Electric Auto Association NEWS

AUGUST 1986 VOL. XVIII NO. 8

Neodymium

Research in the development of a new alloy composed of three natural elements (neodymium, iron and boron), which when formed with a fine crystaline structure, results in a material that can be magnetized to produce a permanent magnet of extremely high power, a Super Magnet.

Current magnet materials

Ferrite magnets make up 92% of magnets produced in the western world at present, Alnico (aluminium/nickel/cobalt) 7.3% and SmCo (samarium/cobalt) 0.7%. Ferrite is mid grey in color and has the appearence of a 'paste' that has been moulded and cooked. The better Alnico magnets are stronger than ferrite (up to double), but more expensive and difficult to prepare for special shapes such as motor magnets. SmCo magnets are generally 5-7 times stronger than ferrites but six times more expensive than ferrite for the same energy level. Cobalt is a by-product of copper and nickel mining in southern Africa (Zaire), and due to the single source and the political instability of that source, supply and price has been erratic since 1979. Cobalt is also used in steel manufacture for high temperature superalloys for aircraft, and has been classed as a strategic material by some Western countries.

Rare-earth alloy developments

The major development of these alloys has taken place in the United States, and later in Japan. In the U.S., the Office of Naval Research and General Motors Reasearch Laboratories have been the main movers picking up from the work of Arthur Clark in 1973. He discovered that the addition of a rare earth element (such as samarium) to the main metal gave improved coercivities to the finished magnet. (Coercivity means resistance to be de-magnetized or magnetically deformed subsequent to the initial magnetization). From this developed the SmCo magnets.

Neodymium alloys

Due to the cost and supply problems of cobalt, research for a mew magnetic material was based on iron (Fe). Theoretically, iron has a potentially higher energy product than other common bases.

A fine crystalline structure in the magnet material is desirable, (the optimum is considered to be about 3 microns), and to help achieve this boron (B) is included in the alloy and the alloy cooled and/or heat treated in a special manner. Boron also improves the magnet's resistance to the de-magnitizing effect of high temperatures. The presence of both boron and neodymium with the iron results (under ideal conditions) in the development of a long crystal, almost 50% longer than it is wide, which when it is magnitized has a very high energy content and very good coercivity.

In the 'sintering' process of manufacture, the components (Nd 14%, Fe 78%, B 8% by atomic weight) are melted by induction heating in an alumina crucible under an argon atmosphere. The ingots cast from this melt are crushed in a nitrogen atmosphere to a particle size of about 1 mm using a jaw crusher, and then reduced to 100 microns by a disc mill. This is further reduced to 3 microns in a stainless steel ball mill. The powder is then aligned in a magnetic field and pressed at a pressure of 200 MPa. These 'green' compacts are sintered in an argon gas atmosphere at temperatures of 1320-1430 K for one hour and then cooled rapidly in a cooling chamber. Next comes heat treatment for one hour at 400-1400 K and then cooled rapidly. The alloy is then magnetized. The alloy for magnets made by the sintering process mormally has a higher boron content, as it is felt that during the sintering stage the excess boron contributes greatly to developing/maintaining the desired crystal shape and inproves the coercivity. This sintering method is used by Sumitomo Metals in Japan under the trade name 'Neomax', and by Crucible Magnetics in the U.S. under the name 'Crumax'. This

production method has to date yielded the most powerful magnets of the Nd/Fe/B type.

Another method of manufacture called 'melt spun' is where the molten alloy is sprayed in a fine stream onto a rapidly spining copper roller which cools the metal extremely quickly resulting in a crumbly ribbon of amorphous material. Altering the speed of the roller determines the size of the crystallites in the material produced. This is then hot-pressed at 750 C, and may be heat treated before being magnetized. This is the method devised by General Motors, and magnets made this way go under the trademark 'Magnequench'. The 'melt spun' magnets are generaly about 60-70% of the strength of those produced by the sintering process - due possibly to the crystal structure not being optimized, and/or being oriented in a random manner.

The very best SmCo magnets to date have strengths of about 250kj/m3, the best NdFeB magnets rate about 340kj/m3, an increase of some 35%. It is expected that this will improve with development. Typically a good ferrite magnet will give about 40kj/m3, or 12% of the NdFeB magnet. The relationship of cost to energy of the three materials shows ferrite to be the cheapest (established mass production helps here), NdFeB to be four times more expensive, and SmCo to be the dearest at 6.5 times that of ferrite. For magnets of equal power, a SmCo will weigh 29%, and a NdFeB 19% of a ferrite magnet.

Advantages & disadvantages

NdFeB is cheaper than SmCo on an energy basis, and far lighter as well. Because the components of the alloy are readily available from several reliable sources, the price should be reasonable and stable.

Two disadvantages exist at present with the new alloy. The first and most important is the relatively low Curie temperature, ie, the temperature by which the material has lost its magnetisim. At present this occurs at about 300 C, and imposes a maxium operating temp of 150 C to ensure no loss occurs. This Curie temperature can be raised to a limited extent by adding more boron to the alloy, but to a greater extent by replacing some of the iron with cobalt. With 15% cobalt the operating temp can be raised to more than 210 C. However, we were trying to get away from cobalt! Further research should reveal a solution to these problems.

The other problem is internal and external corrosion of the alloy. Again the addition of a small amount of cobalt helps, but plastic encapsulation/potting and similar treatments are being tried. Some researchers said they had experienced no corrosion problems and suggest that production techniques may be responsible for this fault.

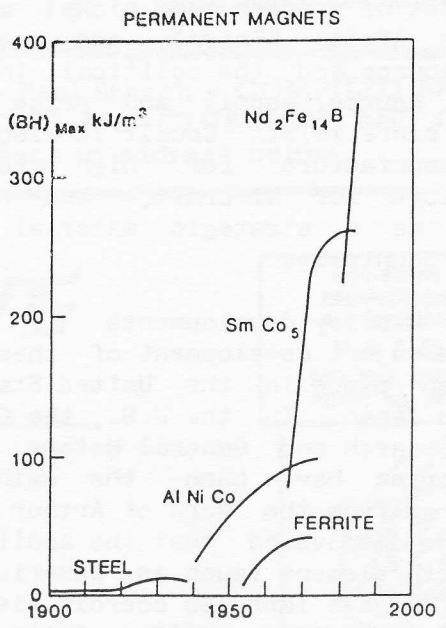
Application

Permanent magnets are used in a wider variety of products than we all realize - we first think of electric motors - but other uses include loud-speakers, sorting of scrap metals and natural ores, plasma physics, eve down to holding notes on the refrigerator door. Many more applications will be realized due to these alloys having greater 'power to weight' ratios.

In the case of electric powered vehicles two options seem to exist - retain the same motor weight but increase the efficiency of that motor which will increase range, (but also cost) or to reduce the motor weight and hold the same efficency for an overall reduction in vehicle weight. The latter may appeal better as it is the least expensive way to go. Whatever way you look at it, a motor that is smaller and lighter for the same power and efficency has to be a move in the right direction.

It is important to note that due to the high energy of flux levels available now for permanent magnet motors, a complete re-design process will have to be done. One new approach now seen as practical is to turn the motor inside-out with the rotor a permanent magnet, and the windings now forming the outer magnetic circuit. This removes the need for brushes in DC applications,as electronically driven switches can replac the brushes at equal (or better) efficiencies, without the need for brush maintenance and the burden of brush drag.

[This is exactly what Unique Mobility has done with motor design. See Aug. '86 Popular Science pgs. 76-79. --Ed--]



The change in strengths of magnets since 1900. The (BH) max figure indicates the maximum available magnetic energy.

from the 7/86 Australian Electric Vehicle Association newsletter -Anthony Mott author.

THE TIMES, THEY ARE A-CHANGING!

By Mike Brown & Shari Prange

Some of you may believe that the day when EVs had the chance to revolutionize transportation are gone. Gas cars today are much more fuel efficient. Gas is plentiful, and people have become so accustomed to the higher prices that anything less than a dollar a gallon is considered cheap. EVs will never be more than high-tech toys for a small but devoted group of hobbyists.

Nothing could be further from the truth. The forces moving toward the demise of the internal combustion engine are more compelling than ever. Petroleum remains a limited and non-renewable resource. In addition, as discussed in last month's EAA News, the damage done by pollutants to the earth's ozone layer, and the impending "greenhouse effect", are daily becoming more serious concerns.

I have spent more than twenty years earning my living working on gas cars, but I know I won't be doing it for another twenty. I can read the writing on the wall. Today's cars are becoming more and more complex in an effort to meet increasingly strict environmental standards. The "cheap" gas of today is merely the lull before the next storm. The gas engine is in its death throes, and the day of the EV is still ahead.

The time to get in on the ground floor of something new is when everyone else still thinks it's a vacant lot. Now is the time for us in the EAA to lay the groundwork for the EV industry. When EVs come of age, they will happen because of us, not because of efforts by big business or government. The bulk of the technical expertise for practical passenger EVs is in our hands.

We in the EAA need to foster an attitude of cooperation, rather than competition, among ourselves, and to take our EVs seriously. It may be only a hobby to you, but what you develop in your hobby may be important to the future of EVs. The EAA should be a place for brainstorming, where we can offer our ideas, however off-the-wall, and get constructive feedback that just might yield a very practical innovation.

In an effort to move toward that end, some changes have been made in this year's rally. The static display time from 10:00 to 1:00 is **NOT** so that you can sleep in late Saturday morning. This is the time when you can look at other people's efforts, see how they've solved particular problems and what they've done differently from you, ask questions, make suggestions, SHARE IDEAS. Don't miss this opportunity!

There are changes in the rally itself as well, including a strict 3½ hour time, the choice of short and long courses, a Tech Inspection for "street legal" status, and a special Long Range class. Any type of vehicle may register for the Long Range class. To qualify, at least 50% of its rally mileage must be run on the long course.

These changes are intended to emphasize practical EVs, and to encourage a wider range of vehicles to participate.

So polish that EV you have and bring it down. You can compete in the rally, or run the course without competing, or simply park it in the lot for everyone to admire.

If you don't have an EV, come anyway. Serve as a judge, or just come to talk EVs and enjoy the afternoon.

I'll be looking for you Sept. 20.

JUDGES NEEDED!
REWARD!

The EAA needs YOU! Enjoy a feeling of power for one day! Hold a dozen delicate egos in your bare hands! Wield the authority to change the course of Rally history!

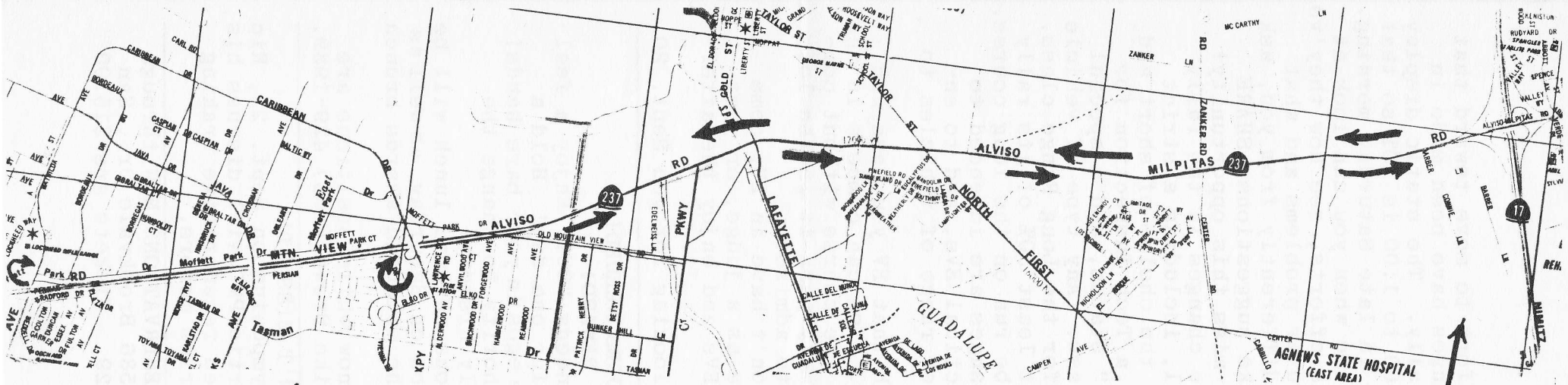
A delicious catered lunch will be provided to you on Saturday, as well as a ticket to the splendid awards brunch on Sunday.

Sign up now while positions are open. Call Mike Brown (408) 429-1989.

DON'T MISS IT!

At the Symposium on Sept. 21, Ric Barline of Curtis/PMC will discuss his new, simplified regenerative braking system for series motors.

MAKE BRUNCH RESERVATIONS NOW through Dave Nonis, 1586 Brookvale Dr., San Jose, CA 95129. Tickets are $15.00



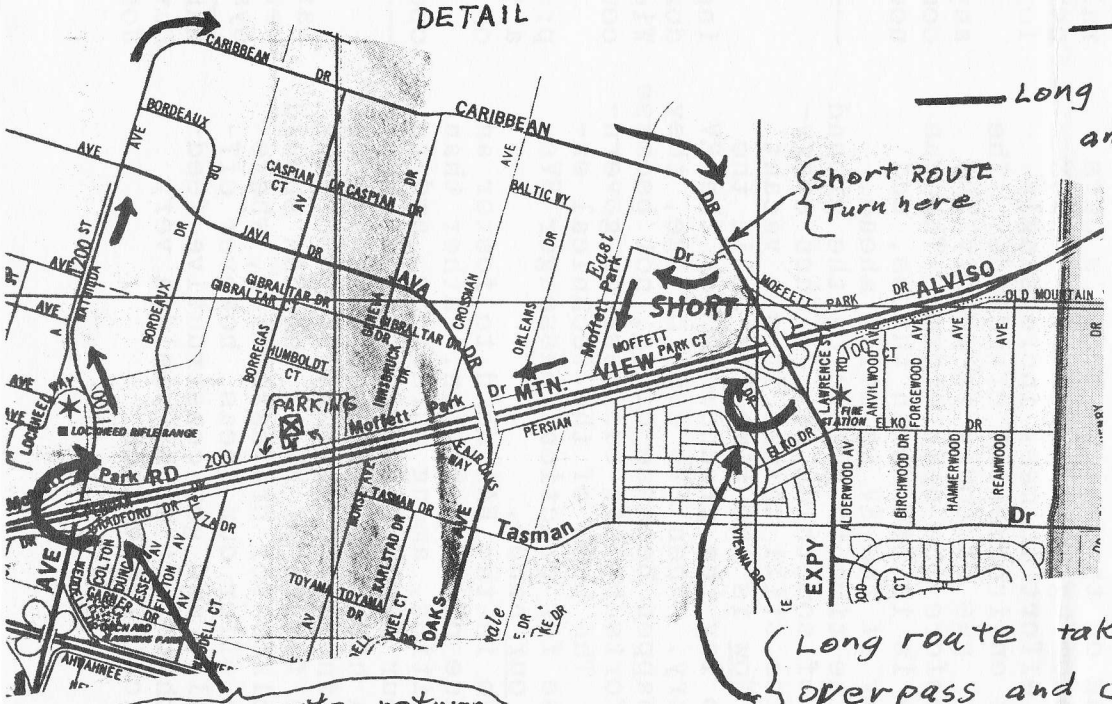
14th ANNUAL
1986 SANTA CLARA CHAPTER E.A.A. RALLY

Two Routes This Year

— Short course as in the Past.

— Long course includes most of short and a highway run to Milpitas.

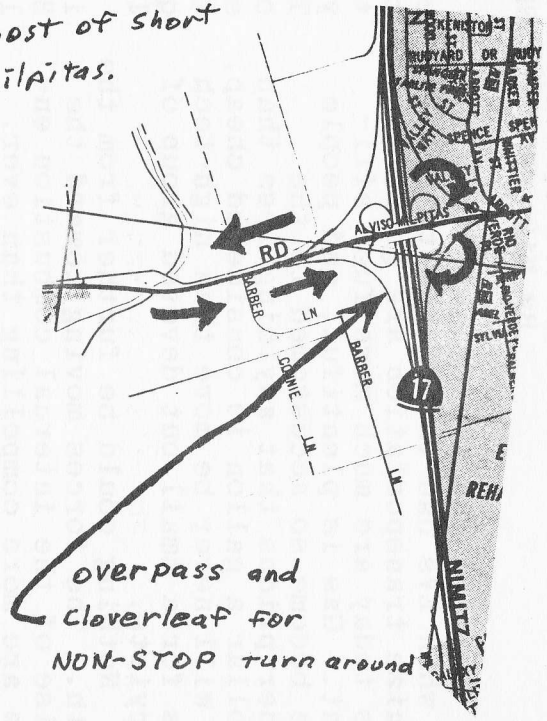
DETAIL



Long route take overpass and cloverleaf to 237 to Milpitas

Long route return from Milpitas should exit 237 at Mathilda Ave. and share ') turn onto Moffett Park for return to start-Finish

DETAIL



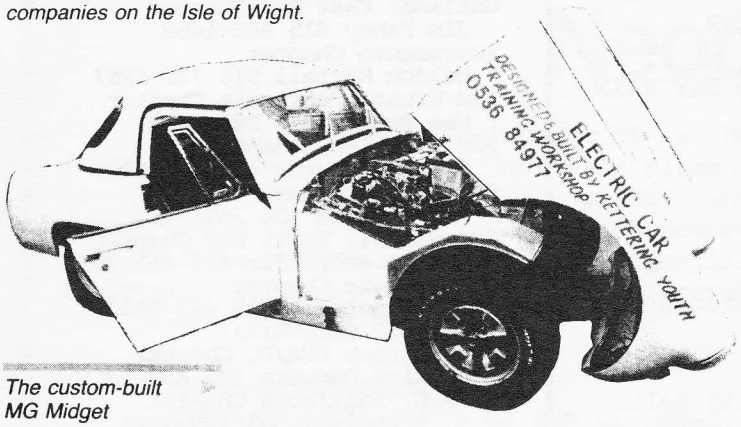
Admiral's new vessel is electric Midget

Trainees at the Kettering Youth Training Workshop have built an electric car for Rear Admiral Gick RN (Rtd), who commissioned the vehicle, an MG Midget in 1983.

Under the direction of the Workshop Manager, Ron Champion, four shop departments (Electronics, Automotive Engineering, Automo- Bodywork and Arts & Craft) have contributed to the building of the car which runs on eight 12V motive power batteries. The car was finished in September 1985.

Top speed of the Midget is claimed to be 50 mph and its range is 50 miles per charge. The batteries have an estimated working life of between five and seven years, says the Workshop.

The Admiral, who is also Chairman of the Electric Boat Association, has now taken delivery of the vehicle, and uses it to commute between his home and his several boat building companies on the Isle of Wight.



The custom-built MG Midget

In the July Popular Science it is stated that Subaru will likely be the first to market with a modern continuously-variable transmission (CVT). The car called the Justy will use a metal belt / variable-ratio pully type CVT with an electronically controlled magnetic powder-metal clutch.
This means that new production automotive magnetic clutches will be available for EV installation.

Bad news about the ZINC CHLORINE battery. Energy Development Associates (EDA) which used to be a Gulf & Western company until G&W divested itself of most of its manufacturing activities a few months ago is being shut down. They were up for sale but had no takers so as of July 31 they closed. They will probably retain the patents and mothball the equipment including a 125Kw ZnCl battery system which was operating successfully right up to the last minute. An example of a technical success without an equally successful marketing effort. 7/86 AET

Stanford researchers have developed a solar cell that could be as energy cost-effective as a coal-fired plant. The key to the cell is very pure silicon with a roughened top surface and reflective back that traps 98% of the light. Also contacts cover only 2% of the cell area, versus 6-8% for regular cells. And a system of 500 times light concentration is used to increase the number of photons while the number of electron-trapping defects in the material remains constant.

All this produces a cell of 27.5% efficiency-above the 25% cutoff where EPRI considers solar cells become commercially feasible. EPRI sponsored the Stanford work and has tagged $10 million for commercializing the device at places like Acrian of SAn Jose. The goal is 29% efficiency at $2 per watt by the early '90s.

EV Marketplace

IMPROVE BATTERY PERFORMANCE Use ENERGAIN to reduce electrical resistance. This will raise gassing threshold so more energy goes into charging and less into electrolysis. The efficiency is improved and less watering required. Battery cycle life is also increased. ENERGAIN is cost effective. Add 3 oz per 100 AHr. Kansas Wind Power, Route 1, Holton, KS 66436 913-364-4407.

FOR SALE: 1981 SCT ELECTRIC VW RABBIT. Diesel Heater, 120/240V ON-Board Lester Charger, less than 2000 actual miles! Original price over $16k, sell for $2800. Call 518-356-0700 after 7 PM EDT.

FOR SALE: Quitting, must sell; 1 Lester 36V charger, GE 2CM76C4L, J&H 6234B, AKKORD speed controller, Vokard fiberglass body for VW. 98N Main, Fayette, Utah 84630, 801-528-3646 after 8 PM. James W. Coles

FOR SALE: 1980 ComutaCar, Electric vehicle. Red/Blk top. Very good condition. 6k+ miles, xtra battery racks (old style). $2500 neg. 8-3, M-F, 313-237-6381. After 5, 313-365-8699.

FOR SALE: '68 King Midget,white,2 seat.78V system,Willey Control,Baldor motor,Salsburry Vary-Speed tranny,Datsun 510 r-end,13 ALCO 2200 bats. Parts to convert back to gas avail.BEST OFFER. ---Also: '79 FREEWAY 3 wheel,red,2 seat.60V system,Skokan controller Comet V.S. tranny,5 ALCO 12V bats.PM motor (needs brushes) or 8 HP Prestolite avail.BEST OFFER 408-379-8746 or 408-746-8219 wk days.

ADS must be received with payment by the 10th of the month, for the following month's issue. AD rate is min. 1 to 5 lines $5.00. 1/4 Pg. $15, Full Pg. $50.00, Full Pg. 2 sides $80.00, WANTED - TRADE - FOR SALE, etc. Mail to EAA 1249 Lane St. Belmont, CA 94002

WHATS HAP'N

EAST BAY Change in DATE & PLACE!!!
SAT. AUG. 2 : EAST BAY RALLY at PLESANT HILL / CONCORD info: 415-798-0909

EXPO 86
VANCOUVER

MON. AUG. 11 : EAA INTERNATIONAL RALLY -UNIV. OF WESTERN WASHINGTON

TUES AUG. 12 :BC HYDRO RESEARCH CENTER

WED. AUG. 13 :EVAC RALLY - SURREY TO SKYTRAIN

THUR AUG. 14 :RALLY TO EXPO

AUG. 15-17 : EXPO PACIFIC BOWL

FONTANA
SAT. AUG. 16 : FONTANA RALLY 714-842-9990

DENVER
SAT. AUG. 23 : DEVC RALLY -NORTHGLEN MALL 303-442-6566

SAN DIEGO
AUG. 24-29 : INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE -TOWN & COUNTRY HOTEL 202-874-4401

SANTA CLARA
SAT. AUG. 30 : S.C. CHAPT. MEETING moved to this date from Aug. 16 for THIS MONTH ONLY!!

SANTA CLARA
SAT. SEPT. 20 : 14TH ANNUAL RALLY
SUN. SEPT. 21 : SYMPOSIUM, BRUNCH AND PRESENTATION OF AWARDS

EAA CHAPTERS
Call the contact person for meeting times and places.

ARIZONA: Phoenix Chapter
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ARKANSAS: Little Rock Chapter
B.S. Boykin 501 562-0252
CALIFORNIA:
Bakersfield Chapter
James Peters 805 393-1749
Concord: Contra Costa Chapter
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Los Angeles: Burbank Chapter
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AUG 87 1986

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TIME DATED MATERIAL - DO NOT HOLD

HELP !!

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$25 "RALLY" DONATION
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