

## INDIA TRIP REPORTS 2007

### First Trip Report

I safely arrived here in India. The plane trip was nice and uneventful and we had no problems in customs. I would have written earlier but we got her at Mangash's sister's apartment after midnight and the next day we ended up leaving for the countryside in the early afternoon. It has only been a few days but I already have been visiting several interesting places right around Mumbai (where I am right now). It used to be called Bombay and is a city of somewhere around 15 million people and terrible traffic jams.

We started by going to a nearby "agratourist" ecotourist resort where the owner, Shekhar is already using a solar water heater and wants to solar power the little cottages. In return for my designing PV system for the places, we got a really pleasant pond house to stay in and nice Indian meals.



**Photo 1, the pond house at Shekhar's ecotourist resort.**

We went several other places and just got back yesterday evening in time to meet with the owner of a very elegant hotel to talk about possibly working together (I would get paid a consulting fee since the man is quite rich).

I finally have a half decent Internet connection, but still dialup, so I'll wait until later to send any photos and a real report. I'll try to stay in touch as best as I can as we move around the country. On Wednesday, we take the overnight train down to the south to places around Mangalore (but we will get to Bangalore as well). I asked if we would get a seat inside or have to ride on the roof, I'll take photos.

## **Second Trip Report**

We are now in Shirali, a tiny town near Bhatkal, north of Mangalore on the southwest coast of India. We took the train down and had an air-conditioned sleeper. Not first class since there were three bunks high on each wall of our "compartment" which was really only a space with no door or anything. Beautiful countryside here, lush and green right after the Monsoons, which did a lot of damage locally this year. We are meeting with very interesting groups of people and I have taken photos of lots of different biogas designs. Biogas is a big thing here and the equipment is off-the-shelf commercially available packages. Yesterday we visited a dam on the local river and I gave some pointers on how to get electric power out of it with the minimal of changes to the dam, which is for water collection. By the way, all the local places we stay at seem to have these fairly sophisticated water filter systems for drinking water and I have not been sick at all from drinking this water.

We are staying in the guesthouse at a local Hindu temple. This is a small 300 year old sect and everybody knows that I met and am working with the 11th Swami who they venerate, so I am treated embarrassingly well. Nice vegetarian food to eat as well. The 11th Swami is following his predecessor (the 10th, of course) in concentrating on village development, so he is excited about the PV as a cottage industry; but things move slowly in these areas.



**Photo 2, the Temple at Chitrapur.**

### Third Trip Report

We are now in Mysore and are resting on Saturday after a busy week. We have now arranged the hands-on PV module assembly course, which will take place starting the 15th of November (This will give time for the people here to organize the workshop). We are working with the Swami Vivekananda Youth Movement (SVYM) out in the countryside and will have a group of about 10 young Dravidian tribal youths as the students. The Youth Movement has a very interesting Montessori type school where the tribal children go through the equivalent of high school and learn English, as well as science and math; but they have very poor employment opportunities when they get out. This should be an interesting course in an interesting area. The school is right next to the Bandipur National Park and lots of wild animals roam the area, which is quite remote. It is also near a lake created by the dam that forced the tribal people to move.



**Photo 3, Ferry (of an ancient design) crossing the lake near the Vivakananda school.**

The Youth Movement also operates several hospitals. We stayed at the biggest one but will be giving the workshop at a smaller, more remote one. All the places already have PV electricity for lighting and back-up for the wonky utility grid, solar water heaters, biogas generators, and 100% rainwater catchment with solar powered water pumping. We will start by building the usual 60 watt PV modules and have already sold at least 6 of them before the project even starts.

Yesterday I gave two seminars, the first was at the Youth Movement's outreach building here in Mysore and the second was at the National Institute of Engineering (NIE), also here in Mysore. Mangesh is an alumnus of NIE and we received quite a welcome, going around to be introduced to everybody of importance and being taken out to lunch, etc. when we arrived. They already have a large renewable energy program and a Renewable Energy Park and Shamasundar, the director of the program gave a paper at the Dresden conference in September of 2006, where we gave the paper about Marco Antonio's new encapsulation system. He wants to work closely with us and already has strong contacts with SVYM so we are getting a great deal of support. We have already shopped for all the parts needed to build the PV modules and somebody from NIE will order and pick up all the material needed before we come back here from Mumbai in November. Two groups of NIE students will be doing their senior thesis (monograph) projects on subjects I will be overseeing: the PV-hot water hybrid and the photovoltaic-still. As you know, I have been wishing to get more R &D work done on these two for years. Now these two groups (4 students each) will actually be building the next prototypes.

All these people expect me to come back to Mysore again next year and to continue working with them. Tomorrow afternoon (Sunday) we leave on the train for Delhi, changing in Bangalore. We arrive in Delhi on Tuesday morning if the train isn't late.

#### Fourth Trip Report

We now have been in New Delhi for almost two weeks but are leaving tomorrow by train for Mumbai (Bombay) and a few days later we are going back to the Mysore area to start the PV cottage industry workshop with the Dravidian tribal youth.

Here in Delhi, little of my time was spent on solar projects, except to inform friends of Mangesh and Anila about what we are doing. Anila is Mangesh's girlfriend and is in the middle of selling her parents' home in New Delhi and finishing up a condominium in a new area west of the Delhi airport, so we have been busy going around dealing with the Indian bureaucracy, which must be about the most complex in the world. They have had thousands of years of practice and a 400 year graduate course in the methods by the British. Her parents' home also has a lot of repairs needed since she is selling it so I have been busy in my usual troubleshooting role. It's a good thing I brought my multimeter and screwdriver with me on this trip.

Today is also Diwali, the Hindu equivalent of Christmas and Thanksgiving put together so we have been going around for the past week or so (the event lasts 9 days, ending today) visiting lots of friends, and will go off to a special dinner this afternoon. All the food has been vegetarian lately, and I have gotten quite used to it (as had my digestive tract, I haven't had any stomach problems at all). I took advantage of the occasion to do Christmas shopping, especially yesterday when the shops had everything marked down on the last day. This Delhi part of the trip has been a great sightseeing and cultural experience. We have gone by city bus, bicycle rickshaw, three wheel put-put rickshaw, and automobiles all over the area. I got to see very interesting areas and seen the city planning by various leaders over the thousands of years that this city has been an important center of civilization.



**Photo 4, British monumental architecture.**

One interesting thing I have noticed about India is how "green" it already is. Most everybody has compact florescent lamps in their sockets, the train system is mostly electrified on all the major routes (and they are working to upgrade the rest), and all the put-puts and city buses run on compressed natural gas (CNG). I also found out about a major car company I didn't know exists: Tata Motors. They make really nice comfortable, efficient cars that rival Toyota's. The most popular model is a short V2-cylindar diesel four-door sedan that runs surprising smoothly and has decent pep, considering its great fuel mileage. Gasoline is over \$4 per gallon and diesel is about \$3.30 at its controlled price, which is supposed to go up any day now. The Delhi area has the kind of boomtown atmosphere I remember from my days in Chicago back in the early 1950's. We visited an architect the other day whose office also is the outsource for "green" design of large buildings in California. He is doing "zero energy buildings" but he also lives in a real Green home

he designed for himself which goes much further (about as far as mine in Maine). He is a friend of John Todd and tries to use the "Living Machines" when he can.

One of the world's largest wind energy companies is Suzlon, an Indian upstart that is taking on GE to be the world's largest wind generator manufacturer. Tata has already joined forces with British Petroleum

to form Tata-BP to manufacture and sell PV systems in a big way (but we intend to compete with them in both price and quality with our village systems). We are being told that the US cannot do anything about going "green" until China and India start doing something to curb their greenhouse emissions. They are actually doing more than the US is, but the definitely have a long way to go: Coal is the major source of electric energy in India and most of the freight trains I have seen on my various train journeys here have been mile long coal drags. Delhi has a real smog problem, it is hard to see any distance when we go to the top of a hill.

By the way, since I have been here, I have been in e-mail correspondence with an assistant professor at Fudan University in Shanghai, China, who wants to start the PV cottage industry in remote Chinese villages. I am afraid that I have quite a profession ahead of me.

### **Fifth Trip Report**

We are back in Mysore, taking the weekend off from the photovoltaic course I am teaching in the Dravidian tribal area. We have just finished the first week of the course and have been successfully making the PV modules from one of the boxes of Evergreen Solar cells I brought with me in my luggage from Maine. Using the method of encapsulation developed by Marco Antonio (the landmine survivor who runs the cottage PV industry in northern Nicaragua) we have finished three of the 60 watt PV modules from the intact Evergreen Solar cells and two of the 30 watt modules form pieces of cracked or broken cells cut in half. The Tribal youth have really taken to this work and are cutting the crystals quickly and perfectly. They have developed an eye for how to use a broken PV cells to the best advantage so that the box of unusable scrap cell pieces is really quite small. By this time, all I have to do is ask them (through an interpreter ) to make a particular module and they simply go about the work, so all I have to do is take photos and keep an eye out for any mistakes that they don't catch.



**Photo 5, Making a 60 watt PV module**



**Photo 6, Testing the module**

Yesterday we made a cell phone charger, using some of the smaller broken pieces of the PV cells. We succeeded, after several tries, in getting exactly the proper voltage and current from a string of 12 of these cells to let the cell phone go into its charging mode. The students clapped and cheered. Next week we

will make several of these chargers for the different brands and models of cell phones around here. We also rewired one of the soldering stations to operate directly from batteries and one of the finished PV modules so that we can continue work when the grid goes down, which is more often than it is up.



**Photo 7, Group with all the PV modules we made during the course.**

These people speak a pre-Sanskrit language called Kannada and only a few of my 14 students know any English at all so everything I say has to be through an interpreter. I am just getting to appreciate their culture and hope in the next week to find out more about their customs and views. The food is good, but strictly vegetarian at the Vivaka ayurvedic clinic where we are giving the workshop, which is right in the middle of the tribal area and completely away from any connection to the Internet. Some evenings we watch a DV movie on my laptop (if the electricity is on) but one evening we had a songfest in the dark. These tribal people have a tradition of singing and beautiful voices so it was a wonderful experience for me, even though I didn't understand a word of the songs.

### **Sixth and Final Trip Report**

I am now back in Nicaragua after traveling to the US and spending Christmas with my sister and friends in Florida; and finally have time to put together all the trip reports with a few of the many photos we took during the trip.

In the second week of the Dravidian student course we finished up two more large PV modules and installed one of them at the ayurvedic clinic, on the building where the students are living. The building already had had a PV system installed but it wasn't working properly. I let the students figure out what was wrong; the main problem was that the PV module had been installed under a coconut tree and was in the shade most of the time (Fortunately no coconuts and fallen to smash the module), Also the module at about 30 watts, was too small for the system. The students installed one of the 60 watt modules without my help, and when they made a mistake, I simply let them go ahead and discover that the system wasn't working and figure out why, rather than tell them what they did wrong.

We also worked with light-emitting-diodes (LEDs) and I taught them how these worked and how to wire them up in series for an efficient 12 volt light source. We made a speed control for the 12 volt rotary cell cutter and they learned how to cut the PV cells several different ways. On Saturday, at the end of the week we had a formal graduation ceremony and passed out diplomas then made plans for the following week when we all would travel to the Mumbai area to install a PV system in an ecotourist resort

Fourteen of us took a 24 hour train ride to get to the resort, which is in a remote area on a beautiful river. The resort has a set of cottages where families stay and we wired one of these cottages to be totally solar powered, with no connection to the utility grid. The grid in these remote areas is very unreliable so that the resort already had been using batteries and an inverter, for when the power line was dead, so it was a simple thing to get the same system and simply use the PV system to recharge the batteries. The students participated in the design of the whole system and worked out the details with the help of myself and three NIE faculty members who had made the trip with us.



**Photo 8, An outdoor classroom**

Since the cottages were in the shade of large trees, we installed a pole mounted PV array of two 60 watt modules, and ran the wires underground to the cottage, to keep the installation as neat as possible. We actually had a ceremony with local politicians and the press to inaugurate the system, which worked perfectly, running lights and a ceiling fan. The next day we visited two police stations, at the request of the district police manager, to design PV systems to run the critical and emergency equipment in the stations.



**Photo 7, Installing the 120 watt PV system at the ecotourist resort.**

Just three days after the ceremony, I flew back from Mumbai through Amsterdam to Boston, then took the Amtrak train down to Florida. Our webmistress, Martha Dickinson has put all these India trip reports up on the Maine Solar Association (MESEA) [www.mainesolar.org](http://www.mainesolar.org) website, so you can go there to read all of them, as well as the scientific paper giving all the details of Marco Antonio's encapsulation process.