WISTAR Promotes Science & Technology

by Helal Uddin Ahmed

THERE are not many organisations in Bangladesh exclusively promoting science and technology amongst the female population of the country less so among the poor women and at the grass-roots level. WISTAR, Bangladesh, a brainchild of one of the most outstanding female physicists of the country is one such organization. Currently in its sixth year of operation it vigorously disseminates the utilities and applications of science ad technology amongst the poor and neglected womenfolk of our society so that the cause of self reliance and development is promoted. Its arsenal ranges from computer literacy to solar energy, from applied electronics to environmental conservation, which are passed on to the target female groups through workshops, seminars, training courses and reseach projects.

In this way WISTAR is promoting human resources development in an impoverished and resource-scarce country like Bangladesh.The genesis and formation of WISTAR, Bangladesh, can be traced back to the regional workshop on 'Popularisation of Science' organised by the Commonwealth Science Council and the Human Resource Development Group at the Zambian capital Lusaka in 1985. It was stressed during the workshop that the women community were disproportionately under-represented in science and technology although their roles as beneficiaries, users, educators and contributors to the advancement of those was quite crucial. A similar regional workshop for Asia on 'enhancing the participation of women in the popularization of science and technology' was held in Dhaka in January, 1987. It recommended the establishment of a regional forum to be called 'Women in Science and Technology in Asia Region' (WISTAR) for promoting the exchange of information and ideas among the interested and active individuals of regional countries to increase the participation of women in science and technology. Dr Shahida Rafique, an eminent physicist of the country was elected the national coordinator for WISTAR, Bangladesh, at the Dhaka workshop.

The next regional workshop held in New Delhi in February, 1990, with the themel Technological change and women towards the 21st century, 'accepted the WISTAR project proposal submitted on behalf of Bangladesh and recommended its implementation in other developing countries as well. An international WISTAR adhoc committee was formed in New Delhi with seven representatives from countries of the Asia Pacific region which included the Bangladesh representative Dr Shahida Rafique. In February, 1990, the organisations set-up of WISTAR, Bangladesh, was further consolidated with the formation of a board of directors with Dr Shahida Rafique as the Executive Director and Dr AZN Tahmida Khan as the treasurer. A separate board of advisers was also formed with people like Dr M Shamsher Ali and Dr Malika Al Rajee as members.

Aims and objectives

The aims and objectives of WISTAR, Bangladesh include (a) Increasing participation of women in science and technology, (b) Collating and disseminating information, ideas and experiences on participation of women in science and technology among interested and active individuals, (c) Work for most disadvantaged women by creating income generating opportunities and providing better quality of life through education and application of science and technology, (d) Promoting awareness or women regarding scientific, technological, and environmental issues through programmes like workshops, seminars, training courses and research projects.

Programmes and Projects

The training courses that WISTAR, Bangladesh, is currently offering include computer literacy and data entry, servicing and maintenance techniques of electronic and electrical appliances, and practical electronics. WISTAR plans to extend its computer training programmes for women throughout the country upto thana level.

One of the outstanding research projects of WISTAR, Bangladesh, has been the development of a solar energy plant which may profitably be employed as a source of power in the remote and far-flung areas of rural Bangladesh. In terms of techno-economic feasibility this plant may prove to be quite viable in the near future.

There are a number of other projects as well as various phases of implementation. These include projects on low cost sanitation, food processing, soap making, fisheries and livestock, food and nutrition, gardening and farming, and physical exercise for women.

In April, 1992, WISTAR, Bangladesh, held its first national seminar-cum-workshop in Dhaka on "Popularisation of Science and Technology and Status of Women". The topics covered in the workshop included science, education, hygiene, sanitation, agriculture, food and nutrition, and status and role of women in science related activities. The workshop proved to be a great success — as could be seen from the massive turnout of female academicians, students and trainees from far-flung areas of the country. WISTAR plans to set up a technical institute exclusively for women in not too distant a future where the trainees will be taught assembling operations of various products and will find employment opportunity in industrial plants attached to the institute.

Madame Premadasa of Sri Lanka talking to the WISTAR trainees at its computer unit. Dr Shahida Rafique in on her right, Mrs Selina Rahman MP on her left.

Dr Shahida Rafique, the driving force behind WISTAR, Bangladesh, has a distinguished professional background. Holding a Ph D degree in nuclear Physics from Italy, Dr Rafique is currently serving as an Associate Professor in the Department of Applied Physics and Electronics, Dhaka University. She is also serving as a member in the Board of Directors of Jatiya Mahila Sangstha and Bangladesh Shishu Academy and is an executive committee member of Bangladesh Electronics Society.

Mrs Rafique usually has a twenty-hours working schedule everyday including her university duties, her WISTAR involvements, socio-cultural engagements and personal undertakings as a scientist and a leader of the scientific community. She has a deep sense of obligations for the underprivileged women folk of our country and an abiding faith in their potentials. In one of her recent articles she writes, "In the global technological atmosphere the Asian region has been overshadowed by the clouds of crisis for long. However, by the beginning of the decade the region has provided welcome shafts of sunlight and developed some appropriate technologies quite spectacularly.

"In Bangladesh, change in social environment is visible with greater participation of women in technological spheres and this has profoundly influenced their socio-culture status. Still we have a long way to go to establish equal rights and privileges for women in all spheres of life. Enterprises need to be established in Bangladesh for promoting the cause of womenfolk in their social, economic and cultural status in order to eliminate gender disparity and provide equal opportunities for all. WISTAR is and will remain strongly committed to such goal."

How the Sun Could Solve Energy Problems

by Dietrich Zimmermann

THE fact that a German Ministry has taken an interest in the energy problems of Mediterranean countries is based on concern for the worlds climate, which is threatened by the irresistible increase in the emissions of the so-called greenhouse gases. Since here carbon dioxide (CO2) is one of the major culprits, the German government is committed to reducing emissions of this gas by 25% by the year 2005.

Extensive analysis has, however, shown that measurers affecting power stations alone will not be enough for this purpose. On the one hand, the construction of nuclear power stations — the most effective and most economical means of avoiding CO 2— is hardly feasible in Germany in the short-term. On the other hand, most of the large power stations in western Germany already operate very efficiently.

Because carbon dioxide pollution is an international problem, it seems most sensible to concentrate conservation efforts at locations where both an increase in consumption is expected and where current energy generation practices cause large emissions of CO2. Just such Region is represented by the Mediterranean area, whose southern part could conceivably cover most of its own energy requirements using solar power.

The aim of the study financed by the BMFT was to investigate if the conditions necessary for solar energy production already exist in the Mediterranean, For the Southern areas of Portugal, Spain, Italy, for Greece, nearly all of Turkey and the Near Eastern and North African states of the Mediterranean, the answer is an almost unconditional "yes". The annual insolation first increases above 1,700 kilowatt-hours (KWH) per M 2- a value at which the introduction of solar power plants becomes feasible — from the fortieth degree of latitude onwards.

At present three types of power station are available. The so-called Dish-Sterling-System consists of a concave mirror, which concentrates the Sun's rays on small Sterling motor situated at the focal point; the motor is coupled directly to a generator. These mini power plants have powers of about ten KW, and their outputs are to be increased in the long-term to 50 KW. Tower and trough power stations are planned as feeders for the electricity network.

Thermal solar power plants have now been developed to the stage where their introduction is not only sensible but a necessity: carbon dioxide emissions could be reduced and thus climatic change slowed down.

In the case of the tower plant a heat receptacle installed at the top of a tower receives heat energy from an array of large individual mirrors. The steam thus generated drives a turbine. The trough power plant is composed of many parabolic mirrors, which are arranged side by side to produce a large trough. The mirrors focus the sunlight onto a heat transfer medium flowing inside a pipe, which then produces the steam required to drive a turbine.

Several such parabolic trough plants have been in operation in California for years. The largest of them delivers 80 Megawatts (MW) and the total power generated by solar means is about 350 MW.

According to the study, should these power plants be introduced in the southern Mediterranean region, the electricity thus generated would cost between DM 0.30 and 0.40 per KWH. Although this suggests that solar power, compares unfavourably with conventionally generated electric power, the picture changes when viewed in a more complete context.

First, the existing power stations operate with low efficiency, which leads to unnecessary emission of CO2 and to an increase in the price of electric power.

Secondly, transport costs are a significant cost factor for any provision of energy to isolated regions.

Thirdly, it can reasonably be expected that while the costs of oil and gas will soon increase significantly, the solar energy price will fall to DM 0.20, thanks to further developments and mass production.

With proper planning, the first plants could be assembled in one or two years and a manufacturing capacity realized which would allow the installation of up to twenty 100 MW plants per year in a decade. This would only initially cover part of the expected minimum energy growth in the Mediterranean region of 5,000 MW annually.

However, a much faster development is also conceivable, considering that a market potential of several billion DM per year is a very lucrative attraction for industry.

—German Research Service

The Promises of the Wind

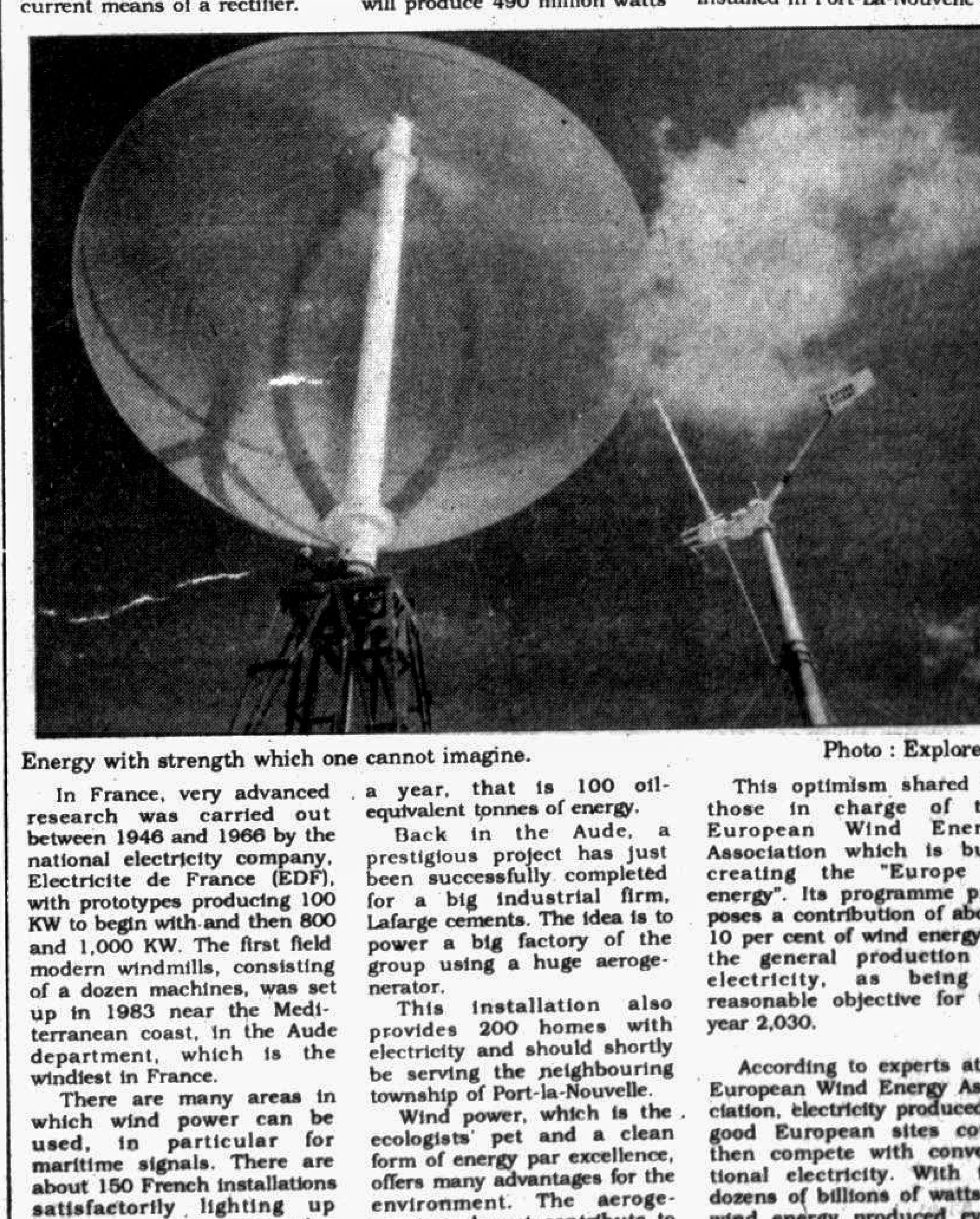
by Camille Herisson

WIND power is the oldest source of energy mastered by man. Sails were used very early, on the first boats and, in the skies of ancient Persia, windmill sails already went round.

Today, almost everywhere in the world, modern windmills, or aerogenerators, move round in the air to pump water or to produce kilowatts. In 1990, 3,17 billion kilowatts were produced, mainly in California, Denmark, the Netherlands, West Germany and Italy.

Modern wind-machines are quite unlike the venerable windmills of old. They are much easier to use, give better results and are far more productive.

The principle consists in having rotor blades, pushed round by the wind, drive an alternator. The electric current produced is turned into direct current and stored in a set of accumulators. When needed, the current can either be used as such, or it can be turned back into alternating current means of a rectifier.



Energy with strength which one cannot imagine. Photo : Explorer

In France, very advanced research was carried out between 1946 and 1966 by the national electricity company, Electricite de France (EDF), with prototypes producing 100 KW to begin with and then 800 and 1,000 KW. The first field modern windmills, consisting of a dozen machines, was set up in 1983 near the Mediterranean coast, in the Aude department, which is the windiest in France.

There are many areas in which wind power can be used, in particular for maritime signals. There are about 150 French installations satisfactorily lighting up lighthouses are beacons with a power of 300 to 5,000 watts.

Windmills also power communications networks. The Telediffusion de France company, which operates the national system of transmission by satellite, has set up a retransmission centre, powered by both solar energy and wind, in the Herault department.

Since January 1991, in Dunkirk, in the heart of a region where wind already used to drive windmills in the 16th century, stands the biggest modern windmill in France. It is a first, both for its power and for its link-up with the electricity grid. Its rotor, which is 25 metres across and goes round 52 times a minute, will produce 490 million watts a year, that is 100 oil-equivalent tonnes of energy.

European experts consider that wind power, which is not yet very common in France, will become competitive in the first third of the 21st century. The technique is progressing and production is developing.

Back in the Aude, a prestigious project has just been successfully completed for a big industrial firm, Lafarge cements. The idea is to power a big factory of the group using a huge aerogenerator.

This installation also provides 200 homes with electricity and should shortly be serving the neighbouring township of Port-la-Nouvelle.

Wind power, which is the ecologists' pet and a clean form of energy par excellence, offers many advantages for the environment. The aerogenerators do not contribute to global warming through the greenhouse effect (no emissions of CO2 or methane or CFCs). They are not at all involved in the phenomenon of acid rains (no emissions of sulphur dioxide or nitric oxide).

So why are there so few windmills in France's skies today? Because wind power is not yet suited for mass scale production of electricity. The kilowatts produced in this way cost three to four times more than traditional electricity obtained from nuclear or hydro-electric power.

So wind power is only justified for scattered use, mainly in isolated sites requiring low power.

But progress is being made in the technique. Ten years ago, a square meter fitted, cost 5,000 francs for a windmill producing 400 KWH per year. Today, a production of 1,000 KWH can be obtained for half the cost.

"Some people predict that before 15 years are up, the equivalent of the production of three or four nuclear power plants will be supplied by ultra-efficient aerogenerators of the kind which was recently installed in Port-La-Nouvelle".

This optimism shared by those in charge of the European Wind Energy Association which is busy creating the "Europe of energy". Its programme proposes a contribution of about 10 per cent of wind energy to the general production of electricity, as being a reasonable objective for the year 2,030.

According to experts at in European Wind Energy Association, electricity produced in good European sites could then compete with conventional electricity. With the dozens of billions of watts of wind energy produced every year by aerogenerators, France's share could, in such a hypothesis, amount to around 9 to 10 per cent. — L' Actualite en France

Gripping Atoms with Laser Tweezers Creating Atomic Fountains

THE scientists also use lasers as "optical tweezers" to grab and move individual biological molecules. Researchers can stretch out single molecules of DNA in water and observe them as they snap back elastically. They can also pin the stretched molecule down onto a microscope slide for observation, says newsletter from the Stanford University.

Using lasers to hold and move atoms and molecules with exquisite control, Stanford University Physicist Steven Chu and his co-workers are making extremely precise measurements in physics and biology.

For example, they have used laser beams to chill sodium atoms to within a tiny fraction of a degree of absolute zero and create "atomic fountain" of slowly falling atoms. These fountains allow such precise measurements that the scientists can detect the gravitational change caused by moving four inches farther from the centre of the earth.

The Stanford scientists believe that a portable gravity meter — suitcase-sized and a thousand times more accurate than current devices — might be available within a few years. With it, seismologists could monitor earth movements, oceanographers could measure sea-level changes, and geologists could locate buried oil deposits or monitor changes in the water table.

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Using these tweezers on muscle proteins, another group is measuring how much does a single molecule contribute to the muscles' contraction. This gives scientists the opportunity to understand for the first time how muscles contract, molecule by molecule.

"Six years ago, none of these applications were considered," Chu says. "No one dreamed we would ever control atoms or molecules this well."

The gravity measurement begins by using lasers to chill a few sodium atoms — about 10 million atoms, or 10 billionths of a billionth of an ounce — and trap them in a region of space only a millimeter in diameter.

At first glance, cooling atoms to temperatures near absolute zero by zapping them with laser beams seems unlikely, even contradictory. Yet a technique proposed by Stanfored Physicists Ted Hansch and Art Schawolow in 1975, and first demonstrated by Chu and his colleagues in 1985, does just that.

The technique, which Chu dubbed "optical molasses," makes high-teach use of the familiar effect known as the Doppler shift. Most people have noticed that a train horn sounds with a higher pitch — a higher frequency of sound waves — as it moves closer and changes to allower pitch as it passes and moves away.

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Similarly, physicists know that the frequency of a light beam appears higher when an observer is approaching it than when the observer is moving away from it — again, a Doppler shift.

Optical molasses takes advantage of the fact that atoms absorb certain frequencies of light much better than other frequencies. A laser beam tuned to light frequency just below one of those critical frequencies thus won't disturb most atoms. If an atom happens to be moving toward the laser sources, however, the Doppler shift raises the laser's frequency slightly, making the atoms more likely to absorb a photon of light energy. The impulse delivered to the atom during its collision with the photon slows the atom's motion.

By directing six laser beams at a single region of space — from above and below, front and back, left and right — Chu and his colleagues can slow any random motion of atoms in the target zone by hitting them with light energy from the opposite direction. Slowing atoms down is the same thing as cooling them, since the temperature of a collection of atoms is just a measure of their random motion.

The Stanford group trapped sodium atoms with lasers and magnetic fields, and used optical molasses to cool them to within 30 millionths of a degree of absolute zero. By adjusting the frequency of some laser beams, the scientists lifted the atoms upward, gently lofting them into a free-falling are, or 'fountain', that lasted for nearly a second.

Heisenberg's famous Uncertainty principle implies that the less time you have to make a measurement, at least at the atomic level, the less accurate it will be. Normal room-temperature atoms travel at supersonic speeds, so they're difficult to follow long enough to measure accurately. The atoms in an atomic fountain, on the other hand, hit a top speed of only about 2 metres per second — roughly the speed of a ball dropped onto a table from eight inches up — and thus allow extremely accurate measurements.

The Stanford group determined the speed of the falling atoms by measuring the size of their Doppler shift as they fell toward yet another laser. Using a highly accurate atomic clock to time their fall, the group could calculate gravity's acceleration with great precision.

"Instead of measuring the distance an atom falls in a certain amount of time, our atomic gravity metre measures the change in velocity during a given time by measuring the Doppler shift of a very well-known atomic frequency, Chu says.

The group so far has measured gravity's tug to a precision of three parts in 100 million, and expects to push that precision still further in the near future, to one part in 10 billion, which would make their technique almost a thousand times more accurate than any others, Chu said.

The researchers have applied for a patent on the atomic gravity metre. A durable, suitcase-sised portable device might be possible within a few years, Chu says.

A portable gravity meter with an accuracy of one part in 10 billion could measure change in elevation to the nearest third of a millimetre, since the pull of gravity diminishes as one moves farther from the centre of the earth. Such equipment would give seismologists and oceanographers easy and accurate measurements of land and sea changes.

In addition, geologists could detect changes in the composition of buried rock formations by measuring gravitational differences, since gravity would be a bit stronger over higher-density formations. This might provide a handy way to search for underground oil deposits or monitor changes in the water table, Chu said.

A second group of Standford researchers uses laser beam at a scale only slightly larger — to grab and manipulate the individual protein molecules that cause muscles to contract.

The goal is to discover how proteins act as motors — how they convert chemical energy into mechanical work.

Each muscle cell contains thousands of muscle biros arranged parallel to one another like a package of dry spaghetti. With in each fibre, bundles of two kinds of protein molecules — called acting and myosin — alternate in bands, overlapping one another like hands with long, loosely interlaced fingers. When the muscle contracts, the actin molecules slide along the myosins, interlacing further and bringing the "hand's" closer together. This shortens the muscle. When the muscle stretches, the hands separate again, with the acting molecules sliding back and reducing their overlap with the myosins.

Scientists theorize that the sliding motion of actin molecules over myosins is controlled by dozens of tiny "heads" looking much like the heads on golf clubs, that stick out from the side of each myosin molecule. The heads attach to neighbouring actin molecules wherever they overlap.

According to the theory, when the muscle contracts, the myosin heads pivot like toggle switches, pulling the acting molecule along. Then the heads release the actin, pivot back to their original position, and repeat the process. In this way, the myosin molecule inches the action caterpillar fashion, along its length.

This model of muscle contraction has been around for some 20 years, but there's no direct evidence of it, largely because scientists have been unable to measure the tiny motions and miniscule forces produced by each myosin head.

Since protein molecules are too small to grab directly with optical tweezers, Finer attached handles — plastic beads about 1/25,000 of an inch in diameter — to each end of the actin molecule.

The tweezers' strongly-focused laser beam creates an intense electric field at its focus, slightly redistributing the bead's electric charges. This draws the bead to the laser beam in much the same way that static electricity draws a piece of tissue paper to the tooth of a comb.

By grabbing each end of the rope and pulling it taut, he can move the acting molecule precisely where he wants it. He is gradually refining his ability to place the acting next to exactly one myosin head to measure the force of its tug.

Musicle physiologists expect that force to be roughly 3 trillionths of an ounce — not an easy pull to measure with a connectional scale. Fortunately, laser traps provide a way to measure forces like this, as well.

The electric field of the laser tends to hold the bead in the dead centre of the beam. Pulling the bead away from the centre of the laser beam requires force, and the farther it's pulled away, the greater the force.

Finer can detect these tiny motions — as little as 1/1,000 of bead's diameter — by shining a light on the bead and measuring changes in the way the bead deflects the light beam.

Once Finer cracks the acting-myosin problem, he hopes to focus his tweezers on other molecular motors found in cells, such as the motor the cell uses to move chromosomes during cell division. — **(PTI Science Service)**