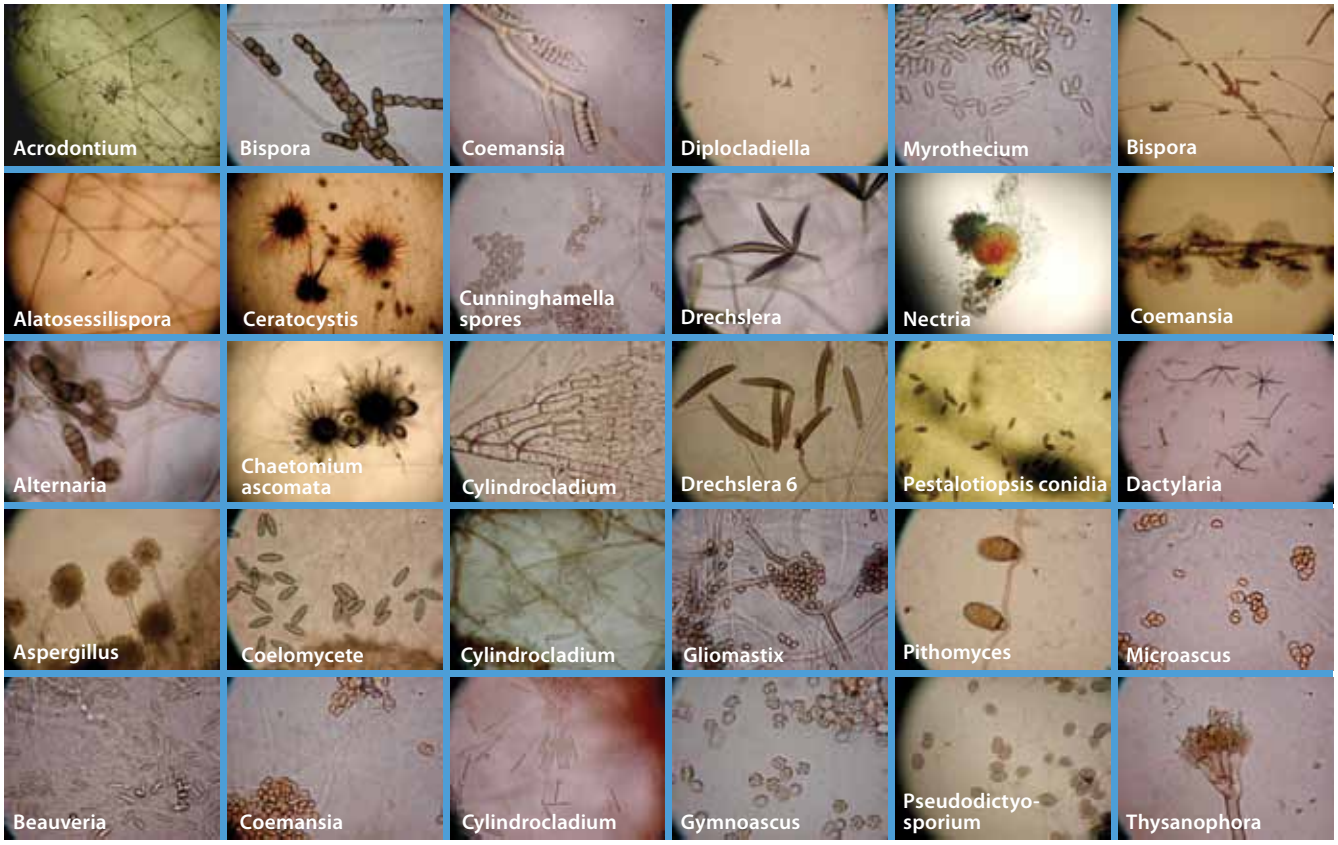
Part of the problem is that this kind of research is very, very expensive – out of thousands of samples collected, isolated and fermented, only one or two will actually prove useful enough as an antibiotic to be worth the cost of commercialisation. The bigger problem, however, is that current patent laws governing patent periods are not very friendly towards pharmaceutical research. By the time a drug hits the shelves, the company is lucky to have five years left on its patent. In that short time, it has to recoup its investment into fifteen years of research, development and clinical trials.

So far, the collaboration with Astellas Pharma has yielded four patents over the last two years. These are for microorganisms and pharmaceutical drugs discovered in 2003 (yes, that's how long it takes), and Dr Neelam is confident that more patents will come in over the next five to six years as the team's hard work finally begins to pay off. But while patents are a great indication of their accomplishments at an academic level, she reckons she will need more than that to keep the microbe data bank going.

A microbe data bank costs money. Samples have to be kept in isolation. They have to be maintained and preserved. They have to be stored correctly and properly identified. And, on top of all that, you need a system for managing all the data and the people to do it.

Still, a microbe data bank is also a potential gold mine. It would become a source of raw material for biotechnological innovations in cosmetics, >>

# THE BEGINNINGS OF MALAYSIA'S MICROBE DATA BANK




**TINY HERITAGE: Dr Neelam Shahab and her team have identified many fungi and actinomycetes, some of which are displayed here. However, this is just a tiny fraction of what Malaysia's microbe data bank could be. She hopes to document as many Malaysian microbes as possible in order to preserve the country's microbial heritage.**

pharmaceuticals, antibiotics, organic acids, food ingredients, biopesticides, biofungicides and antibacterials.

"Right now, the microbe samples we get from overseas collections can only be used for academic research," Dr Neelam explains. "We cannot commercialise any discoveries we make because the microbes belong to someone else."

A wholly Malaysian-owned microbe databank therefore holds enormous commercial potential. It would become a vital resource to researchers as well as a national heritage of the vast and diverse collection of microorganisms available in the country. The databank would also help in future SIRIM endeavours, because researchers would be able to retrieve data from the data bank without having to go through the entire process of analysing and screening new microbe samples.

Dr Neelam and her team have managed to put together a collection of over 20,000 microbes from just 42 sampling expeditions to virgin forest reserves in Peninsular Malaysia. Clearly, there is a lot of ground to cover, but in order to do so, she needs people. Virgin forests apparently hold a wider variety of samples, whereas developed areas yield fewer. Development destroys microbes because it destroys the ground's topsoil where aerobic microbes live. Vegetation, which provides the substrates that microbes feed on, is also cut down for development.

"Like other wildlife, microbes can become extinct, too," says Dr Neelam. "Logging and development activities disrupt the natural conditions in which microbes survive. That's why we need this microbe data bank: we have to gather as many samples as we can right now before they are lost forever."

# SEA OF HOPE

**Just off the idyllic coastline of Semporna, Sabah, over 650 families eke out a living as farmers. Their produce? Seaweed.**

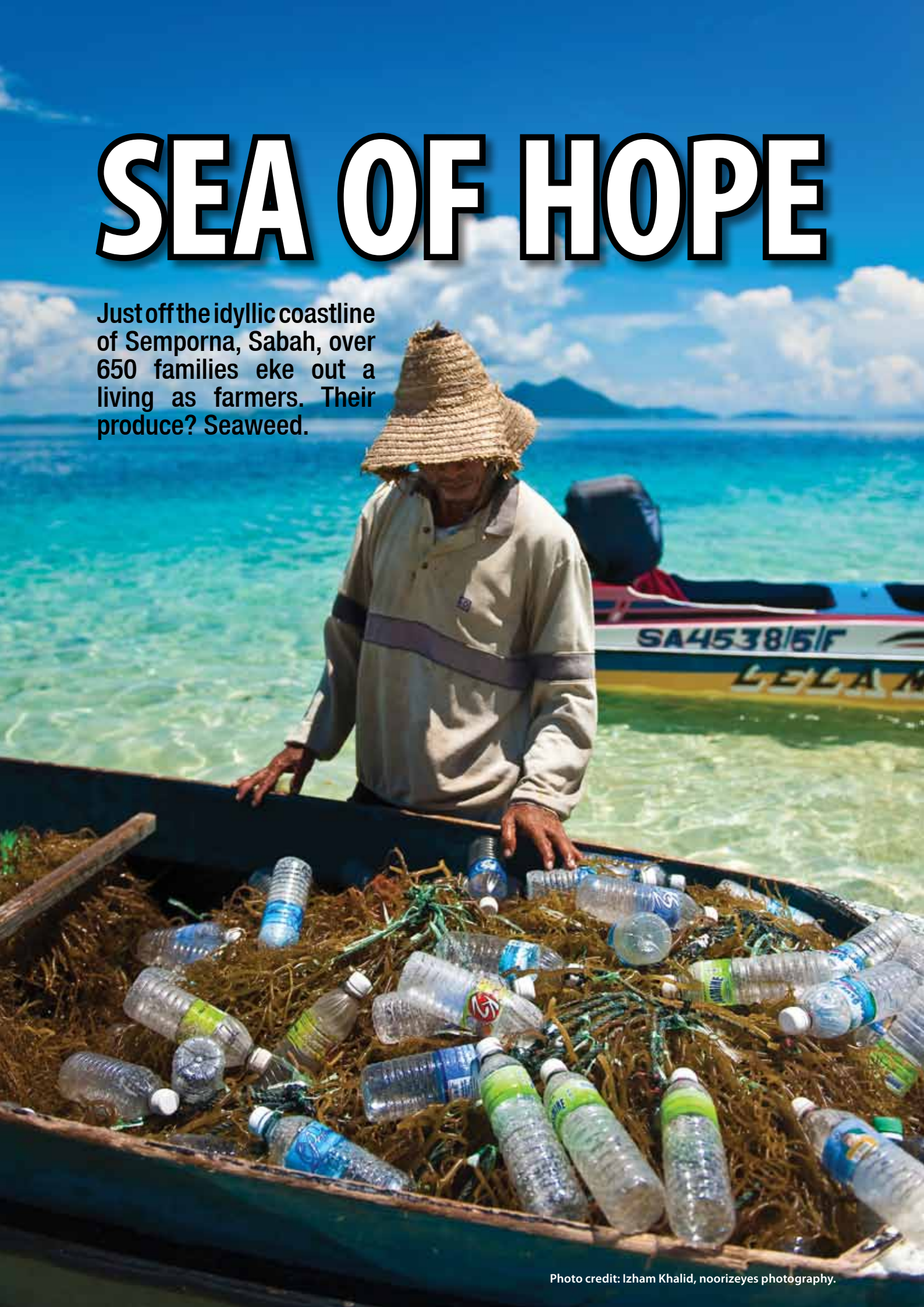



Photo credit: Izham Khalid, noorizeyes photography.

MAN'S RELATIONSHIP WITH marine life began thousands of years ago. Before we learned to hunt animals, we learned to catch fish; and before we learned to till the land, we learned to farm the sea. We've been using marine plants for food, medicine and (later) as feedstock for our cattle for as long as we've been around.

In Semporna, Sabah, this ancient trick of sea-farming lives on. The farmers in this picturesque community produce seaweed by the truckload all year round: a plant that has retained its reputation as an antidote for everything from cancer to bad skin, even in today's age of modern medicine.

These days, man is not so much interested with the seaweed itself, of course, but with its extract, "carrageenan". Carrageenan is a vegetable-based alternative to gelatine (and therefore completely halal), and is used in a variety of ways: as a viscous agent or volumiser in foodstuff, as a stabiliser in toothpaste and as a thickener in shampoo and cosmetics. It is also used as an immobilising gel in biotechnology research and as an inactive excipient in pharmaceuticals.

Clearly, the seaweed business has a lot going for it. The 650 families in Semporna and its surrounding islands produce about 3,570 metric tonnes of *Eucheuma cottonii* seaweed a year, making this small community the world's third largest producer of this species of kelp. But Malaysia uses quite a lot of the stuff, and so despite the prodigious output of this community of seaweed farmers, Malaysia is nonetheless obliged to import seaweed from neighbouring countries like Indonesia and the Philippines.

## THE RAFFIA TRICK

The reason for the shortfall is that the traditional seaweed farming methods used in Semporna are labour-intensive and require a lot of skill. This makes it hard to employ people to do the job, rendering it impossible to achieve any economies of scale. Also, the materials used in the traditional farming process often result in seaweed produce that is littered with debris, thereby compromising the quality of the end product.

**DR JAMIL: "We had to make the process easy enough for inexperienced farmers to learn, we had to shorten the turnaround and delivery time for the produce and we had to make it more productive."**

And thus, SIRIM and the Department of Fisheries Malaysia were asked to see how things could be improved in Semporna. Ir Dr Mohamad Jamil Sulaiman, Vice-President of the Design and Engineering Division of SIRIM Berhad, calls the project "a challenge to creativity and innovation."

"There were some difficult requirements to fulfil for this project as it was very multidisciplinary," says Dr Jamil. "We had to make the process easy enough for inexperienced farmers to learn, we had to shorten the turnaround and delivery time for the produce and we had to make it more productive."

And, SIRIM had to do it all while keeping a tight lid on costs so that the materials and systems did not become too expensive for the farmers.

# GADGETS FOR SEAWEED FARMERS

**AS EASY AS...: With SIRIM's new apparatus, seaweed farming is now easy enough for even novices to learn. Seahooks (left) allow seedstock to be clipped on to the long-line ropes before they are let out to sea, while the seacut (right) lets farmers harvest their produce by merely rolling in the lines in over a guillotine blade. The sealock (inset) allows them to secure the lines to the anchors without spending time tying the rope underwater. It also lets them reuse the rope rather than just throw it away.**

The current long-line method of "planting" seaweed is fairly sophisticated when you stop to think about it.

First, the seedstock is prepared by tying it with raffia string. This process is repeated until there is enough seedstock to be cultured. The seedstock is then tied to a long nylon rope at intervals by using the other end of the raffia strong.

The rope is fixed permanently at sea with both ends tied securely to the seabed. Buoys are attached to the rope to ensure that the seedstock rope floats near the surface of the water. The seaweed is then left to "grow" for up to six weeks with little or no intervention from the farmer, after which the seaweed is harvested.

"After evaluating the community's culturing process, we found two areas which could be improved: the way the seedstock is prepared, and the way it is harvested and dried," says Gendang anak Meggin, Senior Engineer at SIRIM. "We developed devices that help make the process more practical and easier for novices to learn. Hopefully, this will increase the community's productivity."

SIRIM's new long-line apparatus is made chiefly of polyamide plastic. It is an exceptionally durable material, resistant to salt and seawater and can withstand temperatures of up to 150°C. Also, the harvested seaweed currently contains bits of raffia string which often get mixed up in the final product. SIRIM's apparatus eliminates the raffia debris in the final product.

"Our method is also cheaper in the long-run," explains Gendang. "With the old method, the raffia string cannot be reused, which means the farmers need a constant supply of new string. But our sea-hooks can be reused over and over again, and they are so user-friendly that even a child can snap them into place."

## EASY SEAWEED

The present practice also requires farmers to secure the seedstock ropes to the underwater anchors by hand. This is not only risky (there is dangerous marine life in these waters), but also inefficient – if the ropes are not tied properly, they can sometimes come undone and get tangled up with other seedstock ropes, thereby ruining the whole plot. Also, once the ropes are cut, they cannot be reused – they will be too short to stretch the length between anchor to anchor.

"We designed the sea-lock to fix that," says Gendang. "These gadgets allow the ropes to be attached or detached by a simple twist of the wrist, and when the seaweed is harvested, the ropes can be reused."

In addition to systemising the method for farming seaweed, SIRIM has also developed a new process for harvesting it.

Currently, the farmers snip the mature seaweed off the rope by knife, usually mixing it up with bits of raffia string as they do so. The upper half of the raffia string is left on the rope, while the seaweed is transported to the drying platforms out at sea. To fix this process, SIRIM introduced the sea-cut method, whereby the seaweed-heavy rope is pulled over through a guillotine blade that shears the seaweed cleanly away without contaminating it with raffia.

SIRIM's real coup in the whole project, however, is the drying system.

Right now, seaweed crops are placed on nets and sun-dried on drying platforms out at sea. When it threatens to rain, the crop is rolled up and then covered by a tarpaulin. The moisture content of the produce should not be more than 30-40%, which may be achieved after two or three days of clear, sunny skies.

**GENDANG: "We devised a solar thermal drying system that can operate out at sea in rain or shine, thus giving farmers much better control over the quality of their produce. When they are not drying seaweed, they can use it for other aquaculture produce such as anchovies and squid."**

"The problem is when it rains," explains Gendang. "Even with the waterproofing, the moisture content of the produce is affected. So, we devised a solar thermal drying system that can operate out at sea in rain or shine, thus giving farmers much better control over the quality of their produce. And when they are not drying seaweed, they can use it for other aquaculture produce such as anchovies and squid."

SIRIM's new processes will revolutionise the aquaculture farms in Semporna, and with the right support, in other farming villages across the country.

"We are always ready to serve the community," says Dr Jamil. "That's what we're best at."

# VINAIGRE DE MALAYSIE

**The Malaysian vinegar business is beginning to gain a decidedly international flavour about it. Thanks to SIRIM, it is also ready to thrive.**

TO MOST OF THE WORLD, vinegar is little more than a useful preservative. We use it to pickle everything from mangoes to cucumbers, but invariably gag at the thought of using it for anything else. Its sharp, acrid tang assaults our tender sinuses and makes us weep, and unless you're a big fan of jeruk, it is hard to imagine how something so vile could be anything but damaging to your stomach.

And yet, old wives' tales of the benefits of vinegar abound, from the mid-western United States to the tropics of India: vinegar as a cure-all health supplement. Vinegar as a miraculous cleaning agent. Vinegar as a terrific laundry additive. Over time, of course, these tales gained such popularity that scientists around the world were forced to pay them some serious attention and see if any of their fantastic claims were warranted.

The results were predictable. Research through the mid-twentieth century found that most of the supposed benefits of vinegar were plausible, although a couple of claims could not be verified. By the 1950s, there was both scientific proof *and* anecdotal evidence to back up the wonderful powers of vinegar, and when noted physician Dr D.C. Jarvis published "Folk Medicine: The Honey and Cider-Vinegar Way to Health" in 1960, the future of vinegar was secured.

## APPLES, GRAPES AND NIPAH

That said, not all vinegars are created equal.

There are largely two types of vinegars out there: the synthetic kind, and the natural kind. Synthetic vinegar is cheaper and is made from (believe it or not) petroleum sources. Unsurprisingly, this vinegar can be harmful to humans and is actually banned in most countries, although it may still be found because it is so cheap. This is not the vinegar all those old wives' tales are based on.

The vinegar that got all those old wives' so excited is natural vinegar, which is formed of acetic acid made from any plant with a high sugar content. It is the vinegar's acetic acid content that determines its ultimate application.

The "table vinegar" used in most culinary applications typically has an acetic acid concentration of about 4% to 8%, while stronger "spirit vinegar" of up to 20% acetic acid is usually used in laboratory or cleaning solutions. Vinegar has also recently been marketed as a go-green alternative to many conventional household cleaning agents and as an organic herbicide.

Globally, the most popular natural vinegars are made from malt, apple cider and vin aigre ("sour wine"). Malt is the leading vinegar in the U.S. because it is cheap and readily available, but European markets tend to favour fruit vinegars made of more exotic stuff. This includes black currants, raspberries and persimmons, as well as rice, coconut and sugar cane.

In Malaysia, however, the most productive vinegars have traditionally come from sago and the nipah palm.

"We tried commercialising sago vinegar twenty years ago, but it didn't take off because synthetic vinegar was so much cheaper," explains Dr. Ahmad Hazri Abdul Rashid, General Manager of the Industrial Biotechnology Research Centre at SIRIM. "Over the past few years, however, we have noticed a distinct increase in demand for natural vinegar in line with the market's general movement towards healthier, natural products."


**Delicious: A local nipah gatherer showing a nipah fruit.**

**TANGY: The nipah vinegar as it is produced now can sell for several times more than traditionally-bottled vinegar. it can also be exported to markets in which there is demand for certifiably *halal* products like the Middle East.**

This spike in interest led SIRIM to re-launch its exploration of vinegar products. The team began with sago, but has since moved on to nipah palm vinegar: a natural product already sold by communities along rural roads in Terengganu, Kedah and Perak.

"They sell nipah palm juice as a drink, and any juice that remains unsold is converted into vinegar," explains Dr. Ahmad Hazri. "Unfortunately, because of the way these products are processed and packaged, they can never be sold in supermarkets."

Dr. Ahmad Hazri is of course referring to the plastic bottles in which vinegar is typically sold at these roadside stalls, which are a polyethylene leaching hazard. Additionally, the sediment leftover from the community's rudimentary filtration process do not make the product very appealing to consumers (even though that sediment is supposed to be good for your digestive system).

**DR. AHMAD HAZRI: "The (vinegar) business is already a small industry in this Kedah community. We hope to be able to repeat this success with partnerships in Sarawak and Terengganu."**

SIRIM has since managed to get the Muda Area Development Authority (MADA) of Kedah to collaborate on its ambitious project. MADA organises the collection and basic fermentation of nipah juice into vinegar, while SIRIM designed the system used to filter and clarify the produce. The end product can sell for a considerably higher profit margin than the traditional product, and is of sufficiently good quality to be exported to foreign markets – Dr. Ahmad Hazri sees no reason why it shouldn't sell well in Europe or America.

## HEALTHY, WEALTHY NIPAH

SIRIM's endeavours in commercialising nipah vinegar have significantly improved the community's standard of living, as both the volume and yield of the produce has increased tremendously ever since the new fermentation and clarifying processes were introduced.

Previously, the village folk collected nipah juice and left it to ferment in plastic bins. After about ten days, the juice would turn into alcohol, or tuak, as it is called colloquially. Wait another thirty days or so, however, and the alcohol would become vinegar.

"We decided to speed things up by introducing a culture of the *Saccharomyces* yeast, which is isolated from the original juice," says Dr. Ahmad Hazri. "It acts as a biocatalyst that improves the fermentation process."

SIRIM's new process has halved the time it takes to produce a batch of vinegar from forty days to about twenty days. Vinegar producers can also modify their product to appeal to vinegar connoisseurs by "ageing" their produce, which can result in vinegars of varying quality and uses that appeal to vinegar connoisseurs – like wine, the more 'matured' a vinegar is, the more it can sell for.

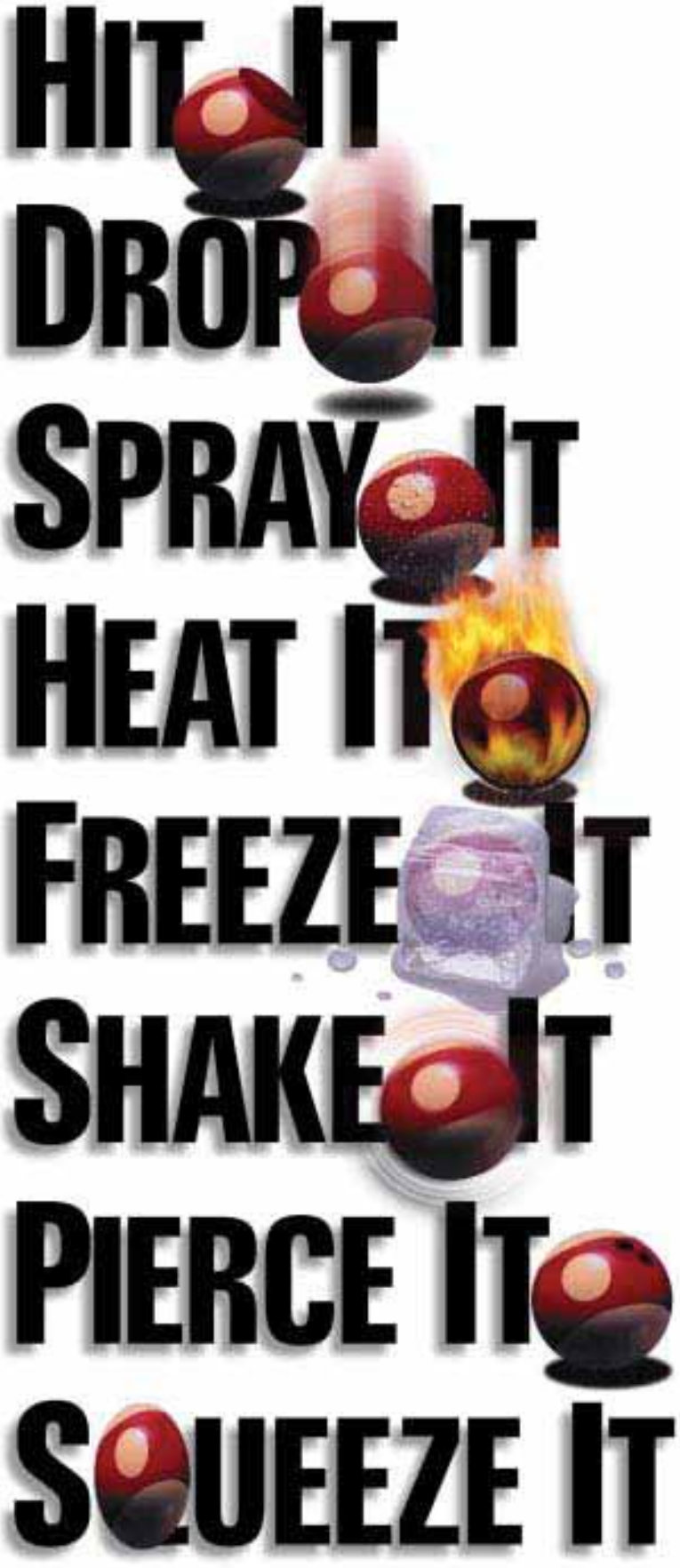
SIRIM is currently going through the necessary procedures to ensure that the process is absolutely halal. When this is complete, the vinegar will be particularly appealing to Middle Eastern markets where vinegar is used for pickles and salad dressing.

"Right now, MADA sells about two tonnes of vinegar per month, so the business is booming in this Kedah community," says Dr. Ahmad Hazri. "We hope to be able to repeat this success with partnerships in Sarawak and Terengganu."

SIRIM is also helping a company in Perlis produce sugar cane vinegar for export to Japan. This vinegar is based on an all-natural Japanese process that uses ceramic pots. A single batch can take up to 18 months to produce, but the result is exceptional. Of course, it is more expensive than regular vinegar, but it is highly valued in Japan. Ahmad and his team are also exploring vinegar from pineapple, mango and dragonfruit.

"Vinegar has a ready, global market, and Malaysia has the raw materials and field labour," says Dr. Ahmad Hazri. "All we have to do is put some processes and technologies into place, and we can turn this Malaysian community vinegar into a self-sustaining industry."

# WE HIT IT DROP IT SPRAY IT HEAT IT FREEZE IT SHAKE IT PIERCE IT SQUEEZE IT



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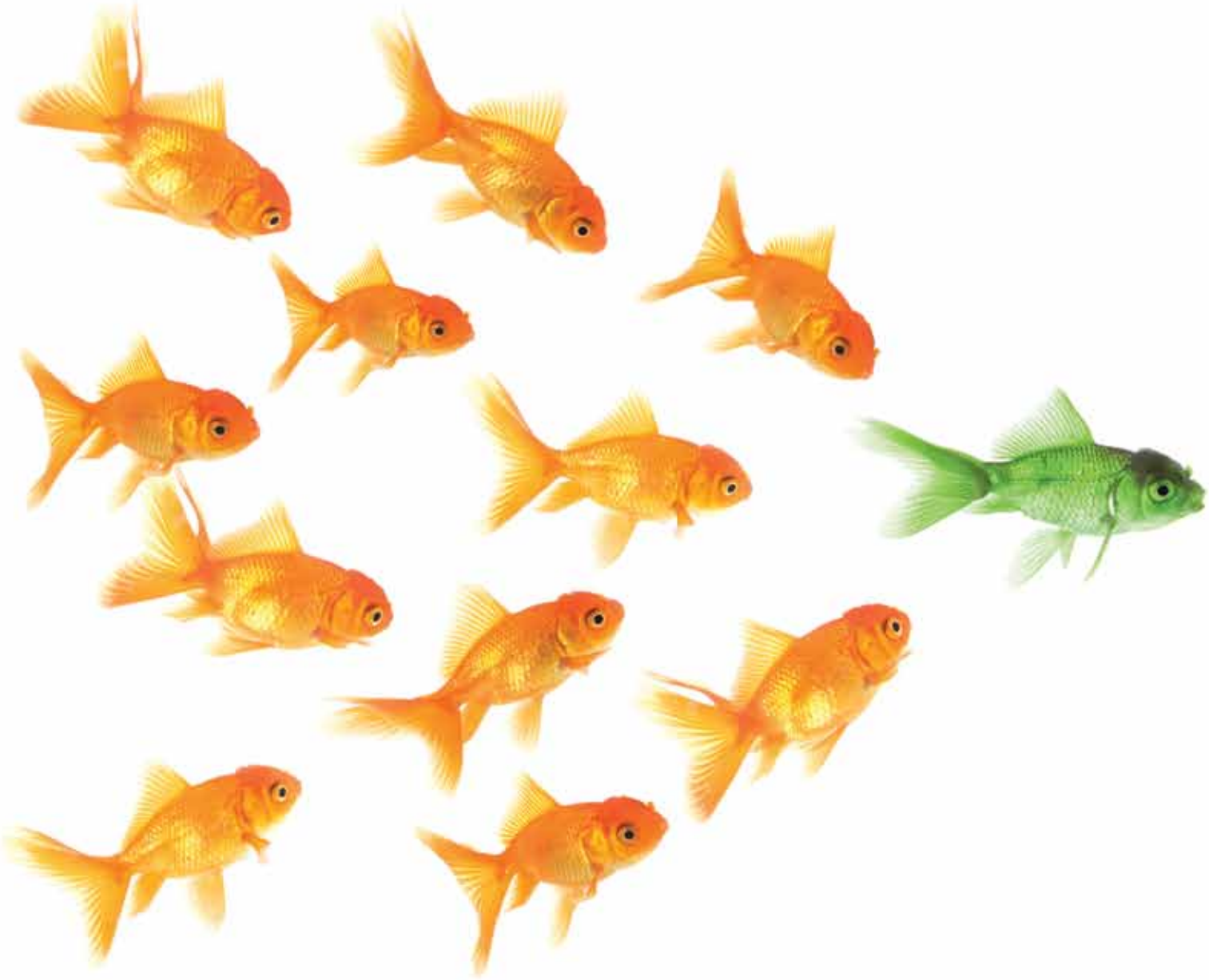

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