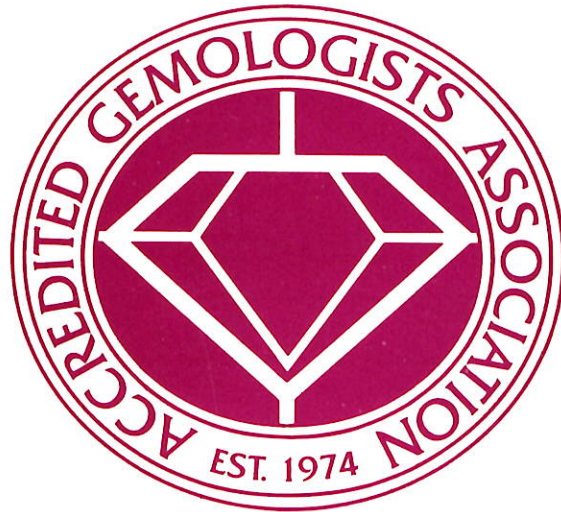


AGA CORNERSTONE



AN INTERNATIONAL NEWSLETTER

Published Quarterly By The

ACCREDITED GEMOLOGISTS ASSOCIATION

A Non-Profit Organization Established In 1974

To Develop and Promote Professional Standards in the Practice of Gemology

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From the President. . .

The 1984 Tucson Conference was highly successful. I wish to thank all those people who participated in organizing the conference and especially all the members who attended. Their efforts have not gone unnoticed in making this conference a meaningful educational exchange. The speakers were interesting, informative and all were well received by those in attendance. The management and staff of the Palo Verde Plaza Holiday Inn were most cooperative and our thanks go out to them as well. All of the conference sessions were well attended, however, we had one rather unpleasant session on the AGA color test. The differences in opinion on the AGA color test are in the process of hopefully being resolved and will be covered in detail in another issue of the CornerStone.

The AGA is planning mini-conferences for the East and West Coasts this year at very affordable

prices. The East coast conference will be held in conjunction with the International Gem and Mineral Show on June 2nd and 3rd at the Sheraton Washington Hotel. The only cost will be \$25.00 per member to cover the costs of the luncheons and \$50.00 for non-members. There will be two, six-hour days giving people time to attend the show as well as the conference. The conference schedule is listed elsewhere in this issue. All of the speakers are volunteers and we greatly appreciate their expertise and time they so generously give.

This year the AGA is going to strive to have a significant chapter and membership growth. The South Florida Chapter held an organizational meeting in Fort Lauderdale, in April. Let's all make a renewed effort towards this growth by encouraging our gemological associates to join the AGA in 1984.

From the Editor. . .

Tucson '84 was a big success! Special thanks to Thom Underwood and to my wife, Myriam, for their support and assistance in seeing that everything ran so smoothly. All of the speakers were excellent, and we certainly appreciate their willingness to share their time and expertise with our members. We were especially fortunate to have on hand Mr. Glenn Nord, President of the GIA, who spoke at the M.G.A. installation breakfast and then again at the afternoon luncheon. We were also privileged to be able to meet and talk with Dr. Truehart Brown, creator of the Kashan Ruby; and Ms. Judith Osmer, creator of the Ramaura Ruby. A complete list of those people in attendance is included later in this issue. Also included, are pictures taken at the M.G.A. installation breakfast.

In this issue, we are publishing an edited version of Dr. George Rossman's talk on *Gems and Technology*. It was very informative and we are pleased to be able to offer it here for those members who were unable to hear it first hand. In future issues we will be presenting highlights from other lectures.

Next issue will deal more with the AGA Color Communication Test. If you would like to express your opinion on this somewhat controversial issue, please write in and we will publish your letters in the July, 1984 CornerStone.

The 1984 AGA Directory has just gone to press, and we expect to be mailing them out to you in about two weeks.

From the Treasurer. . .

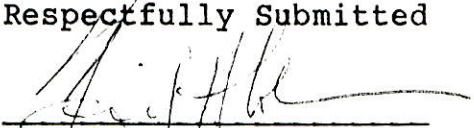
ACCREDITED GEMOLOGIST ASSOCIATION, INC.

**OPERATING STATEMENT AND
CASH SUMMARY**

7-1-83 — 1-31-84

	Hartford Account	Savings Account	Miami Account	AGA Lab MGA Act.
Beginning Balance 7-1-83	(4303.23)	1500.00	1123.87	
RECEIPTS:				
Fees & Dues	19065.00			9220.00
Interest		170.04		
Transfers from new account			1800.00	
	19065.00	170.04	1800.00	9220.00
Transfers-Hartford to Miami	(4000.00)			
Savings to Checking	15170.04	(15170.04)	4000.00	
EXPENSES:				
Phone	5097.93		840.58	
Membership Expenses	65.00		76.18	
Meetings	142.50			
Office Supplies	125.68		354.59	66.67
MGA Expenses	1011.39		85.63	
Master Sets	4500.00			
Postage	899.91		497.40	50.00
Travel	2235.50			2052.96
Newsletters	2717.10		391.00	
Color Test	3707.50		671.90	3168.69
Prof. Services	1450.00			682.73
Subscriptions	1200.00			
Refund	100.00			
Public Relations	2000.00		275.50	1500.00
Tucson Expenses	442.72			
Hotel & Food				683.73
Insurance				257.50
GIA Course				770.00
Secretary			2016.00	
Corp. Filings & Regist.			68.00	
	25695.23		5276.78	9232.28
BALANCE 1-31-84	236.58	-----	1647.09	(12.28)

Respectfully Submitted


Neil H. Cohen, ASA, MGA
Treasurer

Master Gemologist Appraiser Certification Program

Awards Ceremony. . .

Mr. Glenn Nord, President of the Gemological Institute of America, was on hand to offer his congratulations to 26 of the 30 Master Gemologist Appraisers who were awarded their M.G.A. Certificates from M.G.A. Program Chairman Don Palmieri, during a breakfast ceremony in Tucson. Mr. Nord applauded the Association's leadership for responding to the needs of the industry by initiating such a program. He said that he thought our program was especially credible, in that *all* of the people awarded titles had to pass several examinations, and that there was no grandfathering of anyone into the program.

Tucson Program. . .

Ten members participated in the three-day, M.G.A. program offered during the Tucson Conference, although one of these did not take the examinations, as he needs more time in appraisal experience. Eight candidates successfully completed all of the examinations, have met all of the other requirements, and have been awarded the Master Gemologist Appraiser title. Congratulations to all of these successful members, and the Association heartily

welcomes the eight new title holders. Their names and accredited laboratories are listed below.

Future Programs. . .

The M.G.A. certification program will be offered again on May 30, 31 and June 1, at the Sheraton Washington Hotel in Washington, D.C. This is the sight of the International Gem Show and the AGA East Coast Mini-Conference. This class will also be open to AGA members who don't meet the full requirements for M.G.A. certification. Their participation will be limited to the two day training session. They will not be permitted to sit for the written or practical exam. The fee for the two-day session and appraisal manual will be \$300.00, as opposed to the full \$550.00 fee. Attendance by non-M.G.A. candidates will be carefully screened and limited. First priority will go to those who have most of the requirements for M.G.A. candidacy, but who lack the experience (3-5 years appraising) or the lab equipment required.

Future programs will be held again in New York and Los Angeles, later in the year.

For registration or more information, please contact Don Palmieri or Susan Bower at (412) 344-5500.

New M. G. A. Members

David S. Atlas, G.G., C.G., A.S.A., M.G.A.

D. Atlas & Company, Inc.
732 Sansom Street
Philadelphia, Pennsylvania 19106

Elena Davy, G.G., M.G.A.

Gemological Service International Laboratories
World Trade Center #168
P.O. Box 581343
Dallas, Texas 75258

Christina M. Harrington, G.G.,

DGemG., A.S.A., M.G.A.
Associated Gem & Jewelry Appraisal Service
1424 Fourth Ave., Suite 528
Seattle, Washington 98101

Bruce A. Keno, G.G., M.G.A.

Gold Coast Gemological Laboratory
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International Gem Trade Laboratory
650 South Hill Street, Suite 229
Los Angeles, California 90014

Larry Phillips, G.G., M.G.A.

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2411 San Pedro N.E.
Albuquerque, New Mexico 87120

Eric M. Shelton, C.G.A., M.G.A.

Butterfield Jewelers
2411 San Pedro N.E.
Albuquerque, New Mexico 87120

G. Marilyn Thomas, G.G., M.G.A.

G. M. E.
1600 Howe Avenue
Sacramento, California 95825

A. G. A. East Coast Mini-Conference

Location: MADISON ROOM

Sheraton Washington Hotel
Woodley and Connecticut Avenue, N.W.

Date: June 2nd and 3rd, 6 hours each day.

Two Day Cost: \$ 25.00 for Members, \$ 50.00 for Non-Members

SCHEDULE

Saturday, June 2, 1984

- 9:00 A.M.-
9:50 A.M. EVALUATING AND APPRAISING EMERALDS
By Joseph W. Tenhagen A.S.A., M.G.A.
- 10:00 A.M.-
10:50 A.M. LEGAL PITFALLS OF GEMOLOGY
By Dave Michaels, G.G., F.G.A.
- 11:00 A.M.-
11:50 A.M. APPRAISAL REPORT WRITING AND THE PROPOSED
MGA LISTING AND BROKERAGE SERVICE
By Neil H. Cohen, A.S.A, M.G.A.
- 11:50 A.M.-
1:00 P.M. LUNCH
- 1:00 P.M.-
2:20 P.M. COLOR SCAN, GRADING COLORED STONES
By C.R. "Cap" Beesley, M.G.A.
- 2:30 P.M.-
4:00 P.M. EVALUATING & APPRAISING RUBIES AND SAPPHIRES
By Don Palmieri, M.G.A.

Sunday, June 3, 1984

- 9:00 A.M.-
10:20 A.M. ADVANCED SPECTROSCOPY AND IMMERSION MICROSCOPY
By Ted Themelis
- 10:30 A.M.-
11:50 A.M. GEMOLOGICAL INSTITUTE OF AMERICA'S
COLOR GRADING SYSTEM
By Janice Mack, G.G.
- 12:00 P.M.-
1:00 P.M. LUNCH
- 1:00 P.M.-
1:50 P.M. EVALUATING AND APPRAISING DIAMONDS
By Don Palmieri, M.G.A.
- 2:00 P.M.-
2:50 P.M. RARE AND UNUSUAL GEMSTONES
By Tony Bonanno, F.G.A., P.G., M.G.A.
- 3:00 P.M.-
3:50 P.M. EVALUATING AND APPRAISING PEARLS
By James S. Seaman, M.G.A.

For Further Information Contact: Joseph W. Tenhagen, A.S.A., M.G.A.
Accredited Gemologist Association
36 N.E. 1st Street, Suite 419
Miami, Florida 33132
(305) 372-0872

Tucson '84



Tucson '84



Tucson 1984 Conference

Participants

Marshall Adams
San Bernadino, California

Ellamae Anderson
Spokane, Washington

Suzanne M. Anderson
La Jolla, California

David S. Atlas
Philadelphia, Pennsylvania

Cortney G. Balzan
San Rafael, California

Lewis A. Bannon
Baton Rouge, Louisiana

Alice Barlow
Appleton, Wisconsin

John Barlow
Springfield, Virginia

Austin J. Barker
Houston, Texas

Ronald A. Base
Upland, California

Ruth Base
Upland, California

T. William Benedict
New Canaan, Connecticut

Howard N. Biffer
Jefferson Valley, New York

Antonio C. Bonanno
Silver Spring, Maryland

Frank C. Bonham
Newport Beach, California

Susan Graham Bower
Pittsburgh, Pennsylvania

Hugh Brazier
Houston, Texas

Brenda Joyce Caldwell
Tucson, Arizona

E. Esperanza Calvino
New York, New York

Neil H. Cohen
Hartford, Connecticut

Mervyn Cohn
San Francisco, California

James D. Coker
Winter Park, Florida

Elaine Cooper
Chestnut Hill, Pennsylvania

Elena Davy
Dallas, Texas

Lisa Digioia
Pittsburgh, Pennsylvania

James T. Dolleslager
Houston, Texas

Dayna Forde Dunn
Sunnyvale, California

Karen Ford
Silver Spring, Maryland

Constance D. Foster
Sarasota, Florida

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Lincolnwood, Illinois

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Alton, Illinois

Kip Keener
Seattle, Washington

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Marvin D. Miller
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J. Paul Ouellet
Glendale, Arizona

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Pittsburgh, Pennsylvania

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Corona del Mar, California

Robert L. Praska
Fresno, California

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Shadow Hills, California

Laurel L. Peterson
Shadow Hills, California

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Spokane, Washington

Michele Retzignac
Key Biscayne, Florida

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Brooklyn, New York

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Bayside, New York

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Allen L. Smith
Delanson, New York

Barbara Smith
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Sterling Tucker
Dallas, Texas

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Gems and Technology

George R. Rossman, Ph.D.
Associate Professor of Mineralogy,
California Institute of Technology
Pasadena, California



In my work as a mineralogist, I spend a lot of time studying the properties of minerals. One of the most prominent properties, of course, is the color of a mineral. Therefore, I spend a lot of time concerning myself with the nature and the origin of color in materials. Now I work with all minerals, but what people usually like to hear about, yourselves included, are the gem materials. What I would like to do today is to examine the use of technological manipulations or treatments of gem materials from the eyes of a scientist. Worrying about how these particular treatments occur at the atomic level within the crystal and to worry about some of the methods that we use in our laboratories to distinguish the existence of these treatments. This will, hopefully, give you an insight into a sort of high-tech approach to gemology. Many of the techniques that we need in the more difficult situations are really quite advanced, but still it should give some insight into what the future holds in terms of the types of tests that will be needed to sort out some of the more difficult problems which we will be facing as time proceeds. I will start with some of the more primitive methods of technological manipulation of gemstones and then work onward into the more modern methods such as radiation and heat treatment, taking a variety of examples as I go along the way.

Let us begin by discussing jade. Jade is an appropriate starting point because it represents a gem material that has been known and used for a very long period of time. It also is a material which is amenable to some minor amount of technological manipulation. Chemically speaking, jade is a rock, but the precious jade is really a mixture of primarily the mineral jadeite plus a small amount of minor constituents. If jadeite were absolutely chemically pure it would consist only of sodium, aluminum and silicate. Each of these three constituents is in itself, intrinsically incapable of giving any color to the stone. Something else must be added to the jadeite in order for there to be color. Occasionally, you can find them absolutely chemically pure and they are, as expected, colorless. But more commonly, you may have a trace amount of iron in jade that may give it that sort of apple green color. About 1% to 3% by weight, of iron, is perfectly adequate to generate this type of color. Far more desirable, a small amount of chromium will give rise to the more brilliant emerald green type of color in the jade. It

takes only a small amount of chromium, about 1/10 of 1% by weight is perfectly adequate, to give the depth of color to the imperial jade. There are also other ways of generating color in jade, beyond the incorporation of chromium or iron which are naturally occurring phenomena. For example, jade can be dyed using chemicals very similar to food coloring. Various mixtures of dyeing agents can be mixed and soaked into the jade to give rise to the color. The distinction between natural color and dyed is fairly easy: we simply take a look at the optical absorption spectrum between 400 and 700 nanometers and plot out on a chart paper, in the case of my laboratory, the absorption of light versus wave length. In our laboratories, we cover not only the visible region between 400 and 700 nanometers, but we also continue our studies into the infra-red and ultra-violet portions of the spectrum, to gain information which we will find is necessary in some of these gemological distinctions. It is fairly easy to tell the different jades apart. Iron has a relatively weak absorption pattern with a sharp band around 440 nanometers - that is the key to iron. Chromium has a somewhat different looking pattern - much more intense bands and significant structure over around 600 - 700 nanometers which is quite distinctive for chromium. Both of these transmit light around 520 nanometers - that is the reason why it is green, but the dyed material also has transmission in this region. It also will appear green, but just visually looking at these patterns it is quite easy to tell with the instruments, the absorption pattern of the dyed versus the natural coloring. The detection of dyes are a relatively trivial problem - it can be seen quite readily from absorption spectra, and there are a variety of chemical tests that can extract some of the dye and detect its presence. This is relatively low technology for treatment of gem materials.

Another ancient technology deals with turquoise. Turquoise is often somewhat incoherent and in former times our precious Iranian turquoise would be soaked in camel's grease. The grease would go into the stone, it would let light penetrate further into the stone increasing the depth of color, and the grease would act as a binder so the stone would be somewhat less crumbly. Again, a very primitive technology entirely displaced nowadays by modern epoxy resins that are far more permanent and much easier to deal with than camel's grease - par-

ticularly in this continent. But again, the technology of impregnating things like turquoise with resins or epoxies is an existing technology that is readily detected via hot pin test or via spectroscopic methods in the infra-red, that can see the presence of these additives that are used in this case. A more interesting, recent technology is the complete synthesis of turquoise, as has been done by Pierre Gilson. There was a time in the early 1970's when Mr. Gilson used to advertise that there was no test known to science that could distinguish his product from natural turquoise; and believe me, a challenge like that will not go past. It turned out to be quite easy to make this distinction because in the process of synthetic turquoise, although the processes are literally generating turquoise, the distribution of grain sizes in the synthetic product is quite different from the natural material. In particular, in the synthetic material there is a relatively large component of extremely fine grained material which is so tiny that it, in fact, is undetectable by X-ray diffraction techniques. An X-ray powder pattern of synthetic turquoise will detect the large size crystallites in the material, but there will be a fairly significant fraction of the material which is so tiny in its grain size that the X-ray techniques will not see it. The X-ray pattern says turquoise, therefore, you would detect it as natural turquoise; but, when examined in the infra-red portion of the spectrum, the shape of the patterns are quite different. The natural turquoise, being well crystallized, large grains, gives a sharp pattern with lots of structure to the infra-red absorption spectrum; whereas the synthetic material gives broad and diffuse patterns which are readily distinguished. Although there are now some other techniques based upon grain and porosity that can be used to distinguish synthetic from natural, these are not necessarily intrinsic and in time some of these commonly used distinguishing patterns may go away as the product improves. However, as long as the component of fine grain material exists, the spectroscopic method using thermal radiation and the infra-red will remain a good way to distinguish synthetic from natural turquoise in cases where it is important enough to use this sort of elaborate type of technology.

Another example of the primitive technology is the mineral beryl. Again, if beryl were chemically pure - beryllium aluminum silicate - it would have no color. Each of these constituents is intrinsically incapable of causing color in the mineral beryl. Other minor substituents have to be present. In the case of golden beryl, the minor substituent is iron - anywhere from ½% to 3% by weight, of iron, will impart this type of golden color. In the blue varieties, known as aquamarine, we find again that iron is the chemical impurity that gives rise to the color. Again,

about ½% to 3% by weight, is perfectly adequate to cause the blue color. So, the first problem that I, as a scientist, would want to address would be how is it that iron can cause both the blue color of aquamarine, and the golden color of the golden beryl. Also, we must recognize that there is the technology involved - mainly that the yellow, and greenish yellow colored beryls, as they are mined, are generally heat treated - charcoal fire pits, things like that - to remove the yellow component leaving a blue colored stone as a result. The nature of these transformations has to do with the nature of the iron contained within the stone. Through detailed study of the spectroscopic and chemical properties of the beryl, we found that the iron responsible for the golden yellow color is fully oxidized iron, ferric iron in the plus three oxidation state; whereas the iron responsible for the blue color is reduced iron, ferrous iron in the plus two oxidation state. And the nature of these transformations that take place even at the mine and charcoal fire places, involved heating the beryl in such a way that the iron is reduced; the oxidized iron is transformed into the reduced iron and the transformation from yellow to blue takes place. This technology was known literally hundreds of years ago and was practiced as such. Now there is a more recent twist of this technology involving the reversal of the process - namely, the transformation of the blue component into a beautiful yellow golden beryl. This is accomplished with irradiation technology. Gamma rays or X-rays can be used to bring about the reverse process, namely, the oxidation of the iron in the beryl rendering it back into the fully oxidized state giving rise to the golden color. We will have a lot more to say about this radiation process in a short time.

Another primitive technology involving heat treatment is with zircon. Zircon is a zirconium aluminum silicate. Chemically speaking, there should be no color whatsoever because the components of zircon are intrinsically incapable of causing color. But, as we know from the mines, zircons do come in a sort of chocolate, reddish brown color. They are then heat treated - they can be wrapped in rice bread, they can be thrown in charcoal fire pits, they can be wrapped in soggy paper and heated over night, things like that. The net result of any of these treatments is that the reddish colored stones, as they emerge from the heat treatment, come out the blue with which you are more familiar. The nature of the blue color in the zircon and the nature of these reddish brown colors has to do with chemical impurities that are present in the stones. When zircon crystallizes in nature, it has the right site size inside the crystal to incorporate a minor amount of impurities. In the case of the zirconium component in zircon, because zirconium is a very large atom, it can incorporate some

rather exotic impurities. In particular, the elements uranium and thorium are incorporated in zircon from the extent of a few hundred parts per million, up to the extent of a few tenths of a percent, in the natural process. Over a hundred million years of geological time - for example, the South East Asian time scale - the naturally occurring radioactivity of the uranium will proceed bombarding the zircon from within with a variety of various forms of energy: gamma rays, alpha particles, electrons, and the decay products of uranium itself. To illustrate what takes place, let us follow the path of the gamma rays that are emitted from the radioactive decay process of the uranium atom. These high energy rays go through the crystal and ultimately, the gamma rays may strike an oxygen ion in the crystal and they can eject an electron from the oxygen and send that electron cascading through the crystal of the zircon. That electron will start out with enormous amounts of energy, careening off atoms and atoms, as it goes slowly through the crystal losing energy and finally coming to rest in some particular site. Now, the site where this electron may take up residence, is a position where an atom is missing inside the crystal. A free electron sitting inside the crystal is intrinsically able to cause color. The Germans have a word for it: it is a farber center. In English we call it an X center, or a color center. These trapped electrons inside the crystal are the cause of that reddish brown color of zircon, a consequence of natural radioactivity from within the stone. These electrons in the crystal are intrinsically not totally stable, they would just as soon be back somewhere else, they don't belong here but they are trapped. And the way you can get these electrons out of the trap is to apply enough energy so that the electron can finally gain energy and escape from the trap. That energy is the charcoal fire place which is used in the heat treatment of the zircon. The electron can then be driven out of the trap and it can ultimately come back and reconstitute zircon the way it ought to be. The zircons then are transformed into the blue color that you associate with gem zircon. The blue color of the zircon is the intrinsic color of the uranium impurity in the zircon; the more uranium it has, the deeper the blue color will be. We know this quite certainly because now synthetic zircon is being made in the laboratory - synthetic, gem quality zircon up to a centimeter in size - and they can be doped with the uranium in the laboratory, generating exactly the color of the heat treated blue zircon. In fact, if I look into my crystal ball, I can foresee the possibility, if anyone would want to, to come up with very high quality, synthetic zircons as a laboratory production product.

The use of radiation by nature is exemplified by zircon, but as we all know, the use of radiation in the

laboratory is a blossoming industry. And one of the first examples I can throw forth is the example of the spodumene minerals in two varieties: kunzite and hiddenite. Kunzite and hiddenite are both chemical variations of the mineral spodumene. Kunzite, a lavender variety, contains manganese as a minor component; and hiddenite contains chromium as a minor component. The lavender kunzite you are probably all familiar with, and it is relatively inexpensive, as far as such things go, in the rough; whereas, the green hiddenite is far less common and far more valuable as a gem material. In fact, hiddenite is so uncommon that it is extremely rare. The marvelous thing would be if there was some way to transform relatively inexpensive lavender kunzite into very expensive green hiddenite; and, needless to say, people have put significant amounts of effort at making this happen. As was discovered in the 1930's, I believe, it is possible to subject lavender kunzite to X-rays and to bring about a color change. X-rays have relatively poor penetrating power. They don't go very far, so they cannot give much of a body color to stones. Today we have cobalt 60 gamma rays that are very penetrating, so what I did was to take a lavender kunzite up to the Jet Propulsion Laboratory, in Pasadena. I put a large stone inside the chamber of a cobalt 60 source and let it bathe for a couple of days in cobalt 60 gamma rays and I was able to transform lavender kunzite into what looks to be green hiddenite. Technically speaking, I did not make hiddenite. There is no chromium in the green material I made; it just happens to look like it in terms of its color. It is a fantastically beautiful stone but I have not made my fortune in this process for one simple reason: there is a minor problem with this process. It fades and it tends to fade in a matter of about two hours of exposure to sun light; and to make matters even worse it does not fade back to lavender, it fades to colorless. So we lose on this one. Although I did not make my fortune, as I said, I did learn a lot of science in regard to the nature of the radiation induced processes. The radiation is capable of knocking electrons away from the manganese atoms inside the kunzite thereby oxidizing them. And the color transformation that we see is the result of these oxidation changes in the manganese ions inside of the stone. Today, I can assure you, there is a relatively major effort amongst some individuals trying to find ways to stabilize this extremely beautiful color of the green irradiated kunzite. So far, it has not succeeded to my knowledge.

Whereas kunzite is yet to be a commercial success story, the example of topaz, in the use of radiation, has been a phenomenal success from the commercial point of view. Topaz, an aluminum silicate, should be colorless if it were chemically pure; and, indeed, a large proportion of topaz is found in a

colorless state. However, if topaz is exposed to radiation - gamma rays, X-rays, stuff like that - it will turn into a chocolate brown color. The chocolate brown, technologically induced color mimics, for all practical purposes, naturally occurring brown topaz - for example, from the Thomas Mountains in Utah, which again is an example of natural radiation induced color in topaz. The laboratory induced color duplicates the natural process - the natural brown color that nature produces when topaz sits over geologic time in an environment which is weakly radioactive such as the Thomas Mountains of the Waw Waw range in Utah. These brown colors, as they are formed in nature, are generally not stable; hopefully, you advise your customers to wear topaz in subdued lighting because bright sunlight will bleach out the brown components of many topaz. The same is true for the technologically produced material. The cobalt 60 treatment generally produces a relatively unstable color, although I have seen a process that has been developed but has not yet been put on the market in large quantities, where the brown radiation induced color is stable for all practical types of exposure that people would receive. But this is not the success story of topaz. The thing about topaz is that if this brown material is heated after the irradiation, heated to about 250° centigrade, sometimes a marvelous transformation will take place and the stones will turn blue - the blue topaz that is so common now in the market place. The blue topaz, as a product, is not totally reliable from the producer's point of view; the success rate for a given batch of raw starting material, depending on from where it comes, can be as low as 0% transformation to the blue for some localities, to as high as 90% transformation from other select localities. So part of the large, trade secret of the business is knowing where to get the right source of material which is free of defects, which is capable of producing the blue color in commercially viable economic quantities, and which is free of zonation after the irradiation so the blue is uniform rather than splotchy or color zoned. Typical runs nowadays may be where a third of the material is quite valuable, a third of the material barely makes up for expenses, and a third of the material is a commercial loss from the production of radiated topaz. This material is stable, it does not fade; I know of no authenticated example of irradiated blue topaz fading. We have done laboratory tests using quantitative absorption measurements of the amount of color, and I have not seen any fade whatsoever once the stone reaches the commercial point after it has gone through the irradiation and heat treatment.

How can one tell whether or not the stone has been irradiated, if this distinction becomes important? One technique that can be used is thermo-

luminescence. This is a scientific test that involves the generation of light from a stone by the application of heat. Very simply, a stone is placed on top of a heating plate of some sort, and a light detection device - typically, a photo multiplier tube - is placed above the stone. Then, as the stone is gradually heated, a graph is made that shows the amount of light emitted from the stone as a function of the temperature. The temperature typically ranges from room temperature up to about 400° centigrade. In other words, a stone which has been subjected to radiation, be it natural or be it man-induced, will give off light at a temperature far below the temperature of incandescence. Some of these things are absolutely spectacular; some stones glow so brilliantly at about 200° that you can read by them. In the case of topaz, one of a natural blue topaz, and one of an irradiated blue topaz, there are clear cut differences in the nature of these curves. In most cases one can distinguish stones irradiated in the laboratory environment from natural radiation, and the reason is very simply that in nature you have literally hundreds of thousands of years for unstable, radiation induced centers to dissipate; whereas in the technological process they are still present, and some of these differences relate to that time scale. The test is not practical for blue topaz - the cost of the test in many cases would exceed the cost of the stone at today's economic level. Typically, in my lab, I will scrape off about 50 micrograms (.05 milligrams) from the girdle of the stone and then apply it to this type of process. With scraping, the weighing of the sample, and the measurement, I would spend probably about 2 hours per stone to make this type of measurement; something not viable as a routine test, but in the case of large museum donations or something like that, the test could be used in cases where it is critically important to have this information.

Let's take a whirlwind tour through a variety of materials and look at the different types of treatments - primarily radiation - that have been used in the gem or gem materials. Let's begin with fluorite. I would say 80% of all natural fluorite is the consequence of natural radiation. In the laboratory one can also generate a wide variety of colors in fluorite - blues, greens, violets, lavenders, pinks and so on, all of which depend upon the presence of minor amounts of the rare earth elements: cerium, lanthanum, yttrium, and samarium. These funny elements give rise to the colors when they are exposed to radiation. Very often, the technologically induced colors in fluorite are unstable. The only application this would have in the market place would be materials like bookends and stuff like that. There really is not much monetary incentive to irradiate fluorite.

Smokey quartz is another example. All smokey quartz from the mine is an example of natural radiation induced coloration. A quartz is normally colorless but if it has aluminum present in a few hundred or few thousand parts per million, and is also exposed to natural gamma radiation, the smokey color will develop. If, for some reason, the crystal is so young that nature did not have enough time to bring about this transformation, man can do it in a laboratory. I have seen a large number of Arkansas quartz crystals that have been irradiated in a commercial, military irradiation facility in Arkansas, which have had a lovely smokey color produced in them, for sale as specimen material. They look quite attractive and, of course, just like natural smokey quartz, this is a stable color.

Amethyst is an example of radiation induced coloration also. Whereas smokey quartz had aluminum as the minor component of the quartz, amethyst has iron as the minor component and, given radiation, the iron can be changed from the yellow citrine, which is the way it would occur naturally, to the violet or lavender color of amethyst - a radiation induced transformation. Amethyst is now produced synthetically in at least two different countries: Japan and the Soviet Union. Quartz crystals are grown with iron intentionally added and then they are exposed to gamma radiation for the sole purpose of making gem synthetic amethyst. This type of color, like natural amethyst, given a couple of years in bright sunlight, will fade noticeably.

Tourmaline is one of the hopes of the future for the people in radiation technology. You are going to see a lot of irradiated tourmaline on the market. Natural tourmaline is colored green if it contains iron as a minor component. Blues are also caused by the occurrence of iron in tourmaline. The pink colors are the result of naturally occurring manganese present in the tourmaline, plus natural radiation. As tourmalines grow with manganese, they are virtually colorless, but given natural levels of radiation from feldspars in the pegmatites, the manganese is oxidized to the much darker pink color. But very often nature has not brought the process anywhere near saturation - there is a lot more potential to deepen the quality of the pink color by the technological addition of more radiation.

Garnets are interesting. They are one example of a mineral where, for all practical purposes, there just is nothing you can do to these things - you mine them, you do the technology of cutting, the technology of faceting, the technology of polishing, but that's it. You can heat them, you can irradiate them and basically, nothing happens with the vast majority of garnets.

What about the biggies? What about sapphire, for example? I think it is absolutely no secret that sapphires on the market today have about a 95% chance of being technologically doctored. Heat treatment is the process of choice for sapphires. Sapphires are mixed with a variety of chemicals, most of which are carefully guarded proprietary secrets in a little mom and pop operation. They are put in crucibles and put inside large steel drums with charcoal. The whole thing is ignited and they are cooked for a few days. When the stones come out, various transformations have taken place inside the corundum. Sapphire color is brought about by the presence of iron and titanium inside the corundum. If the iron is fully oxidized, the stones will be yellow; if the iron is fully reduced, the color will be blue. Often times the yellow colors are so pale that it is for all purposes colorless. So the transformations between colorless and blue are possible in this technological manipulation of sapphire. Under the right conditions, the intensity of blue can be increased; under other conditions, the intensity of the blue can be decreased. Take dark, blue black corundums like the Australians, and heat them to make them lighter, take pale ones like from Burma, and intensify the color with heat treatment. The practice of this technology in South East Asia, as it is now done, is a very primitive, unscientific technology. It is a trial and error process by people who have no chemical insight at all into what they are doing, and simply go to the drugstore and buy at random various insundry things until they find something that works for the particular batch they are treating. People have nearly been killed in this process by explosions - again, no chemical understanding. The potential for the future is that scientifically wise people will come in and optimize these processes to be far more efficient so the recovery becomes much higher than it now is. Large amounts of stones are destroyed in these processes - cracking or simply sintering together, all sorts of nasty things - but there is a lot of potential in the future, and I think there are, in fact, a number of individuals beginning to make the move in this direction to improve these technologies into a science rather than a very haphazard art at the moment.

Golden Sapphires are another example which have come out of the heat treatment process. Heat treatment changes the iron content so that the yellow color comes out quite strongly, and again, on the market place, you've all seen the profusion of these golden sapphires as a result of the heat treatment. Another way can be used to make golden sapphire. Absolutely beautiful stones can be made, not by heat treatment, but by radiation treatment. A relatively mild dose of cobalt 60 gamma rays is perfectly adequate to transform a large proportion of

colorless to off color corundums into lovely golden yellow stones. They look for all purposes like heat treated stones in many cases, but there is a fly in the ointment - these things fade rapidly. Given a couple of days in sunlight and they are gone, back to colorless. So you, the potential consumer, have to be very careful that you get heat treated stones which are stable, and not radiation treated stones which are quite transient in their color.

Ruby is another example where technology has raised its head. The technology in ruby can be as simple as dying. In Bangkok, stones are routinely soaked in a red, ruby oil to enhance their color. Be aware of the fact that almost every ruby you buy from South East Asia has been soaked in stuff like this, and what comes in can go out just like with oil in emeralds. Another technology which is far more promising is the heat treatment technology. Here, a dark ruby that has a sapphire (or blue) component in it, can be heat treated to render the sapphire component colorless bringing out the crisp ruby color. This is a growing and common technology to improve the color of rubies.

Stars are perfectly amenable to heat treatment. Stars that are poor in quality, that detract from the stone, can be removed from the corundum gems by heat treatment - about 1600° - 1700° centigrade - very hot for a couple of hours and fast quenching will remove the star by re-dissolving the tiny rutile needles that cause a star. Although there are patented processes in the public domain about inducing stars in synthetic corundum, it should be, in fact, possible to improve the star in a natural stone under certain circumstances. I'm not aware that this is done on a large scale in natural stones, although a large number of synthetics have stars grown in them in a technological process.

Finally, we come to diamonds. Diamonds, of course, are colorless if they are pure carbon, but you have all seen fancy colored diamonds. Blue diamonds, like the Hope diamond, have a minor amount of boron in them replacing some of the carbon. The boron is the cause of the blue color. Yellow diamonds are the result of a small amount of nitrogen replacing some of the carbon. Fancy yellows are simply diamonds that have a relatively high concentration of nitrogen; the pale, off-color, yellow diamonds that are somewhat undesirable, are simply low concentrations of nitrogen. There can be a wide variety to your colors in diamonds - greens and blues and reds and oranges. The colors of diamonds can be manipulated to a very large degree by a suitable combination of irradiation and heat treatment. For example, green stones can be generated by high intensity gamma radiation. If the

stone is kept cool, blue colors can be generated from a Van de Graaff generator, where high voltage electrons are allowed to impinge into the stone; or, low energy neutrons can do the same thing. Change the energy of the neutron and you can change the shade of the green or the blue color in the diamond. In all cases though, these blue diamonds are easily distinguishable from natural blue diamonds through the use of the absorption spectrum. Routinely, the gemological testing of irradiated diamonds is done at liquid nitrogen temperature, that is about 200° below zero, because the features sharpen up at low temperature and are then more readily identified in the spectroscopic measurement. There is no way in the world that a competent testing lab could confuse irradiated blue diamond from natural blue diamond. On the other hand, natural green diamond is caused by radiation in nature, and technologically produced green diamond, as far as the color is concerned, is identical to natural green color, and on the basis of color alone one could not make that distinction. With extreme doses of radiation, the color produced is sort of an ugly, dark, green black. However, if you take these stones which have been irradiated to very massive doses, and then heat treat them, you get a brilliant, canary yellow diamond. Very beautiful, canary yellow diamonds that rival the best natural stones in color, are produced by the application of heat treatment following the radiation treatment of diamonds. People like to believe it is possible to distinguish them based upon certain spectroscopic features, and, in the majority of cases, that is true. Please note what I did not say; there might be some cases where in fact this distinction, at least with a casual test, would be virtually impossible. Very detailed testing would be necessary to reliably make this distinction in all cases. I think that in some cases, even the testing labs refuse to issue a certificate of natural color in yellow diamonds now, because of the recognition of this difficulty of making a reliable distinction in all cases.

The ultimate technological achievement in diamonds is the synthetic diamond, 100% made in a laboratory. There are a number of labs in the world - one in the United States, General Electric; one in Ireland; one in the Soviet Union; one in China - which are capable of making synthetic diamonds of gem quality and gem size. The story is that they are far more expensive to produce in the lab than they are to mine in nature. Now, of course, if that situation ever changes, will they tell us about it? Right now, in my lab, we literally have about 500 synthetic diamonds - four of them large, gem quality and the rest of them small ones. We are developing tests that can distinguish synthetic diamonds from natural diamonds in the gem quality. So far it looks like indeed we have a test which will prove quite

reliable, although it is a high tech test - something beyond the realm of the simple type of testing that anyone of you could do - involving magnetic properties of the stone.

Looking into my crystal ball, the future is not totally clear, but I am willing to make a few predictions about what might lie in the future in terms of technological treatment of gems. Number one, heat treatment of corundums is going to be a growing science displacing a haphazard art. Given modern equipment and modern electrically controlled furnaces, chemical atmospheres, and people with a degree in chemical engineering or science like that, we can see the vast improvement in the quality and the quantity of heat treated corundums. I also see a few surprises down the road for the use of radiated stones. For example, although not yet reaching the market in commercial quantities, I have seen a number of pink danburites with very pleasing colors from radiation technology. I have seen golden danburites. I have seen a variety of colors of scapolites: blues, golds. I have seen some unusual colors in beryl which are being developed as a product that have yet to reach the market. I have seen stabilized kunzite - enhanced color in kunzite - coming out of radiation treatments under an experimental basis. So I think we'll see some surprises, not major surprises, not revolutionary changes, but we'll see some different types of products coming out in the specialty stone market. At this point in time virtually every possible gemstone has been subjected to virtually every possible source of radiation, so the vast majority of the possible transformations are known and those which are commercial have in fact been commercialized. The only possible change might be the discovery of a new source of raw material where currently the commercial inavailability of a particular product keeps it from hitting the market; but, if a new find was made - some African pegmatite that had the right properties - then we might see a quantity introduction of the new product. But, by in large, don't expect major surprises in these areas.

On the other hand, what I do see is the ever increasing role of synthetics. In the 1960's and 1970's there were large aerospace industries devoted to the production of lasers for a variety of technological purposes, and these companies hired large numbers of Ph.D's, skilled in crystal growing, whose job it was to come up with new materials for laser crystals. Nowadays, these laser products are commercial; the laser projects are no longer necessary because the needs have been satisfied. And the crystal growers are being transferred into other very dull jobs of their industries. I am seeing a number of these individuals quitting their commercial industries and taking up

something for more exciting - in their basements, so to speak, namely: growing synthetic gemstones. In the past few years a number of extremely high quality synthetics have come out from exactly that type of process. Many of them are only just beginning to become commercialized. So certainly look forward to the ever increasing profusion of super high quality synthetics that would challenge even the testing laboratories to distinguish them from the highest quality natural materials. I will just bring a couple of examples to mind. I call your attention to the production of commercial levels of synthetic alexandrite as a laser material; the alexandrite laser is going to revolutionize eye surgery, but this means one can grow boules of alexandrite, about three or four inches in diameter and up to a meter in length, of absolutely flawless, homogeneous, gem quality, synthetic alexandrite. Furthermore, you have not seen it in the market, but it exists - the emerald laser; we will see large boules of synthetic, high quality emerald grown from a flux process coming out of the laser industry and when these things hit the market I think that the quality will be absolutely phenomenal and the quantity will be correspondingly large.

Membership Meetings

Tucson General Membership Meeting Tom Tashey

The 1984, AGA Membership Meeting was held at 9 P.M. on February 6, 1984 at the Palo Verde Holidome, in Tucson. President Joe Tenhagen called the meeting to order and welcomed the members. He began by saying that the Association's Board of Governors had met for the first time the previous evening and had accomplished much. One of the things was to accept the recommendation of the Color Communication Test Committee, that the Association require one of the two approved color systems for use by all M.G.A.'s in their Accredited Laboratories by July 1, 1984. He said that he felt enough had been said about this test, earlier in the day. He then explained the difficulties he had had in trying to keep a good, part-time secretary last year. The Board of Governors had appropriated more money for this now, so he hoped he would have better success. He said once this is accomplished, he plans to begin publishing a short, monthly publication - to keep the membership better informed about the Association's activities - as well as the quarterly CornerStone.

He also said the Association was still in the process of filing with the IRS for tax exempt status, but that he hoped the process would be completed soon. He then called on the immediate past Treasurer, Neil Cohen, for his report. Mr. Cohen read the Association's operating statement as of July 1, 1982 through December 31, 1983, when the treasury was passed to Mr. Jeff Hurwitz. He said that the portion from July 1, 1982 through June 30, 1983 had previously been published in the October, 1983 issue of the CornerStone and that the portion from July 1, 1983 to December 31, 1983 would be published in the April, 1984 issue. Mr. Cohen also pointed out that the Association's funds are separated from the Master Gemologist Appraiser program's funds and that they are now in two different accounts.

Mr. Tenhagen then again took over and said that later in the year, he intended to organize an AGA week at the GIA. This would be where members could come to Santa Monica and take several of the GIA one and two day seminars at a corporate, reduced rate.

He then opened the floor for questions from the membership. Ms. Esperanza Calvino said she would like to receive a copy of the Association's Constitution and Bylaws. She also suggested that the Association try to make available study sets of some of the more difficult synthetic gemstones. Mr. Tenhagen said he thought this was a good idea and

that he would contact the producers of these synthetics and try to make the arrangements.

Mr. Lew Bannon suggested that we make a well designed membership application and include it in the CornerStone so that members can encourage other gemologists to join our organization. Mr. Tenhagen said that this could easily be done and that he would follow up the suggestion.

Mr. Marvin Miller then took the floor and suggested that all of the people involved in the Color Communication Test, and especially the Color Test Committee including Joe Tenhagen, Don Palmieri, and Neil Cohen, be commended for the time and effort they had expended in this endeavor. Applause followed.

Mr. Tenhagen thanked the audience on behalf of the people involved in the test, and said that any organization depends on the support and participation of the membership for its success, and said that the AGA was fortunate to have so many members willing to give of their time, and energy.

He then called on Mr. Jeff Hurwitz, for a report from his Admissions and Membership Committee. Mr. Hurwitz said he had sent out about 650 applications to gemologists who were members of the GIA Alumni Association. From these, he received about 15 responses from people who wished to join the Association, so the mailing was deemed a success. Ms. Michele Retznac offered to do translations for mailings to foreign gemologists, as she thought the Association could grow by attracting gemologists from other countries. This suggestion was well received.

Mr. Tenhagen then called on Mr. Don Palmieri, for a report on the M.G.A. program. Mr. Palmieri said he was pleased with the response the program has generated. He said there were presently thirty Master Gemologist Appraisers and that ten or twelve more were scheduled to take the program later that week. He said he looks forward to slow but steady growth in the years ahead. He said the Association intends to enforce the regulations and the Code of Ethics, and that judgements will be swift but fair. He said the Association is actively promoting the new, professional appraiser designation, and showed the recently published M.G.A. brochure. He said that there have been several articles on the new program written up in the jewelry trade press, as well as in outside periodicals, such as one in an insurance industry journal. He also said that the Association will be soliciting donations of gems and jewelry from both members and from the jewelry industry at large, for use in testing and policing of the program.

Mr. Tenhagen then again took over and asked if

there was any further business of the Association that anyone would like to discuss.

Mr. Tony Bonanno suggested again (last year, too!) that foreign members be given a financial consideration in their dues payments because they are unable to attend any meetings. Mr. Tenhagen said that because it costs so much more to send them the Association's publications, they *are* given financial consideration in that they are charged ten dollars more than members in this continent. He also pointed out that foreign members can have their articles published in the CornerStone, if they are unable to participate in other ways.

On this humerous note, the meeting was adjourned.

Washington D. C. Chapter

Ginger B. Morgret

Our regular bi-monthly meeting was held February 20, 1984.

Marvin Miller began the meeting by re-elaborating how the two (out of four) color systems were selected. He went on to bring up several points: 1) In his opinion colored stone dealers do not really want a systematic color grading system. They prefer to hang onto vague mysterious color terminology. They don't want the industry to be able to determine what a particular stone should sell for by how it rates on a recognized color system. 2) One of the primary reasons for the furor, created by our endorsement of color systems, is the *great* deal of money involved. 3) Cap Beesley must have his system ready to market by July 1, 1984. Otherwise, A.G.A. will have to go back to "square one" and evaluate the four systems again. This brought him to a fourth point which is that A.G.A. members need two systems to choose from, one for laboratory use and one portable.

The meeting then broke into a general discussion of the pros and cons of the color systems. Bill Dougherty explained that we only endorsed the two systems for A.G.A., *not the entire industry*. However, due to the publicity we received from "Jewelers' Circular Keystone", the entire industry is now in an uproar. Marvin Miller stated further that, in the end, it will be the entire industry, not one organization that decides which is the best color system. He stated also that, in his opinion, A.G.A. has gone as far as possible in making a decision for *now*; all the questions surrounding the issue cannot yet be answered. He feels strongly that we are headed in the right direction; however, Tony Bonanno discussed how the Color Master works, and pointed out that it grades not only color, but clarity and cut. He is of the opinion that most jewelers do not have the

time or training to understand and use the color master.

On a separate topic, Mr. Bonanno went on to demonstrate how diffusion-treated sapphires can be proven by immersion in methylene iodide.

Marvin Miller brought the meeting to a close by expressing the urgent need for *new members!!* We need to *double* in size!! Please help!!

Los Angeles Chapter

Michelle Jeand'Heur

The Los Angeles Chapter of the Accredited Gemologists Association held a meeting at the Los Angeles County Museum of Natural History at 1:00 P.M. January 29, 1984.

Interim President Frank Bonham opened the meeting with a brief talk on the Tucson Gem Show. There was also a discussion about future meetings and Mr. Bonham asked for suggestions for a meeting place or speakers.

Frank Bonham then introduced Dr. Anthony Kampf, curator of the Gem and Mineral Collection. Dr. Kampf gave a brief history of the Gem and Mineral Collection of the Museum and the Hixon Collection and discussed his functions as Curator. A question and answer period followed.

Dr. Kampf then conducted a tour of the Hixon Collection and the Gem and Mineral Section, as well as a special tour of his office and surrounding work areas.

The day was very interesting and informative, and we wish to thank Dr. Kampf for his willingness to share his time and knowledge with our members.

San Diego Chapter

Suzanne Anderson

The most recent A.G.A. meeting for the San Diego Chapter was held on the 19th of January. The meeting was held at Thom Underwood's San Diego Gemological Laboratory located in downtown San Diego at 7:00 PM. The meeting was comprised as a gemologist diamond grading update, which turned out to be a very educational meeting. Thom had around eight diamonds on hand and the Wright's brought a batch of unusual diamonds from their stock. Each person went through and color and clarity graded each diamond and at the end we all compared notes. There was somewhat of a diversity in the grading which made the meeting a very educational and meaningful gathering. I feel it is these "hands on" meetings that will really motivate gemologists to get what they want out of the AGA. I hope to see everyone in the San Diego area at the next meeting.

Membership Update. . .

Renewal of Membership

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