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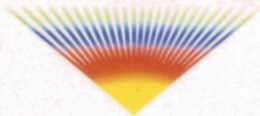
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CONSERVATION & THE ORIENTAL BIRD CLUB IN 1991

The rich bird habitats of the Oriental region are under severe pressure. Major threats include: forest clearance, wetland drainage, population pressure, agricultural improvement and pollution. Over 300 Oriental bird species are globally threatened. A primary objective of the Club is to encourage interest in Oriental birds and their conservation and so we are pleased to offer two initiatives in this field for 1991. The conservation aims of the Oriental Bird Club are to collect information and make this available for use by wildlife conservationists and to promote conservation education.



FORKTAIL - LEICA AWARD

Leica Camera have generously donated £1000 for this award in 1991. The Forktail-Leica award will be given to a project which fits one or more of the following categories.

1. A forest survey useful for conservation.
2. A survey or study of globally-threatened species.
3. A study of a little-known protected area.
4. Conservation education which has an emphasis on birds.

Project applications are welcomed from individuals and non-affiliated groups, as well as groups organised by a conservation organisation or university. Applications from nationals in the Oriental region (which can include the support of an on-going project) are particularly encouraged.

The closing date for applications is 1st October 1991. The winning project will be announced at the AGM in December.

Applications, which should include a summary of objectives and details of implementation, should be sent to The Conservation Officer, OBC, c/o The Lodge, Sandy, Beds. SG19 2DL, UK.



Leica

SURVEY GRANTS

Information on the habitats, status and migration routes of many Oriental birds, and the threats they are facing, is urgently required for use by Departments of Wildlife Conservation and National Parks, by national bird clubs and by other non-governmental societies and organisations. OBC members can make valuable contributions by undertaking surveys. Examples include:

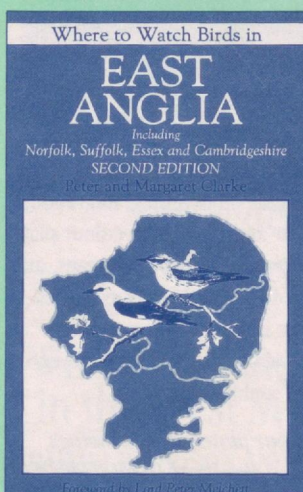
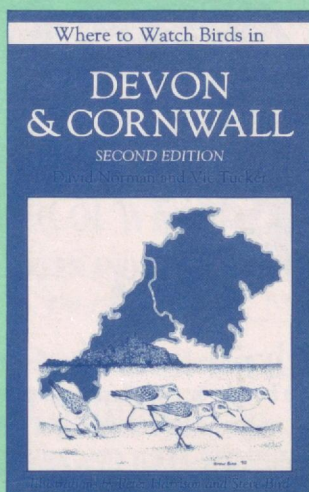
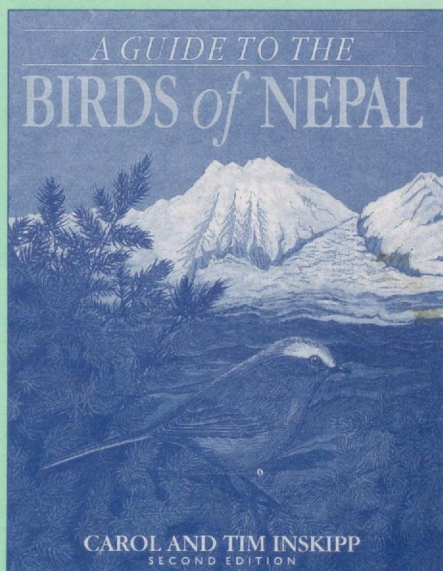
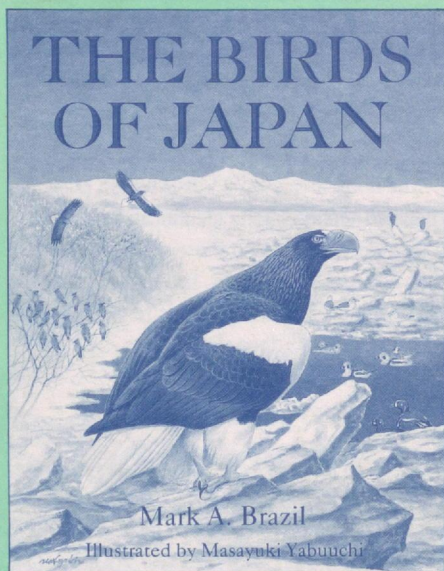
1. Contributing to check-lists of poorly-known protected areas held on national databases.
2. Surveys of habitat types which are currently unprotected in the country concerned.
3. Surveys of threatened or little-known species.
4. Identification of migration stop-over sites.

There are opportunities for surveys lasting from a few days to a few months. We appeal to Oriental Bird Club members visiting or living in the Oriental region to consider undertaking a survey. The OBC will award small grants each year to facilitate and encourage such survey work. The grant will be towards alleviating the extra expenses incurred in reaching remote areas, hiring local guides etc, and is unlikely to exceed £300. Applications, which should include a summary of the survey's objectives and details of implementation, will be considered at any time during the year. Applications for funding are especially welcome from nationals in the Orient.

Recipients of the Forktail-Leica award and of the survey grants will be expected to produce a written report which will be made available to relevant government bodies and conservation organisations. They will also be encouraged to publish the results of their project in either Forktail or the OBC Bulletin.

For further information on these initiatives or for help in developing a project please write to The Conservation Officer, OBC, c/o The Lodge, Sandy, Beds, SG19 2DL, UK. Ideas for survey work were published in OBC Bulletin 10.

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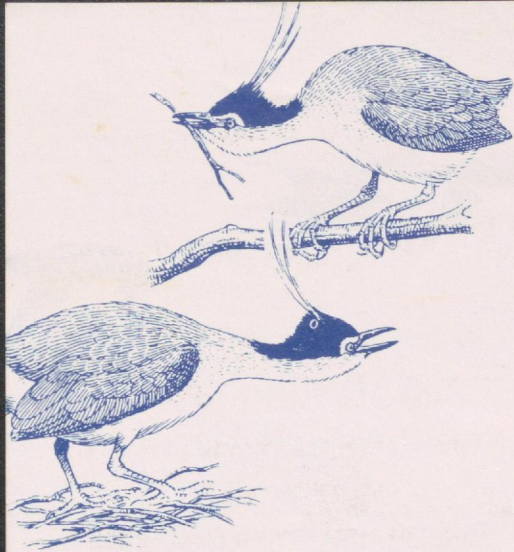
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In the year 1883, the first white settlers came to Ketchikan and built a fish saltery, followed by more than a dozen canneries producing more than 2 million cases of salmon per year. Ketchikan quickly earned the title "Salmon Capital of the World." In 1897, mining contributed to the growth of the settlement with the Gold Rush Era and, believe it or not, today "Gold Rush Fever" is still alive! In 1903, the Ketchikan Spruce Mill opened and provided lumber to the salmon industry.

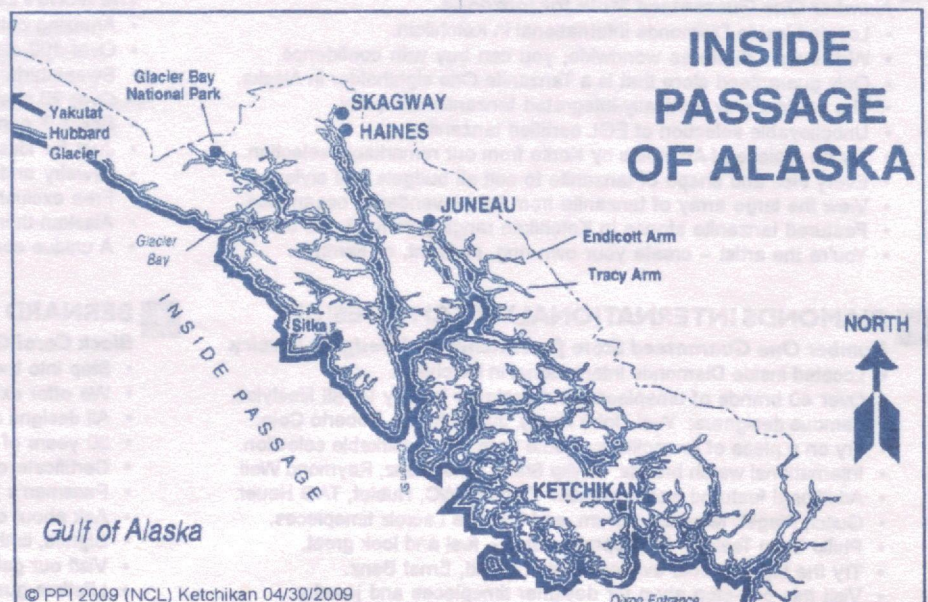
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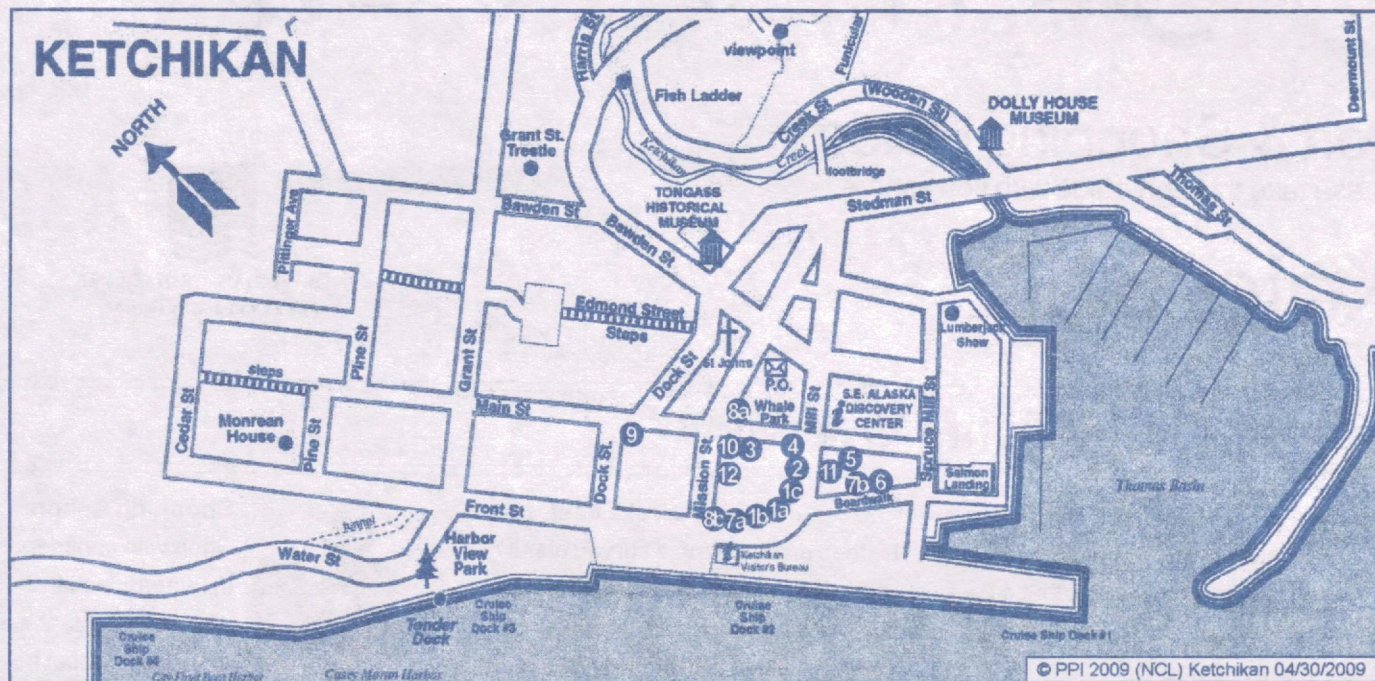


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- Famous for our reversible 14kt. gold royal omega for over 10 years.
- Indulge yourself with confidence.
- 1-800 customer service number based in the United States.

7a 7b EFFY JEWELERS

Exclusive Retailer of DiVersa Jewelry.

- For over 30 years, Effy Hematian has designed beautiful jewelry.
- Effy is the only authorized dealer of DiVersa jewelry.
- DiVersa is an easy way to take an outfit from day to night.
- Wide assortment of men's jewelry.
- Well known for colored gemstones and rainbow sapphires.
- Silver Balissima collection with diamond and gemstone accents.
- Balissima is Balinese handcrafted jewelry for both men and women.
- All Effy jewelry is factory-direct, which means incredible savings.
- White or blue diamond pendant and earring sets for a super price.
- Lifetime warranty on all jewelry, New York customer service center.

8a 8b BLUE DIAMOND

Free Gemstone with Map - "No Purchase Necessary."

- Hearts On Fire located at the Front Street location.
- We carry "The Feel Good" Phillip Stein watch.
- Raymond Weil, Tissot, Seiko, Citizen, and more.
- Large collection of blue, pink, yellow, and white diamonds.
- Be sure to see our designer lines: Yvel, Simon G. and Oliva.
- Kabana pink mother-of-pearl and gold quartz inlay jewelry.
- Exotic and rare high-quality alexandrite, tanzanite, and ammolite.
- Excellent selection of topaz and other semi-precious stones.

9 JULIE'S FINE JEWELRY AND GIFTS

The "One-Stop Shop" of Ketchikan.

- Your local family-owned one-stop shopping experience.
- Authentic gold quartz boutique by Orocal. Enter to win \$10,000.
- New Alaskan gold nugget jewelry sets in sterling silver.
- Ammolite by Korite, exclusive ammolite set with gold nuggets.
- Ammolite by Korite Elements collection in sterling silver.
- Large selection of local Alaskan made totem poles.
- Exclusive Swarovski cruise ship paper weight.
- Liadro-Nao figurines at a 10% discount.

10 NICK MICHAEL'S FINE GALLERY

A "Must See" Gallery Next Door to Del Sol.

- Quality ulus and knives by Alaskan artist, Bob Merry.
- Collectible whale bone carvings by Ekimo Studios.
- Sculptures and fountains in bronze, brass, and copper fill.
- Carved glass by award-winning Alaskan artist, Lise Hoffman.
- Blown and carved glass from Alaska. Locally owned and operated.
- Denali crystal sculptures, carved Eskimo dolls by Alaskan artists.

11 USA JEWELS

USA Jewels, the color store.

- Extensive selection of sapphires in every color of the rainbow.
- Exclusive Sea Life Collection by Reyes del Mar.
- Fresh water pearl and earring set at a fantastic price.
- Timepieces by Citizen, Seiko, Timex, Fossil, Guess, ESQ, etc.
- Free matching bracelet with purchase of a diamond cut necklace.
- Free freshwater pearl just for stopping by.

12 SALMON ETC.

To Get the Best Salmon, Go Where the Best Salmon Go.

- Seafood at great prices, located under the "welcome" arch.
- We ship Alaskan seafood: salmon, halibut, canned smoked salmon.
- Featuring hand-processed salmon and halibut from Alaska.

More About the Port

Docking/Anchorage

The ship docks in downtown Ketchikan, near Front Street.

Shore Excursions Departures

Check your ticket for the correct time and location for your tour. Your Shore Excursion Team will direct you to your transportation.

Banking

Banks are open from 9:00 a.m. - 5:00 p.m., Monday-Friday. Cash machines can be found at the First Bank of Ketchikan (331 Dock St.) or Wells Fargo Bank (306 Main St.). There is also the Alaska Federal Savings and Loan located at 400 Mission St. (no ATM)

Post Office

Located at 422 Mission St. Open Monday-Friday from 9:00 a.m. - 5:00 p.m. Open limited hours on Saturdays and Sundays.

Airport

Ketchikan International Airport is located on Gravina Island, three miles outside of town. A ferry or water taxi can be taken from Revilla Island to reach the airport.

In Case of Emergency

Cruise Line Agencies of Alaska, Rick Erickson. 1249 Tongass Avenue, Suite B P.O. Box 8080, Ketchikan, Alaska 99901. Tel: (907) 225-0999. Fax: (907) 247-6042. E-mail: ketchikan@c1aalaska.com

Spirit of Ketchikan

Shop in these locally-owned businesses and enjoy a truly native Alaskan experience!

Arctic Spirit Gallery

Specializing in Northwest coast and Alaskan native art.
310 Mission Street

Julie's Fine Jewelry & Gifts

"One-Stop Shop" for everything "Alaska."
326 Dock Street

Nick Michael's Fine Gallery

"Capture the beauty where last memories forever."
328 Mission Street

Salmon Etc.

Premium seafood at great prices.
322 Mission Street

Scanlon Gallery

Come discover the art of Alaska.
318 Mission Street

Port Shopping Buyer's Guarantee

Shop with confidence in Ketchikan, as all shopping in Alaska is unique and must be experienced! The stores listed on this map advertise with the cruise line in order to promote the wonderful shopping opportunities shore side. They have paid an advertising fee to advertise onboard the ship, and they guarantee their merchandise for 30 days. This 30-day guarantee ensures buyers that stores listed on this map will repair or replace any unsatisfactory item, excluding buyer's negligence or buyer's remorse. Many stores in port may offer similar guarantees. Please inquire about individual store return policies before finalizing any purchase. For purposes of determining quality and value of jewelry related to a buyer's complaint, only appraisals secured by a buyer from independent graduate gemologists, not affiliated with any retail jeweler, will be acceptable. Please do not mail merchandise without prior authorization. Guests are responsible for postage and appraisal costs. Price paid for merchandise or verbal claims/agreements between retailer and guest will not be considered grounds for returns. Electronics and watches requiring service must be returned by the guest to the respective manufacturer. All purchases, including fragile items, must be checked before leaving the store. The port shopping program is operated by The PPI Group. The PPI Group handles all customer service claims relating to the guarantee. Should you require assistance during this cruise regarding a purchase from a store listed on this map, please contact the Shopping Consultant onboard for immediate assistance. If a problem arises after the cruise but within 30 days of the purchase date, contact the Customer Service Department at: The PPI Group, 4517 NW 31st Avenue, Fort Lauderdale, Florida 33309-3403. Phone: 1 (888) 774-4768 or (954) 377-7777. Fax: (954) 377-7005. Email: NCLservice@ppigroup.com

Hours of Operation: Monday - Friday, 8:30 AM - 5:30 PM EST.
Please send a letter and include the name of the ship, cruise date, store name, and merchandise problem. Also enclose a copy of the sales receipt and any relevant documents relating to the sale. The PPI Group will contact the store on your behalf for repair or replacement, and you will be notified accordingly.

Featured businesses have paid a promotional fee for inclusion in the shopping program.

At a Glance

Capital: Juneau, Alaska

Location: Inside Passage - Tongass Forest

Taxi: Taxis available pierside

Currency: U.S. Dollar

Language: English

Population: Approximately 14,070

International Designer Brand Guide

Ammolite by Korite

- Diamonds International
- Julie's Fine Jewelry and Gifts
- Royal Jewelers
- Treasures of Alaska

Balissima

- Effy Jewelers

Charriol

- Treasures of Alaska

Crown of Light

- Diamonds International

DiVersa

- Effy Jewelers

Ernst Benz

- Diamonds International Watch & Design

Hearts On Fire

- Diamonds International
- Blue Diamond

Kabana

- Blue Diamond
- Royal Jewelers
- Treasures of Alaska

Mark Henry Alexandrite

- Treasures of Alaska

Natural Gold Quartz by Orocal

- Julie's Fine Jewelry and Gifts

Philip Stein

- Diamonds International
- Blue Diamond

Pink Panther Collection

- Diamonds International

Sophia Fiori Blue Diamonds

- Venetian Jewelers

Freestyle Daily



NORWEGIAN CRUISE LINE
FREESTYLE CRUISING

Norwegian Sun

Thursday, May 7th, 2009
Skagway, Alaska

Today's forecast
Cloudy 52F/11C

Sunrise
5:04am

Sunset
9:10pm

Arrival
7:00am

All Aboard
8:30pm

Tip of the day

Before retiring Thursday evening, please remember to advance your clocks forward 1 hour.
Don't miss all the fun on Friday, by sleeping in late!

Tonight's entertainment

Stardust Showtime: History of Alaska in Stories & Songs, 6:30pm

Norwegian Cruise Line is proud to present a taste of true Alaska with Local Entertainer Steve Hites. Join us for a celebration of the gold rush, Skagway and more with the songs and stories of one of Skagway's most popular "attractions". Don't miss it! One Show Only!

Stardust Lounge, Deck 6 & 7, Aft

Showtime: Dynamic Music & Comedy of George Solomon, 9:15pm

Enjoy a wide variety of music and lots of laughs with this explosive performer voted Las Vegas Entertainment Personality of the Year! Video/audio recording & photography is prohibited. No reserving of seats. (One Show Only)

Rock 'n Soul-Motown Night: 10:30pm, Dazzles Disco, Deck 6, Mid

Sit and listen or get up and dance the music of the Motor City and more comes alive with hits from The Four Tops, Aretha Franklin, Marvin Gaye and others. Featuring the Jean Ann Ryan Company, Kim Doolittle, Keith Channer, accompanied live by the Sun Orchestra & Friends.

What's on tap today

Welcome to Skagway, Alaska:

Guests on Shore Excursions, please check your tickets for meeting times and locations. Please have your NCL-Sun-keycard ready. (Take Photo ID for identification purposes upon returning).

Jazz Brunch a la Bistro: Wake up and smell the cappuccino because we've got a new brunch experience at Le Bistro and everyone's invited. We're mixing it up on Saturday with cool jazz, hot cuisine and the ambiance of a Parisian Café. Indulge in our Belgian waffles, French toast, Italian pastas, eggs Benedict-the choices are endless. Got a sweet tooth? Bite into some fresh croissants, muffins, crème brûlée dessert, hot apple crumbles, and more. It's hot. It's ooh-la-la good. Make your reservation in the Atrium, Deck 5 or call 58200, Cover Charge Applies.

Tribute to Frank Sinatra- with Keith Channer

Join Entertainer Keith Channer as he pays homage to "The Chairman of the Board" Enjoy such hits as "My Way," "New York New York" and more in the hippest joint around the Windjammer, 8:15pm, Deck 6, Mid

Masters Exhibit: On exhibit: Museum-quality masterworks in the Art Gallery tonight. Rembrandt, Goya, Picasso, Dalí, Miró, Chagall, Matisse, Toulouse-Lautrec, Renoir. Very rare artworks. All with Certificate of Authenticity & worldwide shipping. Art Auctioneers available tonight to assist you. 8:00pm to 10:00pm, Outside the Art Gallery, Deck 7 Mid.

Chocoholic Buffet: This is the culinary experience you have been waiting for all cruise long! Our expert galley and pastry teams will delight you with their chocolate creations. Delectable, sinfully delicious deserts...Go ahead, indulge and enjoy... 10:30pm-11:30pm, Four Seasons, Deck 5, Mid

Skagway

Skagway, lying at the head of the Lynn Canal is the gateway to the Golden Interior. The small town sits at the top of the Inside Passage, framed by the deep waters of Taiya Inlet and the rugged Coast Mountains. Its distinctive name comes from the Tlingit word skagua, which is said to mean "home of the north wind." Legend has it that as the wind blows so much; you will never breathe the same air twice. Downtown Skagway was restored with old shop fronts and buildings and looks very much the same as it did when it was a gold rush boomtown in the 1890s. In many ways, Skagway remains a gold rush town today. Relive the Days of 98 on the "Skagway Street Car" or become a prospector and try your hand at gold panning at the "Klondike Gold Dredge". Whatever you choose to do, have a great time in Skagway!

Don't miss this!

Country Western Dance Party: 8:30pm, Dazzles Disco, Deck 6, Mid

Enjoy classic & contemporary country favorites with The Ironics and learn some easy line dances with your Cruise Director's Staff team

Bar Promotions

Morning Specials at all bars from 8:00am-11:00am: "Bloody Mary, Bloody Caesar, Screwdriver, Mimosa & Kir Royale" \$4.25
Drink of the day: "Blue Lagoon" \$7.95 **Smoothie of the Day:** "Tutty Fruity" \$8.50 **Martini Special:** "Coco Cababatini" \$7.75
White wine of the Day: "Weinbach Gewurztraminer, France" \$56
Red wine of the Day: "Concha y Toro, Chile" \$42
Sparkling Wine of the Day: "Zardetto Prosecco" Bottle \$34 **After dinner drink of the day:** "Brandy Alexander" \$6.50
Freshly Squeezed Fruit and Vegetables Juice: Garden Café 6:00am-10:00am, Small \$2.50 Large \$3.50

Dear Pedro,

This was an amazing vacation. We want to come back again soon...any ideas?

Absolutely! Where would you like to go? Europe, Alaska, The Caribbean, The Hawaiian Islands, or New England and Canadian coast... NCL has the youngest fleet in the world and many convenient departure ports in the US, Canada and Europe with destinations as exotic and exciting as any on Earth.

NCL now offers \$100 off your current onboard account when you sign up for the Freestyle Cruise Rewards Program-It's easy, simply fill in a cruise rewards form from the Cruise Consultants desk and drop it off at the 24 hour drop box or at Reception desk. You can have up to 24 months to book your next NCL cruise through any Travel Professional and 2½ years to sail again. When reserving your next cruise with cruise rewards, your \$250 deposit will be deducted from the rate on your next cruise and no additional down payments will be required.

Cruise Rewards allow you to search for the best available promotions directly with your travel agent or with NCL. Visit our Cruise Consultants in the Atrium, Deck 6, Mid.

Shore Excursion

Your ports, your itinerary. Don't forget to order your Souvenir Cruise DVD featuring each of your exciting ports - of - call. This is the perfect keepsake from your unforgettable cruise - a video memory you can share with friends and family for years - only available at the Shore Excursions Desk.

Mandara Spa

Allow us to pamper and rejuvenate you after a long day of sight seeing and adventure. If you went on a tour today you will receive 30% off any of our signature Treatments from the Spa Menu. We look forward to indulging you. Spa Open 8am- 10pm Book for your Miracle Facial Today and get a free eye treatment. Mandara Spa, Deck 11, Fwd or Call #29

Colombian Emeralds International

Visit us and view the latest styles from some of the worlds most prestigious watch brands. Discover the hottest new trends in timekeeping and find your perfect time. It's not just about keeping time... it's about celebrating life. With savings up to 70% Off U.S Retail Prices. Colombian Emeralds Intl, Deck 7, Aft
Store hours: 9:30pm - Midnight

Freestyle Cruise Rewards

Do you enjoy Freestyle Cruising? Sign up today for NCL's Cruise Rewards program and get an instant \$100 onboard credit. See Matt, your Cruise Consultant Manager for more details. Cruise Consultant Desk
Deck 6, Atrium, 7:00pm-9:00pm.

Ken Shotwell Art Work Unveiling.

Come and discover the unseen world of Ken Shotwell's works as we show you what his Painted can do. Revel in the detail of his Europe street scenes and let your mind free in his surreal masterpieces. Meet the man responsible for these amazing pieces live!
8:00pm-10:00pm Gallery, Deck 7 Midship.

Sun Club Casino

Over 200 slot machines & 15 table games for you to choose from. Experience the ultimate gaming experience with our friendly casino staff. Don't miss the thrill & excitement of our various tournaments tomorrow starting at 3pm onwards. Sun Club Casino opens ½ hour after sailing. Deck 7, Mid.

Internet Cafe

Happy Hour! Go online between 7:00pm & 9:00pm and get half your minutes back! Print your receipt or see Alvaro the Internet Manager to claim your free minutes
Internet Café, Deck 6, Atrium, always open...
Manager's Hours: 8:00am-10:00am, 4:00pm-6:00pm & 7:00pm-10:00pm.

Photo Gallery

If you didn't get great photos of Sawyer Glacier, don't worry, as we already did that for you. Just drop by the photo gallery and pick from the finest collection of our professionally shot photos. Collection of different albums is also available. While you're there, check out the gangway photos that you've had taken in our Alaskan ports.
Photo Gallery: 5:00pm-11:00pm, Deck 6 Aft

Shopping Consultant

This is your last chance for port-shopping. Remember to take your shopping maps into town, and see your Shopping Consultants Michael and Shlomit on the gangway for all your VIP shopping needs. Looking for diamonds, tanzanite, alexandrite, gold quartz, watches or souvenirs? This is the port, with the longest stay; enjoy your extended shopping hours! Please stick to the stores on NCL's Guaranteed Shopping Map.

Need a ride to avoid the taxi lines?

Let us take care of your transportation to Vancouver International Airport. For guests with flights after 12:00pm, only \$30 per person, available for purchase at the Reception Desk. Deadline: 10:00am, Saturday, May 9th, At Sea.



Freestyle Daily Activities



Stuff for the 'morning people'...

Daily Trivia, Crossword, & Sudoku	Library, Deck 6, Aft	Always Available, Everyday
Wake up and Stretch Class	Fitness Room, Deck 11, Fwd	7:00am
Abdominal Class	Fitness Room, Deck 11, Fwd	7:30am
Morning Movie: "Seven Pounds" (PG-13)	Dazzles Night Club, Deck 6, Mid	10:30am
Shuffleboard Tournament (weather permitting)	Sports Court, Deck 12, Aft	10:00am-12:00pm
Brunch Trivia with your Cruise Director's Staff	Windjammer, Deck 6, Aft	11:30am

Add pizzazz to your afternoon...

Sports Court Open with your Sports Staff (weather permitting)	Sports Deck 12, Aft	12:00pm-3:00pm
Sun Trivia Hunt #2! Pick up the List. (Prizes at 4:30pm)	Library, Deck 6, Aft	1:00pm
Movie: The Curious Case of Benjamin Button (PG 13)	Dazzles Night Club, Deck 6, Mid	1:00pm
Informal Bridge with your fellow guests	Ginza, Sushi Bar, Deck 12, Aft	2:00pm-4:00pm
Bowling on the High Seas – Interactive Wii™ Fun	Dazzles Night Club, Deck 6, Mid	4:00pm-5:00pm
Total Body Conditioning Class	Fitness Room, Deck 11, Fwd	4:00pm
Piano Melodies with Michael	Seven Seas Restaurant, Deck 5, Aft	5:30pm-7:00pm
Evening Trivia with Cruise Director's Staff	Windjammer, Deck 6, Aft	5:30pm

Everything's hotter when the sun goes down...

Friends of Bill W.	The Chapel, Deck 12, Fwd	6:00pm
Friends of Dorothy	Havana, Deck 6, Mid	6:00pm
Showtime: History of Alaska in Stories & Songs w/ Steve Hites	Stardust Lounge, Deck 6, Aft	6:30pm
Dance music with Ironics	Dazzles Disco, Deck 6, Mid	6:30pm-10:15pm
Keith Channer the Piano Man	Windjammer, Deck 6, Aft	6:30pm-9:15pm
Dance Music with Avalon	Observation Lounge, Deck 12, Fwd	7:00pm-9:30pm
Guitar Stories & Songs with Kim Doolittle	Las Ramblas, Deck 11, Aft	7:00pm-10:00pm
Tribute to Frank Sinatra with Keith Channer	Windjammer, Deck 6, Aft	8:30pm
Smooth Jazz with Cruise Control	Windjammer, Deck 6, Aft	9:30pm 'til whenever
Country Western Dance Party with your Cruise Director's Staff	Dazzles Disco, Deck 6, Mid	8:30pm
Showtime: Dynamic Music & Comedy of George Solomon	Stardust Lounge, Deck 6, Aft	9:15pm
Guess Bag Mania	Galleria Tax & Duty Free Shops, Deck 7, Aft	9:30pm-Midnight
Karaoke Power Hour	Observation Lounge, Deck 12, Fwd	9:30pm-10:30pm
Piano Melodies with Michael	Observation Lounge, Deck 12, Fwd	10:30pm 'til whenever
Rock & Soul Motown Night	Dazzles Disco, Deck 6, Mid	10:30pm
Late Night Party Zone with DJ Jasper	Dazzles Night Club, Deck 6, Mid	11:30pm 'til whenever

Ok, we know this looks like a schedule (gasp!), but remember you're free to whatever!

Bar Services

Java Café	7:00am-Whenever
Deck 5, Atrium	
Great Outdoor Bar	11:00am-Whenever
Deck 11, Aft	
Topsiders Bar	8:00am-Whenever
Deck 11, Mid	
Sports Bar	7:00am-Whenever
Deck 11, Aft	
Champ's Bar	Weather permitting
Deck 12, Mid	
Observation Lounge	12:30pm-Whenever
Deck 12, Fwd	
Champagne Bar	4:30pm-Whenever
Deck 7, Atrium	
Windjammer/Havana	3:00pm-Whenever
Deck 6, Aft	
Las Ramblas	5:30pm-Whenever
Sangria, Tapas, Margaritas & Nachos, Deck 12, Aft	
Dazzles Disco	7:00pm-Whenever
Deck 6, Mid	
Sun Club Casino Bar	30 min after sailing
Deck 7, Mid	

Guest Services

Art Auctioneers in the Gallery	8:00pm – 10:00pm
Art Gallery, Deck 7, Mid, Atrium	
Credit Desk	8:00am-11:00am 4:00pm-8:00pm
Deck 5, Mid	
Galleria Tax & Duty Free Shops, Colombian Emeralds, Deck 7, Aft	9:30pm-Midnight
Library Hours	9:00am-10:00am 4:00pm-5:00pm
Deck 6, Aft	
Mandara Spa, Steam and Sauna	8:00am-10:00pm
Deck 11, Fwd (#29)	
Medical Center	8:30am-10:00am 4:00pm-5:00pm
Deck 3, Fwd	
Shopping Consultant	6:00pm-8:00pm
Deck 5, Mid	
Photo Gallery	5:00pm-11:00pm
Deck 6, Aft	
Reception Desk, #20	Always Open
Deck 5, Atrium	
Cruise Consultants	7:00pm-9:00pm
Atrium, Deck 6	
Shore Excursion Desk	Closed (Staff available on the pier)
Deck 5, Atrium	
Under 2 Zoo	9:00am-10:30pm
Kids Komer, Deck 7, Fwd	
Pool & Jacuzzi	7:00am-10:00pm
Deck 11, Mid (weather permitting)	
Towel Exchange	7:00am-10:00pm
Deck 11, Mid (Dive-in Locker)	

Alcohol Policy: If you bring alcohol onboard at any time during the cruise, we'll hold it and re-issue on the last night of the cruise during the hours of 7:00pm and 9:00pm in the Tech Style room, Deck 6, Mid.
Corkage Fee: A \$15 corkage fee per bottle will be charged for each bottle of wine not purchased onboard.

Parental Consent: 18 to 20 years old guests can purchase wine or beer by obtaining a Parental consent form from the Reception.

Jacuzzis & Pools: Glass & bottles can't be brought into any of the pools or hot tubs, no children in diapers or pull-ups, including swimmers & no unaccompanied children under 12 in hot tubs.

What to wear: You'll always find a place for your style, no matter what you want to wear. Resort casual (including jeans) is welcome in all of our restaurants, except our designated "dress-up" restaurant Seven Seas. Shorts and tank tops are not allowed after 5:00pm except Garden Café.

Sports Court: is open daily from 8:00am-5:00pm, Deck 12, Aft (weather permit.). Please use caution when utilizing the

Sports Deck. Play at your own risk. Volleyball & Basketball play with your fellow guests is offered daily. Please check your printed Freestyle Daily Program for offered times. Golf equipment is available at the golf cages during these times.

Freestyle Dining

Getting Started

Early Riser Coffee & Danish, Deck 11, Aft	6:00am-7:00am
Garden Café , Deck 11, Aft	6:00am-10:30am
Seven Seas , Deck 5, Aft	7:00am-9:00am
Great Outdoor , Deck 11, Aft	7:00am-11:00am

Satisfy Your Afternoon Appetite

Seven Seas , Deck 5, Aft	Noon-1:30pm
Garden Café , Deck 11, Aft	Noon -2:30pm
Great Outdoor , Deck 11, Aft	Noon-2:30pm
Pacific Heights , Deck 11, Aft Pasta & Pizza	Noon -2:30pm

What Are You in the Mood For?

Garden Café , Deck 11, Aft	5:30pm-9:30pm
Four Seasons , Deck 5, Mid	5:30pm-9:00pm
Las Ramblas , Tapas, Nachos, Deck 12, Aft	5:30pm-10:00pm
Seven Seas , Deck 5, Aft	6:00pm-10:30pm
Pacific Heights , Deck 11, Aft (#93)	5:30pm-10:30pm
Steakhouse* , Deck 12, Aft (#82)	5:30pm-10:30pm
Ginza Sushi Bar* , Deck 12, Aft (#82)	5:30pm-10:30pm
Teppanyaki* , Deck 12, Aft (#82)	5:30pm, 7:30pm, 9:30pm
Il Adagio* , Deck 5, Mid (#80)	5:30pm-10:30pm
Le Bistro* , Deck 12, Aft (#81)	5:30pm-10:30pm
Chocoholic Buffet , Four Seasons, Deck 5, Mid	10:30pm-11:30pm

For Whenever You Are Hungry

Room Service (Dial #27/#28)	Always Open
Ice Cream , Deck 11, Aft	Noon-9:30pm
Great Outdoor , Deck 11, Aft	2:30pm-5:30pm
Sports Bar , Deck 11, Aft	5:30pm-5:30am
Garden Café , Deck 11, Mid	10:00pm-11:30pm

*This little star means that these restaurants charge a cover.

Restaurant Reservations: Reservations aren't required for any of our restaurants. But if you want to make a reservation, say for a special occasion, feel free. Reservations can be made for the day of or the next day before dinner time. Just call extension number 58200 or visit us on the desk located Deck 5, Mid, Atrium.

Reservation Cancellations: To ensure each of our guests receive our best service, we can only hold your dinner reservation for 15 minutes. If you need to cancel, please do so by 5:00pm on the day of your reservation to avoid having the cover charge for up to two guests applied to your account.

Emergency Number: 911 from any ship's phone.

Telephone Messages: Pick up messages by dialing star twice **

Medical Sharps: Ask your room steward for a sharps container for needle disposal. Do not dispose in the trash bin or public bins.

Casino: You have to be 18 (and have ID) to gamble or be in the casino. Sorry, but no winnings can be paid to any person or bets in violation. Still photo is okay but Videotaping is strictly prohibited; pipes or cigars can't be taken in, but cigarette smoking is ok. Slot winnings of \$1,200 and above could be subject to W2-G tax withholding.

Smoking Policy: Permitted in designated areas & open decks.

Customer Advisory: Eat Smart: In case you didn't know, there's a certain level of danger to eating raw or undercooked animal products. It's also risky to drink juices that haven't been pasteurized. So if you have any immune system disorders, you should talk with your doctor.

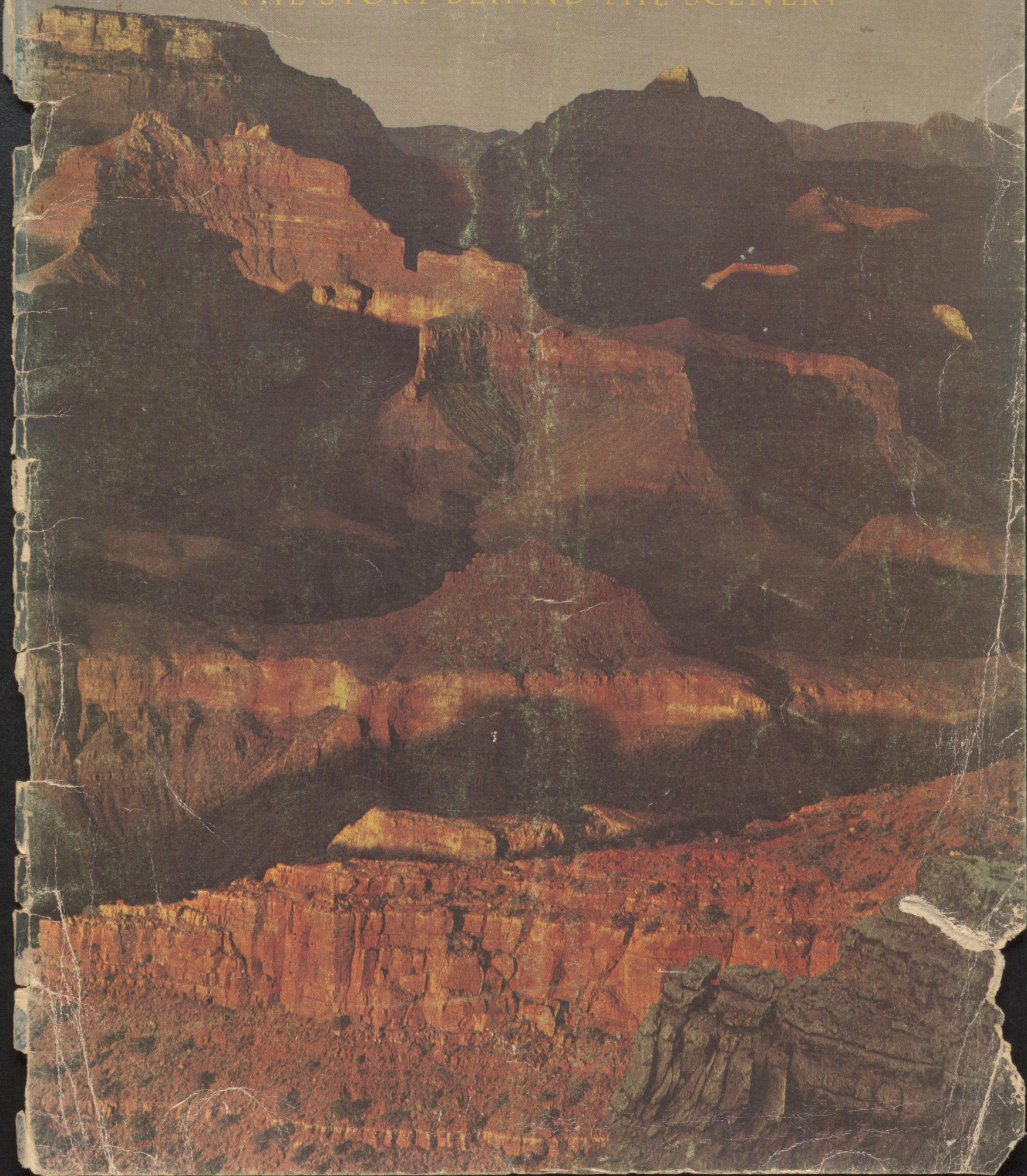
Environmental Hotline: The environmental hotline shall be used only to report actual or potential environmental incidents, spills and concerns. You may phone our hotline at 877- 501-5976 or E-mail EnvironmentalHotline@ncl.com Reports are confidential.

Dazzles Disco: After 11:00pm, 18 years and over only!
Stay Healthy: We kindly advise, while onboard or on land to wash & sanitize your hands frequently, especially before & after eating or using the washrooms, and when returning to the ship from shore.

ONE DOLLAR

GRAND CANYON

THE STORY BEHIND THE SCENERY





Kaibab Squirrel, North Rim



This book is dedicated to all who find Nature not an adversary to conquer and destroy, but a storehouse of infinite knowledge and experience linking man to all things past and present. They know conserving the natural environment is essential to our future well-being.

GRAND CANYON

THE STORY BEHIND THE SCENERY

by Merrill D. Beal

Former Chief Park Naturalist, Grand Canyon National Park

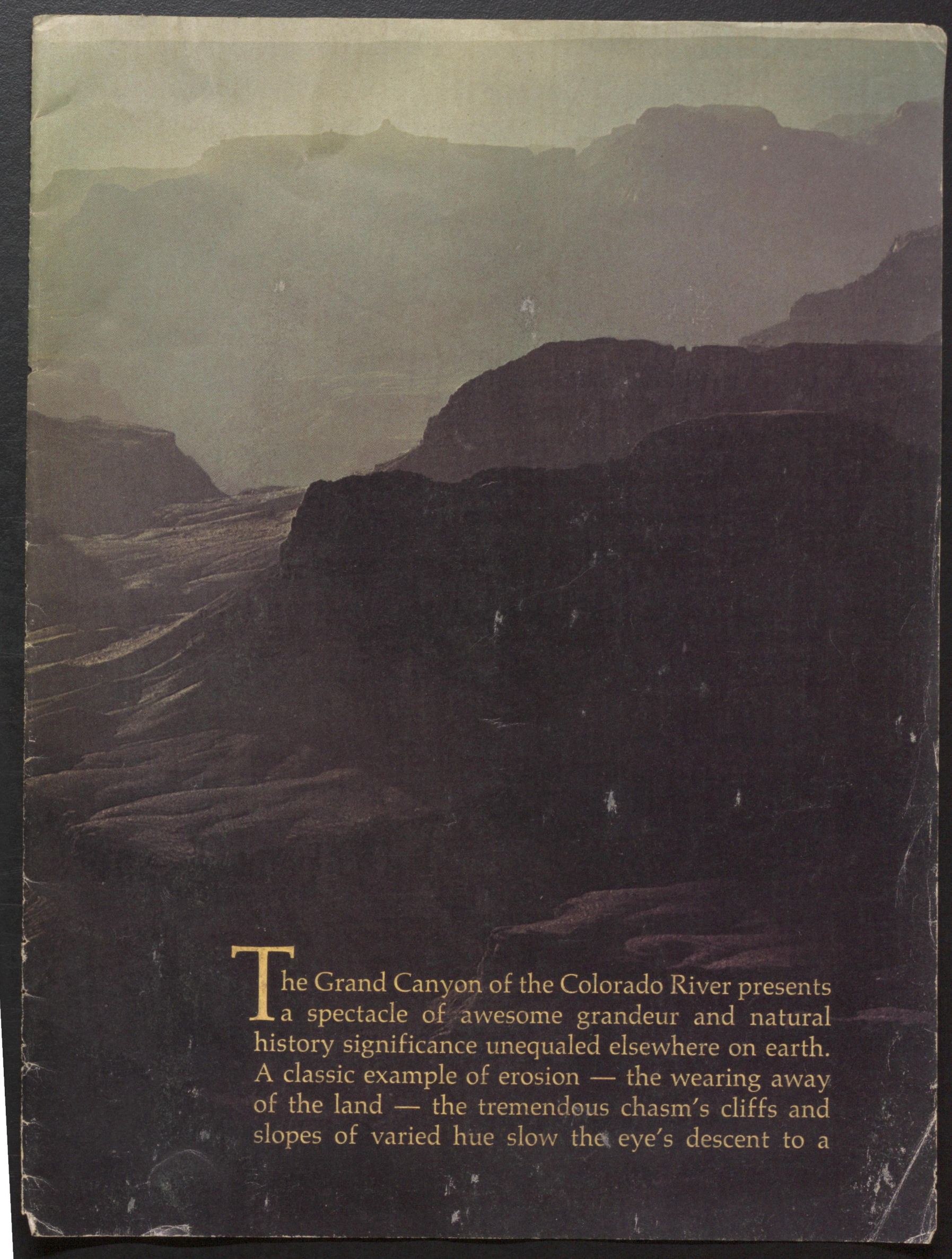
Dave Beal is a career employee of the National Park Service and has been active in protecting and interpreting our natural wonders for more than 20 years. He served first in Yellowstone National Park and was Chief Park Naturalist of Grand Canyon National Park from 1960 to 1969. Well known as an interpretive naturalist, Mr. Beal was active in coordinating research activities at Grand Canyon, planning exhibits and publications, and presenting interpretive programs for park visitors. He has a broad natural history background and graduated from Idaho State University and Utah State University with major studies in zoology and resources management. He is now Assistant Superintendent of Great Smoky Mountains National Park.

Book design and illustrations by Robert Jacobson

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A vintage, sepia-toned photograph of the Grand Canyon of the Colorado River. The image captures a wide, deep chasm with layered rock formations. The foreground shows a steep, dark slope leading down into the canyon. In the distance, the canyon walls rise again, showing distinct horizontal strata. The sky is a pale, hazy greenish-brown, suggesting a clear but slightly overcast day. The overall scene is one of immense scale and natural grandeur.

The Grand Canyon of the Colorado River presents a spectacle of awesome grandeur and natural history significance unequaled elsewhere on earth. A classic example of erosion — the wearing away of the land — the tremendous chasm's cliffs and slopes of varied hue slow the eye's descent to a

dark and somber cleft a mile below where the Colorado still carves deeper into the earth's crust.

The Grand Canyon demands more than visual inspection. It challenges man's imagination and poses questions which must not go unanswered. How big is it? How was it formed? What discoveries about our planet's history have been made here where so many layers of Earth's crust are exposed to view?

The knowledge of an area is assembled gradually by the efforts of many observers. It is through the discoveries of others that we enlarge our own knowledge of a subject. First the facts must be uncovered; later they can be correlated and interpreted.

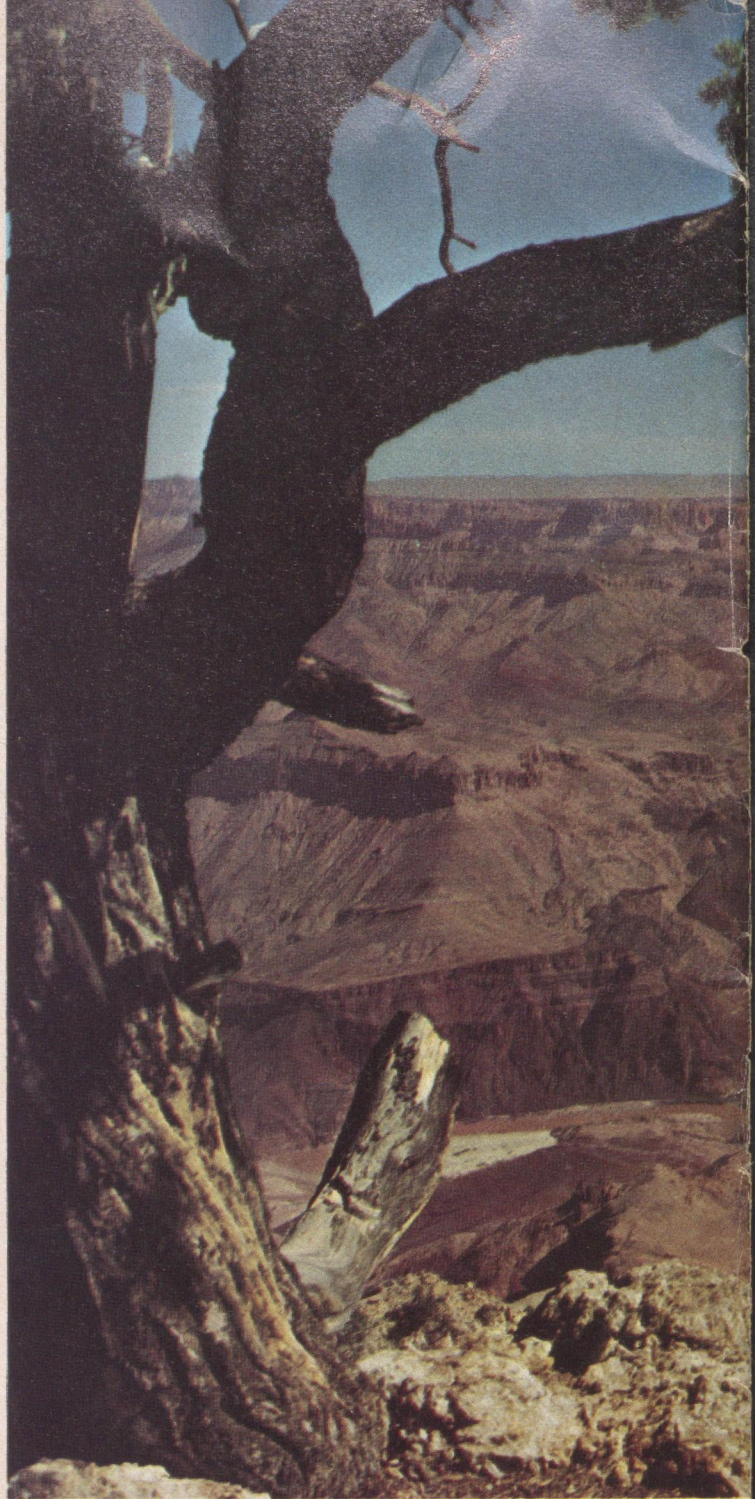
Man's approaches to understanding Grand Canyon are quite varied. Indian legends attribute deep religious significance to the region. Split-twig figurines found deep inside caves in the canyon walls provide physical evidence of prehistoric man's use of the Canyon nearly 4,000 years ago.

Modern men may also find spiritual or philosophical awakening at Grand Canyon. In gaining an understanding of nature's works man can better understand himself. Through the physical challenge of hiking canyon trails or the mental discipline of understanding constant change, destruction and creation, many visitors experience not only recreation but re-creation and their lives are greatly enriched.

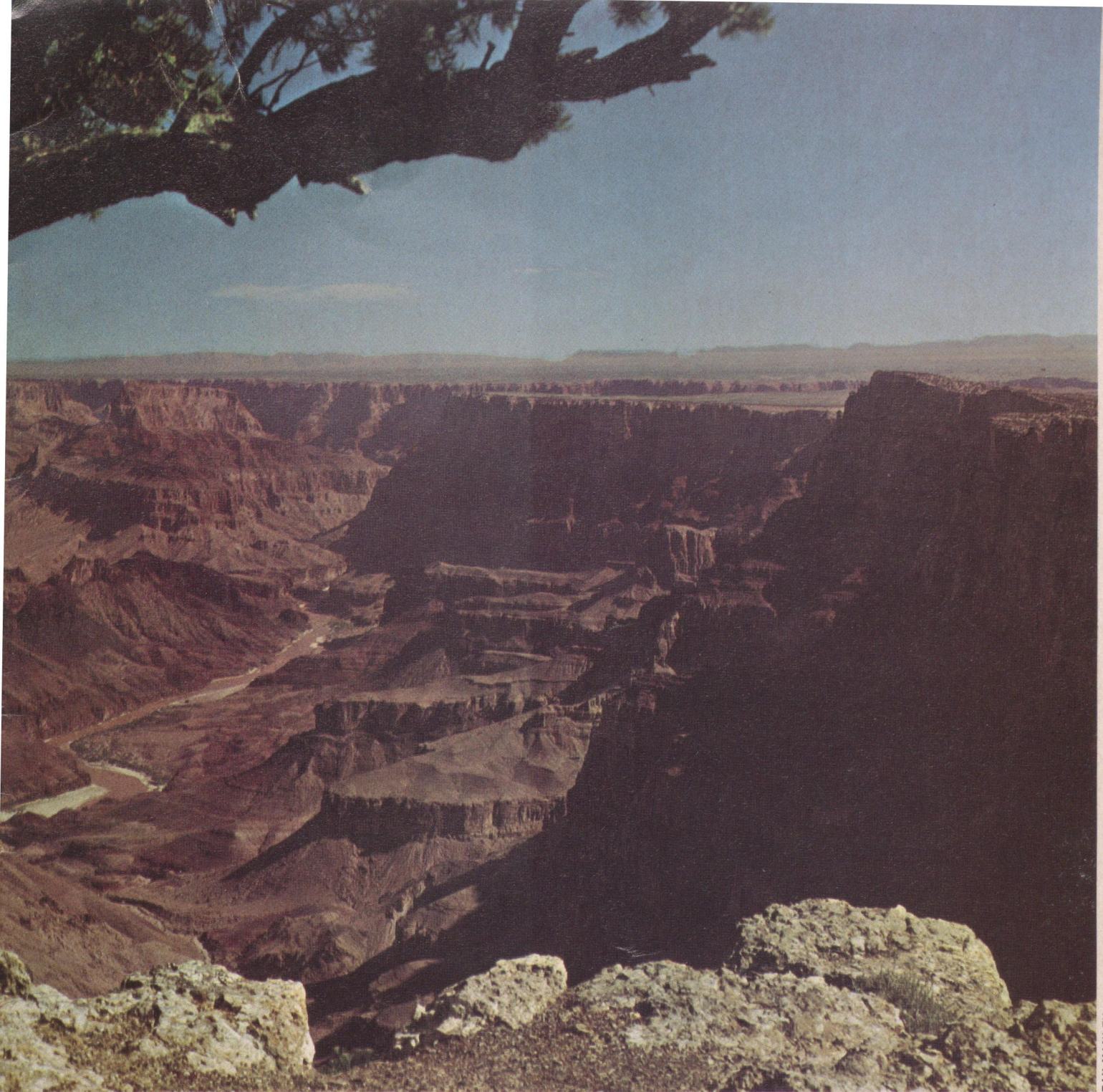
For some people the need for self expression becomes a driving force. They wish to communicate their feelings to others. Grand Canyon has inspired grand poetry and prose, outstanding works of art, and magnificent music. The same subject brings forth a multitude of forms and meanings from different artists.

Scientists, too, have found the canyon a great challenge. For while science is really little more than man's organized effort to understand nature's laws, the path of progress from observed fact into the unknown has been fraught with many obstacles. Theories carefully developed and nurtured have been cast aside as new facts emerged.

For more than a century learned men have studied the Colorado River and its grandest canyon, and pieced together an amazing story of earth building and erosion spanning the last two billion years of earth's history. But scientific theories often must rely upon relative likelihood rather than positive evidence. Studies are still going on and the Grand Canyon Story will be subjected to further revision as knowledge increases.



The Grand Canyon is Nature's finest monument to the combined forces of uplift and erosion, coupled with an unlimited amount of time. Obviously the chasm was carved from the same solid rocks which now form its walls, and most of the work was done by the Colorado River and its tributaries, but the process has been very slow. Nature works more slowly than man in most instances. If she works rapidly we view the results as catastrophic and resent their effects upon the puny efforts of men. However, history shows us that where man



RAY MANLEY

Eastern end of Grand Canyon from Desert View.

The Canyon

learns to live in reasonable harmony with the natural environment his works endure best.

The changes which man brings about on the face of the land are readily observed. Each of us can remember a time when an area now covered with homes was farmland. We also recall changes in roads, development of reservoirs, canals and other modifications to our environment. But the land itself — plateaus, rivers, canyons and mountains — in our memories has always been as it is now. In terms of a single human lifetime this is

largely true, but study of physical evidence reveals interesting stories about land forms everywhere in the world.

The Colorado River has performed its greatest work in northern Arizona. Here earth sculpturing reaches the grandest proportions. The river turns from its southerly course and plunges westward through the Kaibab Plateau, imprisoned in a narrow gorge a mile below the canyon rims. Kaibab is a Paiute Indian word meaning "mountain lying down." This portion of the river's

course, from the mouth of the Little Colorado River to the Grand Wash Cliffs, is called Grand Canyon. It measures 217 river miles in length.

The canyon averages about 9 miles in width from rim to rim, but in places promontories are as little as 4 miles apart. The greatest width, 18 miles, is measured between embayments. Viewing distance from the South Rim to the river averages about 3 miles, but from the North Rim the distance is twice as great. The depth of the canyon is given as one mile.

Yavapai Point on the South Rim is just over 7,000 feet above sea level, while the canyon floor below is less than 2,500 feet in altitude. The difference is 4,500 feet. The North Rim of the canyon averages 1,200 feet higher than the South Rim and so the distance above the river averages 5,700 feet. You can see that the round figure of one mile in depth is reasonably accurate.

THE COLORADO — CARVER OF CANYONS

A mighty river capable of such earth sculpture must start somewhere. The Colorado rises high in the Colorado Rockies in Rocky Mountain National Park. The distance from the source across the high plateau country and down to the Gulf of California measures 1,450 miles.

A major contributor to the torrent is the Green River which begins in the Wind River Mountains of Wyoming and travels 720 miles through canyons and parks to join the Colorado in Canyonlands National Park, some 1,100 miles above its entry to the Gulf. The Colorado and its tributaries drain a land area of over 240,000 square miles. There are many canyons along the river's course, and the stream drops 10,000 feet over hundreds of rapids in its descent from mountains to the sea.

The river has been given many names in a variety of tongues, but the Spaniards came to call it the *Rio Colorado* (Red River) and Americans adopted a translation of the term, Colorado River. The name was appropriate, for the river was indeed red or brown due to the color of sand and mud carried with the current. The wild and turbulent Colorado ran untamed for centuries. Its surging waters moved along at speeds ranging from 2½ to 12 miles per hour, where measured near Bright Angel Creek, and its depth varied from 12 to 40 or more feet.

Accurate records maintained by the United States Geological Survey gaging station in the bottom of Grand Canyon show the volume of flow of the river has varied from a trickle of 700 cubic feet per second on December 28, 1924, to a measured

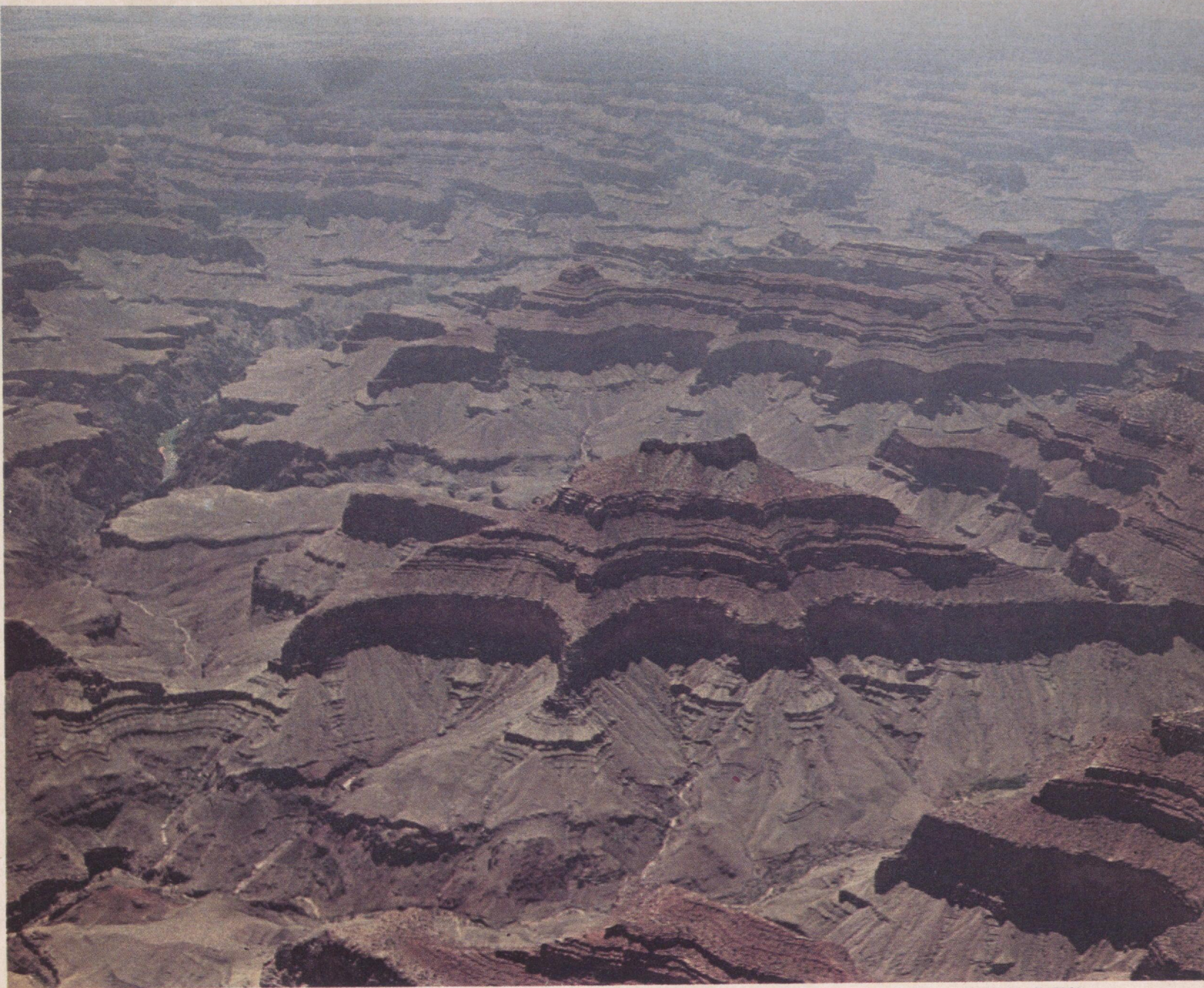
THE DOWNWARD CUTTING Colorado River, horizontal rock layers of varying resistance to erosion, and an arid climate have combined to produce a landscape of alternating cliffs and slopes forming temples, buttes and stepped canyon walls. Aerial view is to west from above Buddha Temple.



K. C. DEN DOOVEN

flood of 127,000 cubic feet per second on July 2, 1927. High water marks upstream from Grand Canyon left by a flood which took place July 8, 1884, were used to compute a maximum flow of 300,000 cubic feet per second!

The ability of a stream to move materials increases in much more than a direct ratio to its volume. Thus a river does its greatest work of transportation during flood stages. The load of suspended solids and dissolved material carried by the Colorado River varied from a few hundred tons a day at low water to a maximum of 27,600,000 tons per day during a flood on September 13, 1927. The average load per day over a span of many years was 500,000 tons.



RAY ATKESON

Such figures can be meaningless without examination. For example: Load the 500,000 tons *average* burden into dump trucks of 5 tons capacity each. There would be 100,000 of them, going by less than a second apart for 24 hours, just to do the same amount of work the river did quite naturally each day.

In addition to the suspended and dissolved materials the river also moved large quantities of pebbles and boulders by rolling or bouncing them along the bottom of its channel. The amount of this load cannot be accurately determined, but it perhaps almost equaled the amount of suspended solids.

Such were the cutting tools which armed the

Colorado River and enabled it to scour and scrape and wear away layer upon layer of rock to create the fantastic landscape we know. All of the debris came from someplace upstream, and it was going somewhere downstream. Rates of erosion vary from place to place, but studies show the overall rate of denudation for the entire Colorado River drainage area is 6.5 inches or more each 1,000 years.

The Colorado and its tributaries gather the products of erosion in all the inaccessible reaches of the plateau country and transport them to new localities. They once came to rest at the mouth of the Colorado River where it empties into the Gulf of California. Over a long period of time sedi-



SWIRLING CURRENTS of a silt-laden Colorado River scoured and polished by abrasion the resistant schist and granite of the Inner Gorge. Such river water sculpture is called stream fluting. Grand Canyon presents a spectacle so massive and overpowering that lesser objects of exquisite beauty are frequently overlooked.

ments built up a vast delta and also filled in the Imperial Valley.

Hoover Dam on the Colorado River below Grand Canyon was completed in the mid-1930's. It backed up a large body of water we call Lake Mead and in that area the Colorado was subdued at last. But from the geologist's point of view lakes, including those made by man, are only temporary features. As soon as they start to fill with water their destruction begins, for the sand and silt that once passed through are now deposited in the bottom of the lake. Lake Mead will eventually be filled with sediments. A reasonable estimate of the useful life of the lake would be several hundred years.

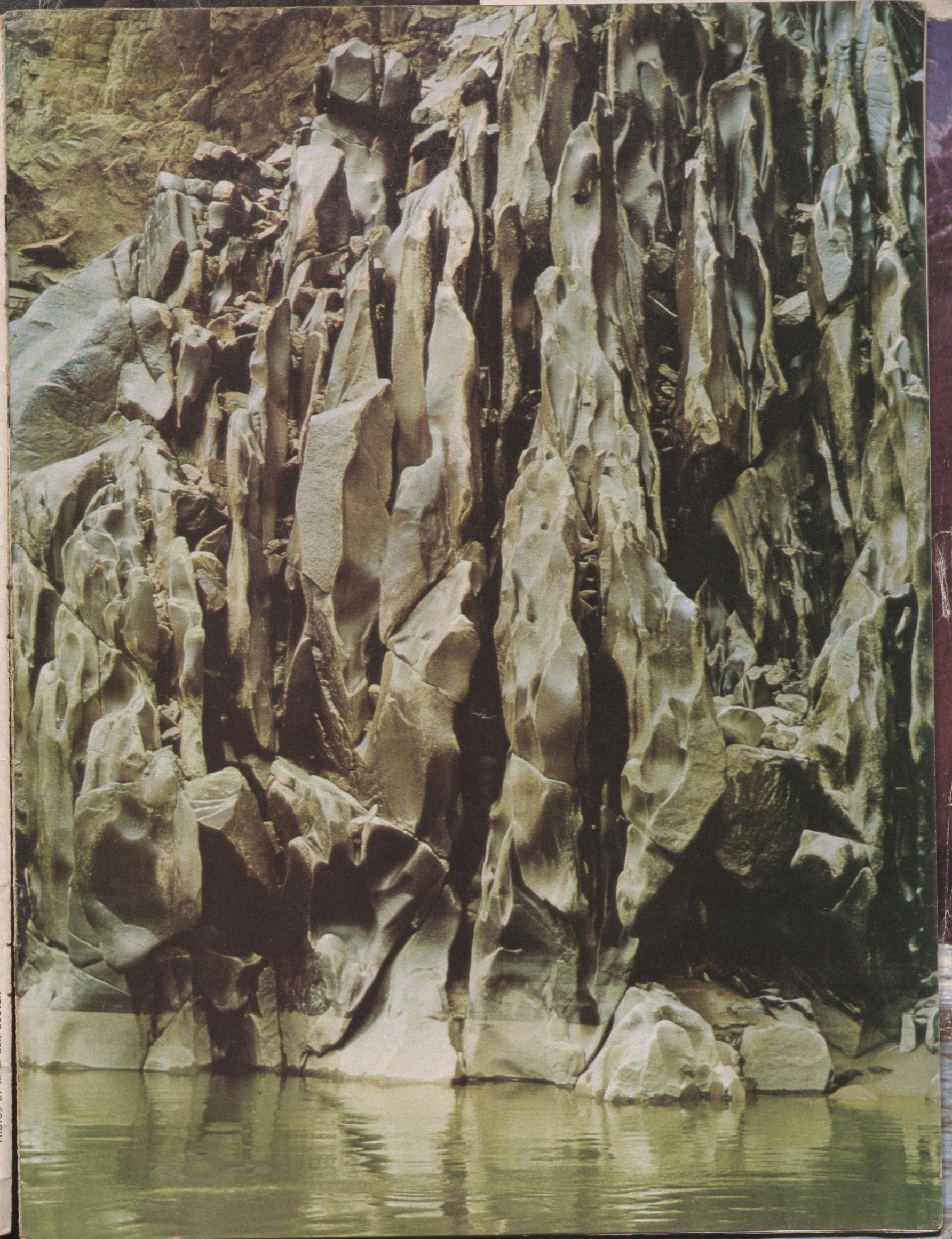
To further utilize the river and prolong the life of Lake Mead a large dam was constructed in Glen Canyon upstream from the Grand Canyon. Its gates were closed in 1963, and behind Glen Canyon Dam was formed Lake Powell, named for Major John Wesley Powell.

Lake Powell now absorbs about three-fourths of the sediments carried by the river, and will probably triple or quadruple the life of Lake Mead. Clear water is released from Glen Canyon Dam. A controlled Colorado flows onward through Grand Canyon. It is often green in color, but at times regains a measure of its former muddy appearance when tributary streams such as the Paria or Little Colorado rivers flood. The load of sediment measured now averages about 80,000 tons per day, about one-sixth as much as the wild river carried.

The Colorado has temporarily lost its power to move tremendous quantities of sand and boulders; it now obeys man's commands. But Grand Canyon remains as a monument to the power of that river. It cannot be denied, nor can it be fully comprehended by any man.

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PHOTOS BY K. C. DEN DOOVEN

THROUGH THE EYES OF THE EXPLORERS

The ancient ones who lived here left no record of their thoughts about Grand Canyon, but the lore of more recent inhabitants has been preserved. Indian legends concerning origin of the abyss are revealing. They support the observation that human beings feel compelled to provide an explanation for everything they encounter or suffer discomfort in its presence.

The Navajo tell of a great flood brought on by incessant rains. During this time the land was flooded to great depths. Finally an outlet was formed by the rushing waters. The ancestors of the Navajo were threatened with drowning, but survived by being transformed temporarily into fish. The outlet formed by floodwaters is said to be the Grand Canyon, and in deference to belief in the legend some Navajos still refrain from eating fish.

Spanish Conquistadores reached the South Rim of Grand Canyon in 1540. These first European visitors were guided by Hopi Indians. They were members of Coronado's expedition under the leadership of Don Lopez de Cardenas. The Conquistadores were mightily impressed by the awesome terrain and three members of the party failed in an attempt on foot to reach the great river they saw far below.

History does not record how these men thought Grand Canyon was formed. Perhaps the singleness of purpose the Spaniards displayed in their search for gold precluded such speculation.

Spanish missionary priests visited the Grand Canyon region in 1776 and American fur traders followed a half-century later. All viewed the canyon and surrounding deserts as obstacles to the success of their primary objectives.

The first comprehensive report on the Grand Canyon country resulted from the work of a War Department expedition of 1857-58 headed by Lieutenant Joseph C. Ives. His mission was to ascend and explore the Colorado River to report on its navigability.

Dr. John Strong Newberry was geologist to the expedition, and as they explored the region his practised eye noted evidence upon which an early scientific explanation and description of the Grand Canyon region was based. He described many physical features, rocks and fossils, stating that the canyons of the Colorado were eroded by the river itself. He wrote:

Having this question [of origin] constantly in mind, and examining with all possible care the structure of the great cañons which we entered, I everywhere found evidence of the exclusive action of

water in their formation. The opposite sides of the deepest chasm showed perfect correspondence of stratification, conforming to the general dip, and nowhere displacement; and the bottom rock, so often dry and bare, was perhaps deeply eroded, but continuous from side to side, a portion of the yet undivided series lying below.

Newberry interpreted the valleys, cliffs and plateaus of the region as evidence of a long period of erosion in which tremendous amounts of rock had been worn away, but he gave no explanation of *how* the Colorado River carved Grand Canyon.

Major John Wesley Powell won lasting fame as a result of his daring descent of the Colorado River by boat in 1869, and again in 1871. His



Running a rapid. Illustration from *Exploration of the Colorado River of the West* by J. W. Powell, 1875.

were scientific explorations and much worthwhile and illuminating information was gathered in spite of the hardships involved. Major Powell's narrative states:

All the mountain forms of this region are due to erosion; all the cañons, channels of living rivers and intermittent streams were carved by the running waters, and they represent an amount of corrosion difficult to comprehend. But the carving of the cañons and mountains is insignificant, when compared with the denudation of the whole area, as evidenced in the cliffs of erosion. Beds hundreds

of feet in thickness and hundreds of thousands of square miles in extent, beds of granite and beds of schist, beds of marble and beds of sandstone, crumbling shales and adamantine lavas have slowly yielded to the silent and unseen powers of the air, and crumbled into dust and been washed away by the rains and carried into the sea by the rivers.

Clarence E. Dutton, a protégé of Major Powell, who conducted geological studies of the Colorado Plateau region in the late 1800's, shared his mentor's belief that the Colorado River was older than the landforms or structures it crosses in descending to the sea. They thought the river must have been well established in much its present course flowing across a vast low-lying plain prior to formation of the canyons. They theorized the river had many twists and bends in it just as other old rivers flowing through their broad valleys possess.

Then uplift of the land occurred slowly raising the entire southwestern part of the continent. The old river was rejuvenated and began to cut downwards into the land. Locally, in the vicinity of today's Grand Canyon, a gentle doming or upwarp of the layers of the earth's crust took place as the Kaibab Plateau was elevated. The river, it was thought, was able to cut downwards as fast as the land rose, thus entrenching itself ever deeper.

If the Kaibab Plateau had been elevated too rapidly it would have blocked the flow of the river and forced the Colorado to find another route. Two cycles of erosion were contemplated in this theory, one in which the plateau surface was formed, and a later one in which canyon cutting in the plateau took place.

For decades this theme and variations of it dominated the field in explaining how Grand Canyon, and other canyons of the Colorado and its tributaries, came to be. Some thought the canyon cutting process could have taken as little as one million years, and others believed perhaps as much as 25 million years elapsed. A figure of 7 to 9 million years was most generally accepted as the age of Grand Canyon.

Some researchers thought the Colorado had developed its route to the sea while flowing across softer rock formations which once covered the region, and maintained that course as it cut deeper and encountered the more resistant structure of the Kaibab and other plateaus. Streams lowered or let down in this manner across underlying ridges are said to be superposed. Geologists later found conclusive evidence that earth movements which created the Kaibab Plateau took place much earlier than formerly supposed, beginning about

65 million years ago as part of a series of mountain-building events geologists call the Laramide Revolution.

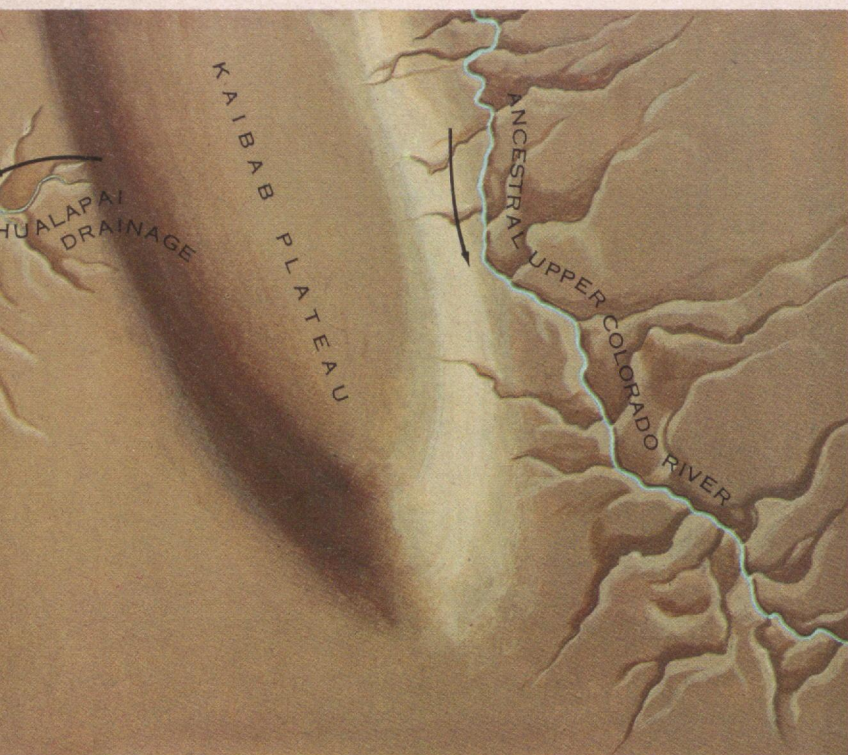
There was no through-flowing Colorado River with an outlet to the Gulf of California at that time. Sediments deposited in freshwater lakes on the Colorado plateau indicate the existence of a series of enclosed basins with interior drainage (no outlet for water). These later were drained by the Colorado River and its tributaries. Some scientists believe the Colorado might first have gained an outlet to the south and east, perhaps draining into the Gulf of Mexico, since high plateaus prevented it from flowing west. If so, the drainage was later terminated because of earth movements that caused uplift in the vicinity of today's Arizona-New Mexico boundary.

Recent studies of Colorado River delta deposits in the Imperial Valley of California support the idea the river formerly emptied elsewhere. The delta deposits began to form about 10 million years ago and have been forming continuously since that time. Minerals and tiny fossils from the *Mancos Shale*, a rock formation found mostly in north-eastern Arizona and southwestern Colorado, upstream from Grand Canyon, mark the sediments as coming from the Colorado Plateau.

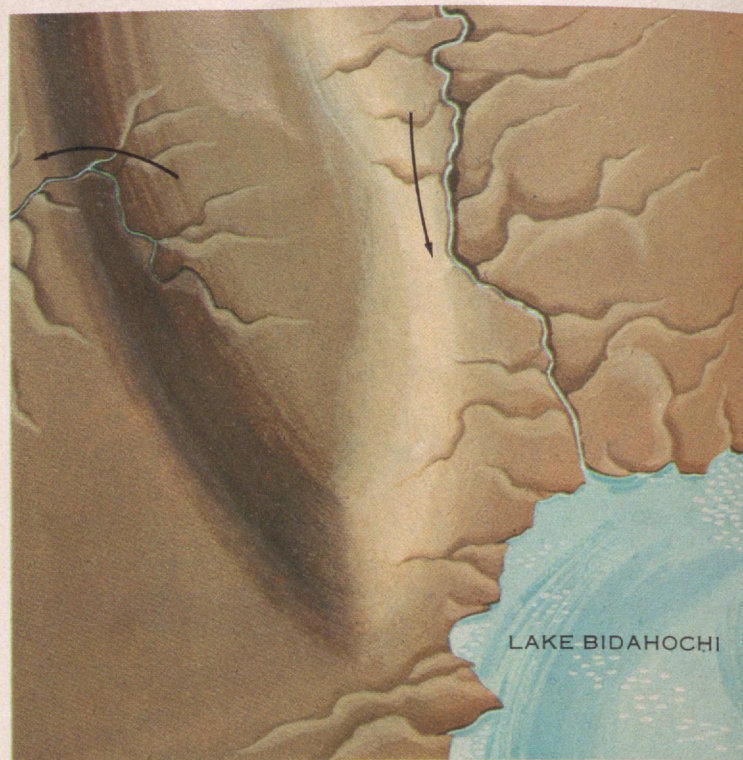
The *Muddy Creek Formation* downstream from Grand Canyon, and through which the river has cut its valley, has been dated by radiometric methods as about 10 million years in age. This formation is known to be older than the westward flowing Colorado River. Thus the Colorado River probably has followed its present general course for only about the last 10 million years, and the Grand Canyon must have been carved within the same period. But how?

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1. Drainage patterns in northern Arizona about 35 million years ago. The Kaibab Plateau separates the eastward flowing ancestral upper Colorado drainage system from the westward flowing Hualapai drainage system.



2. The ancestral upper Colorado drainage is blocked by uplift of the land to the east. Lake Bidahochi is formed by ponding of the Colorado's water. The Hualapai drainage system increases in extent and complexity.

THE CARVING OF GRAND CANYON

About 35 million years ago the Kaibab Plateau separated two river drainage systems. One, the Hualapai drainage, ran southwestward towards the Gulf of California from the plateaus to the west of the Kaibab. The other was the ancestral Upper Colorado system which drained southward into Arizona from Utah. This drainage may initially have had an outlet southeast to the Gulf of Mexico.

Deposits of lake sediments which make up the *Bidahochi Formation* in northeastern Arizona indicate that drainage was probably terminated and a large inland lake formed by ponding of the upper Colorado's waters. Remnants of *Bidahochi Formation* have been found at many places on the Navajo Indian Reservation indicating both wide extent and high elevation of the lake. It is not known whether or not Lake Bidahochi had an outlet.

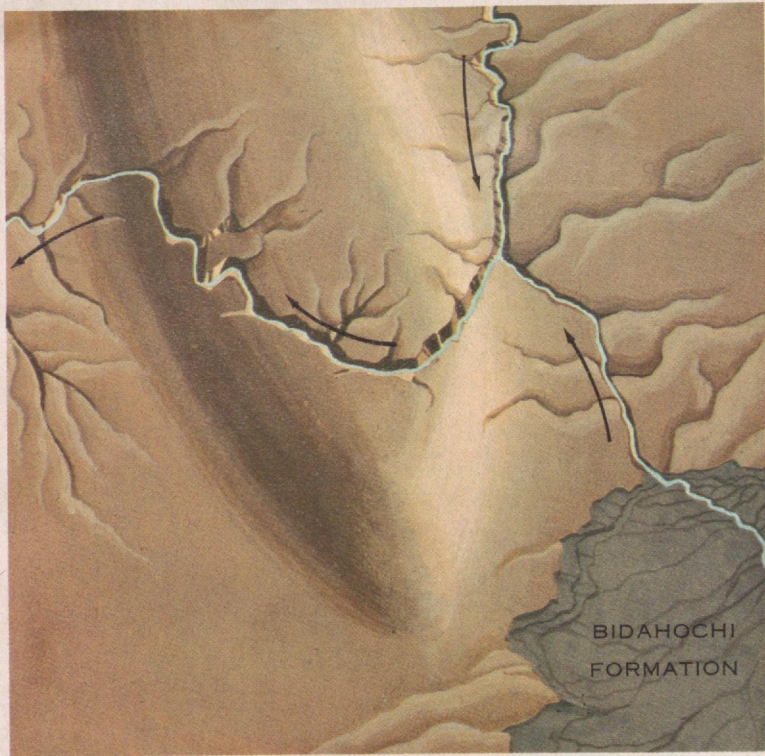
The western or Hualapai drainage gathered water over a wide area, and its headwaters gradually began extending toward the east by headward erosion in the weak rocks which covered the plateau. It grew longer, slowly eating back into the western slope of the Kaibab upwarp until finally it crossed the southern margin of the plateau and captured the drainage of the Upper Colo-

rado. Thus the Colorado River was born as a through-flowing stream from the Rocky Mountains to the Gulf of California.

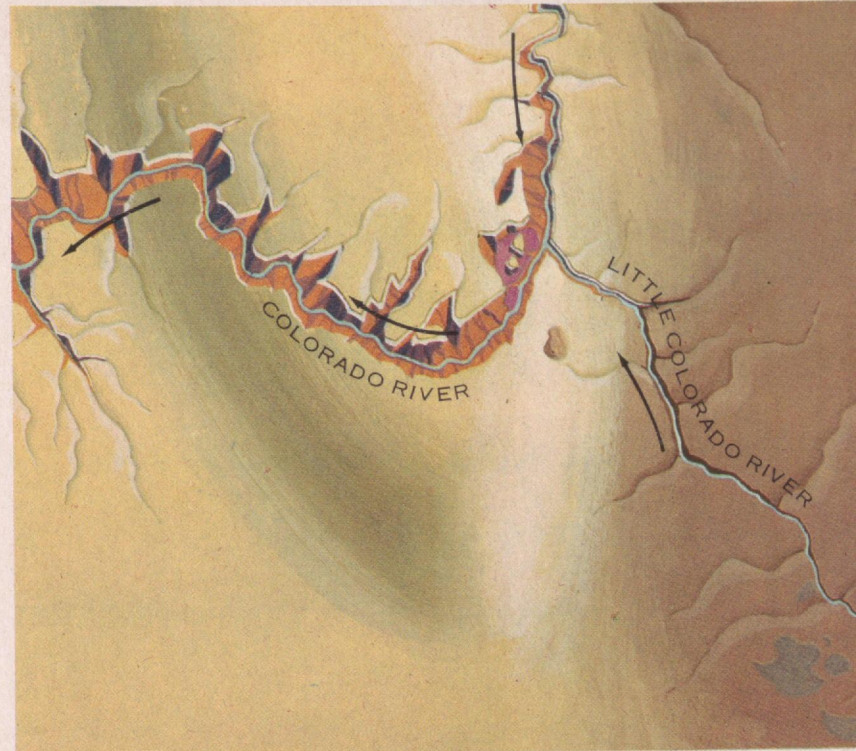
Through stream piracy the alignment of the river was achieved and it began to cut downward through thousands of feet of rock to create Grand Canyon. This event probably took place no earlier than 10 million years ago. The age of certain lava flows which cover river gravels west of Grand Canyon indicates it was certainly at least 2.6 million years ago.

The river itself has carved a vertical distance of a mile into the earth's crust. The canyon has been widened by other forces of erosion. They are not as dramatic as the mighty river, but their work is important nonetheless.

Expansion and contraction due to heat and cold, combined with wind and chemical action, weather exposed rock surfaces to loosen bits of material which can then be moved. Rain falls from the sky and each droplet has the power to displace loose sand or soil. Floods course down side canyons carrying debris towards the river. Snow falls on the South Rim in winter, but seldom accumulates to great depths. During the heat of the day it melts and percolates into the surrounding rocks. At night temperatures drop and water turns to ice, expanding and wedging rocks further apart.



3. The Hualapai drainage system is extended eastward by headward erosion and captures the upper Colorado drainage. This probably occurred about 10 million years ago. Sediments deposited in Lake Bidahochi indicate its former size.



4. The now westward flowing Colorado River entrenches itself deeper into the Kaibab Plateau. Tributary streams carve side canyons. Grand Canyon grows wider and approaches its present form.

Grand Canyon was cut through the southern slope of the Kaibab Plateau and the North Rim is 1,200 feet higher than the South Rim. Elevation of the plateau increases to 9,000 feet above sea level farther north. The North Rim climate is more severe than that of the South Rim. Snow builds up several feet deep in winter. When spring comes the snow and ice melt rapidly and water flows southward off the plateau into the canyon. Drainage from the South Rim is actually to the south and away from the canyon in many places. Consequently, Grand Canyon is being enlarged to the north twice as fast as to the south.

Most of the streams which have carved side canyons are intermittent, while others are spring fed, carrying water all year. Many drainages have been formed along faults or fractures in the rock layers where the weakened rock is more easily worn away. When floods roar down side canyons they carry huge boulders as well as smaller debris to the Colorado River at the canyon bottom. The river, already laden with sand and silt, cannot remove all this added material at once. Roaring, leaping rapids are formed where the river channel is partially blocked.

Hard layers of rock in the canyon walls form cliffs, while softer rocks form slopes. Cliffs retreat or are eroded by the falling of large blocks as softer

rocks at the base are worn away and the cliffs are undermined. Erosion takes place underground as well as on the earth's surface. Sinkholes in the limestone cover of the Kaibab Plateau, and large caverns in the *Redwall* and *Muav* limestone layers of the canyon walls attest the ever present processes of solution and transportation of rock by water.

What is the future of Grand Canyon? It could grow nearly one-half mile deeper, since the river is still that high above sea level. If erosion continues unabated and new earth-building events do not occur the canyon will certainly continue to grow wider. The cliffs will retreat and the rock layers forming canyon walls will be eroded bit by bit. Ultimately, after many millions of years, the Grand Canyon will be no more. A sluggish Colorado River may flow in wide loops and bends across a level plain, an erosion surface not unlike others that have left evidence of their passing in the walls of Grand Canyon.

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Time and the Canyon Walls

Geologists have divided the history of the earth into four eras, each of which spans many millions of years. The First Era is so much longer than the rest that we will divide it into two parts. We can then speak in terms of five "chapters" of geologic time. The evidence of passage of these chapters is preserved extremely well in the Grand Canyon region, and they can be "read" much as the chapters of a book if one understands the language.

Of course a few pages and many paragraphs are missing here and there, but the record in the rocks can be tied together in a satisfactory manner.

The First Era, and the longest, representing most ancient times, is called the Precambrian. Thus Chapter I is called the Early Precambrian and Chapter II is the Late Precambrian. Chapter III is the Paleozoic Era, Chapter IV the Mesozoic Era, and Chapter V the Cenozoic Era. Chapter V is



still going on today. It has lasted now for approximately 65 million years. An important thing to remember is that the Grand Canyon has been carved in the last part of Cenozoic time, the last 10 million years, but the rocks which make up the canyon walls are a great deal older than that.

THE ROCKS AND EVENTS OF CHAPTER I

Rocks of Chapter I can easily be identified from the rim of Grand Canyon. They form the walls of the Inner Gorge, a canyon within the canyon. Its walls rise as much as 1,500 feet above river level. These rocks appear very dark and forbidding, and give the impression of vertical layering. Seams of lighter colored material appear here and there in the gorge.

The dark-colored Early Precambrian rocks were not always as we see them today. Some of them were originally laid down in horizontal layers, much like the upper layers of the canyon walls. Others were volcanic materials. The rock layers

were many thousands of feet thick when something happened which permanently changed their nature.

The earth's crust was buckled and warped by tremendous internal forces and a range of mountains was created where the horizontal rock layers had been. These mountains were probably as high as any in the world today, perhaps six or seven miles high. This period of mountain building is called the Mazatzal Revolution.

Tremendous heat and pressure generated in the rocks as earth movements took place and the rocks recrystallized; they became changed or metamorphosed. Molten material from the interior of the earth penetrated into the base of the newly created mountain chain, forcing its way into the rock and then cooling and hardening.

The metamorphic rock which formed the mountains is called schist, while the lighter colored intrusive material is granite or pegmatite and is locally known as *Zoroaster Granite*. Two kinds of schist have been described in Grand Canyon. One, derived from rocks which were primarily sedimentary in origin, is named *Vishnu Schist*, while the other, formed from rocks primarily volcanic in origin, is locally called *Brahma Schist*. Most geologists refer to the entire formation as *Vishnu Schist*. This rock probably extends thousands of feet below the present floor of Grand Canyon.

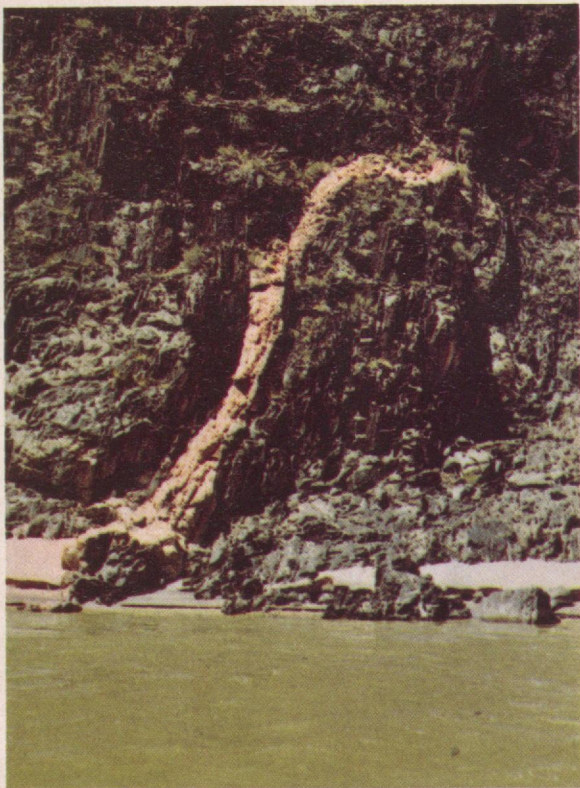
While the high mountains of Chapter I were being constructed the most certain processes we know in nature were also at work. The mountains were assailed by the elements and were gradually, bit by bit, eroded to a plain. Only the roots of the mountain chain remained when the land slowly submerged beneath an advancing sea marking the end of Chapter I in Grand Canyon's book of time.

How long ago did this take place?

Radiometric age determinations on granite from the Inner Gorge indicate the mountain building with its accompanying metamorphism and intrusion occurred about 1.7 billion years ago. The original Vishnu sediments are even older and an estimate of 2 billion years in age seems reasonable. Chapter I came to an end more than 1.2 billion years ago.

If any living things existed during Chapter I no fossil traces have yet been found in these rocks. Perhaps the heat and pressure which accompanied mountain building erased all signs of life, for evidence of living things has been found in rocks of this age and older in other parts of the world.

Scientists have recovered traces of organisms



THE INNER GORGE is carved in ancient schist and granite. On either side is a broad bench or platform called the Tonto Plateau. Kaibab Bridge for mules and hikers crosses the river at bottom of picture. This aerial view is from above Bright Angel Canyon looking east. A SEAM OF PINK granite near the river contrasts with dark schist around it.

believed to be bacteria and single-celled plants from the *Gunflint Chert* of the Canadian Shield, and believe their age to be nearly 2 billion years.

ROCKS, FOSSILS AND EVENTS OF CHAPTER II

In shallow water which covered eroded remnants of the Chapter I mountains sediments began to accumulate. Inch upon inch, layer upon layer, the rocks of Chapter II were formed. Distant highlands were worn away and materials transported to form the building stuff of rock layers at least two miles thick. The lowermost layer, deposited directly on the eroded surface of the schist, is called *Bass Limestone*. Primitive plants played a part in building this formation. Many limestone reefs were formed through the agency of algae, and the peculiar wavy line structures in some parts of the

rock represent the oldest known life recorded in Grand Canyon.

Geologists noticed a similarity between specimens from the *Bass Limestone* of Grand Canyon and limestone being formed in modern times near Harpers Ferry, West Virginia. *Bass Limestone* also preserves ripplemarks and mud cracks which suggest the deposit was formed under alternating shallow water and mud flat conditions.

New layers of sediment covered older ones. Immediately above *Bass Limestone* lies a brilliant vermilion rock, *Hakatai Shale*, also probably formed under shallow water conditions with occasional emergences. Ripple-marks, mudcracks and raindrop impressions attest to this origin. Next come deposits of quartz sand grains tightly cemented to make a hard resistant rock which stands

THESE COLORFUL sloping rock layers were once horizontal, but were tilted when the fault-block mountains of Chapter II were formed. Horizontal layers of Chapter III rock above them were deposited after the mountains were eroded. THE RIVER FLOWS in wide loops and bends across an open canyon floor in the eastern end of Grand Canyon. These Late Precambrian rock layers were more than 2 miles thick at one time. Aerial views to the north and northeast from above Hance Rapid.



PHOTOS BY K. C. DEN DOOVEN

as cliffs wherever exposed. The name *Shinumo Quartzite* has been given this formation. It too contains ripple-marks and cross-bedded layers which suggest shallow water deposition.

Still another layer, the *Dox Formation*, was added. It bears evidence of a similar origin.

During deposition of the *Dox Formation* molten material from great depth was forced upwards into the rock where it spread out between layers or penetrated cracks and cooled to form sills and dikes or reached the surface as basalt flows. Still other rock layers accumulated until the total thickness of Chapter II rocks was 12,000 feet or more. Evidence of simple plant life is found in



these rocks, but animal fossils have not yet been satisfactorily demonstrated from these Grand Canyon rocks. Fossils of jellyfish, sea pens and other primitive animals have been found in rocks of this age in Australia.

A tremendous span of time was required to build these rock formations, but dramatic events still lay ahead before Chapter II came to an end. Forces and stresses within the earth reshaped the land and another series of mountain ranges was formed. These ranges differed from the mountains of Chapter I. They were fault-block mountains. Zones of weakness or fractures in the earth's crust developed and slippage or movement along these faults permitted some blocks to be elevated, their rock layers tilted at an angle, while other zones were lowered. The basic character of the rock layers and their horizontal relationship to each other were preserved, however, since the great heat and pressure which altered or metamorphosed the rocks during Chapter I mountain building were not present during formation of the Chapter II fault-block mountains. This period of mountain

building is called the Grand Canyon Revolution.

Even as the mountains arose erosion took its toll. The highlands were attacked vigorously and as the rock wore away the landscape became more level. Finally, after millions of years, only a plain remained with ridges and monadnocks of resistant rock rising here and there. In many places the entire 12,000 foot thickness of Chapter II rocks had been completely worn away exposing the ancient schist of Chapter I. In a few places tilted wedges of Late Precambrian formations remained. This situation prevailed at the end of the Precambrian Era approximately 600 million years ago. Chapters I and II in Grand Canyon's book of time were completed.

Today these Late Precambrian rocks are exposed along the South Kaibab and North Kaibab trails. The Bright Angel Trail does not pass through these formations but they can be seen nearby. Extensive outcrops of Chapter II formations are found in remote Shinumo Amphitheater to the west of Grand Canyon Village. These rocks also form the broad canyon floor in the eastern end of Grand Canyon. There, because of the relative weakness of the rocks, the river is twice as wide as in the areas of resistant schist and granite of the Inner Gorge and broad benches flank the stream.

CHAPTER III — THE PALEOZOIC ERA

The upper two-thirds of the canyon walls are composed of formations deposited during Chapter III. The Grand Canyon region was beneath the sea, covered by river flood plains, invaded by desert dunes and affected by various other environments. During this time erosion intervals produced several unconformities or gaps in the record, now revealed in canyon walls.

The first rock formation of Chapter III, *Tapeats Sandstone*, was deposited along the margins of a sea which covered the eroded remnants of Chapter I mountains. Here the rocks of Chapter III rest directly on the rocks of Chapter I. The record of Chapter II, the Late Precambrian, is completely missing many places in Grand Canyon.

The contact or plane between the *Vishnu Schist* and *Tapeats Sandstone* is called the Great Unconformity and represents a time interval of 500 million years! This was the length of time required to deposit the rock layers of Chapter II, elevate them as fault-block mountains and then wear those mountains away. The Great Unconformity can be seen at a distance from many places on the canyon rims and inspected at close

Continued on page 22

range below Indian Gardens on the Bright Angel Trail.

Tapeats Sandstone is composed of strata ranging in character from coarse pebble-rock to fine sandstone and the formation averages about 200 feet thick in the central part of the Grand Canyon. Fossil shells, impressions of seaweed and ripple-marks point to the nature of the sea margin in which it was deposited.

Above the *Tapeats* lies the *Bright Angel Shale* composed of greenish siltstone and shale which also was formed as a sea deposit and now averages about 400 feet in thickness. Fossils in this formation show life was abundant in the sea. Typical forms are brachiopods (primitive shellfish), and peculiar crablike creatures called trilobites which ruled the seas for hundreds of millions of years.

Bright Angel Shale forms the Tonto Plateau, a broad bench or platform above the Inner Gorge of Grand Canyon. Under the surface this formation constitutes an aquiclude or barrier to downward penetration of percolating groundwater. Very little surface water is found on the canyon rims. Rain or snow seeps into the porous rock and



K. C. DEN DOOVEN

THESE HORIZONTAL ROCK LAYERS above the Inner Gorge were formed during Chapter III.

The contact between the bottom layer of Chapter III and the vertical schist of Chapter I is called The Great Unconformity. Aerial view toward Shoshone and Yaki points on South Rim from above Vishnu Creek.

some finally emerges as springs in the canyon walls above the *Bright Angel Shale* from a sea-deposited limestone layer called the *Muav Formation*. This rock layer averages 400 feet thick and constitutes a regional aquifer or water-bearing formation. It contains caverns created by percolating ground water which dissolves the limestone and carries it away. Fossil trilobites and brachiopods are common in this gray or buff colored rock.

A period of emergence from the sea and erosion of the land surface followed deposition of the *Muav Formation* leaving an unconformity. Channels or hollows formed on the erosion surface were later filled with a lavender-colored sea deposit called *Temple Butte Limestone*. The fossils of animals with backbones are found in this formation. Bony plates or scales of an armored fish were preserved along with corals and brachiopods. A pocket of *Temple Butte Limestone* occurs along the South Kaibab Trail.

After an erosion interval the next formation to be deposited was *Redwall Limestone*. Abundant fossils of sea creatures such as corals, brachiopods and crinoids (sea lilies) attest to its marine origin. The Redwall forms an impressive cliff averaging 550 feet high. Many caverns occur in this formation. The characteristic red color of the cliff is deceiving, for the natural color of the limestone is gray. The surface of the cliff is stained by red iron oxide washed down from the *Supai Formation* above. Where the overlying formation has been eroded away and no longer supplies the red "paint" *Redwall Limestone* weathers to gray.

Another erosion interval followed deposition of the Redwall and so another gap in the record exists. Then the land subsided and deposition of the *Supai Formation* took place. The limey lower part of this formation was probably formed in a shallow retreating sea, whereas the sandy upper parts were deposited by rivers. Land plants grew near the water.

Four-footed animals, probably amphibians which lived both in and out of the water, left tracks along the muddy banks of streams. The tracks were covered with sand, later cemented by water borne minerals, and hardened to rock. Erosion later exposed them to view. The bones of these creatures have not been found, but one can surmise a great deal about them from studying only tracks. The tracks are close together, indicating short legs. They are deeply pressed into the mud which later turned to rock, showing that the creature was heavy bodied. Between the right and left side tracks of one variety is a trace of a drag mark, indicating this creature

probably had a tail. Scientists theorize these animals looked somewhat like modern-day alligators or crocodiles. What do you think?

The *Supai Formation* appears as a stepped slope in the Canyon walls just above the Redwall cliff. It averages nearly 1,000 feet thick and is red because of the iron oxides it contains. Erosion altered the surface of the *Supai Formation* before the next rock layer was deposited, thus creating still another unconformity. Then *Hermit Shale* was deposited by freshwater streams as mud and clay. Iron compounds account for the deep red color which it shares with the underlying *Supai Formation*.

Mud cracks and ripple-marks indicate shallow water deposition. Fossils in this rock include delicate impressions of ferns, cone-bearing plants, and insect wings. The footprints of small salamander-like animals are also preserved. The formation averages 300 feet thick in eastern Grand Canyon and the fossils in it give evidence of semi-arid climate at the time of its origin.

Coconino Sandstone overlies the *Hermit Shale*. Windblown sand gathered into shifting desert dunes covering thousands of square miles. Cross-bedded layers of sand resulting from the shifting winds can be observed readily along all canyon trails. The formation is 300 feet thick in parts of eastern Grand Canyon and less than 100 feet in Grand Canyon National Monument to the west. *Coconino Sandstone* forms an imposing white or buff cliff about 600 feet below the rims of the canyon. Fossil footprints of primitive reptiles are preserved in the sand, and in a few places the trails of insects, scorpions or worms are found.

A warm shallow sea encroached upon the desert dunes eroding away their tops and flattening the surface. The *Toroweap Formation* consisting of red and yellow sandstones at top and bottom with a gray limestone between was deposited in this sea. The formation is more than 250 feet thick and contains fossils of brachiopods and mollusks which indicate abundant marine life. The *Toroweap Sea* retreated leaving this evidence of its passing.

Still another time marine waters inundated the Grand Canyon region; the *Kaibab Sea* advanced across the area. The uppermost 300 feet of rock in the canyon wall consists of a massive creamy-white limestone rock called the *Kaibab Formation*. It contains many fossils of sea organisms, mostly brachiopods but including corals, sea-lilies or crinoids, sponges and shark teeth. Today's rimrock, *Kaibab Limestone*, was the last formation deposited in this region during the

Paleozoic Era, Chapter III.

Chapter III came to an end about 230 million years ago! At that time the newly deposited *Kaibab Formation* was at or below sea level, but now it is as much as 9,000 feet above sea level in some places.

CHAPTER IV — THE MESOZOIC ERA

We have said rocks representing nearly 2 billion years and five chapters of earth history are present in the Grand Canyon region. Yet upon reaching the canyon rimrock of Chapter III we have more or less run out of rock! Rocks of Chapter IV, the Mesozoic Era, once covered this region completely in layers totalling perhaps 4,000 to 8,000 feet in thickness. These rocks have since been eroded away, but we know that they were here because remnants were left behind.

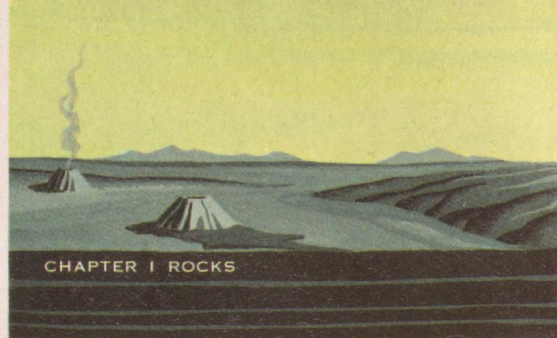
Cedar Mountain, near Desert View and the eastern boundary of the park, is such a remnant composed of red sandstones and shales of the *Moenkopi Formation* and capped by a resistant pebble-rock layer called *Shinarump Conglomerate*.

These rocks, and some others which formerly covered them, were nonmarine in origin. Some consist of riverborne mud and gravel, others of



THE SOLITARY MESA 2 miles east of the canyon rim near Desert View is Cedar Mountain. It is a remnant of the Chapter IV rocks which formerly covered this region. The bulk of the mountain is composed of easily eroded sandstone and shale, but a resistant pebble-rock cap has protected the softer material underneath. The gash in the plateau beyond Cedar Mountain is the canyon of the Little Colorado River.

These diagrams illustrate the most important geological events which have taken place in the Grand Canyon region. A story of 2 billion years of earth history has been reconstructed from evidence preserved in the rocks. Roman numerals indicate the Chapters in which the events occurred beginning with the oldest rocks and ending with the carving of the canyon.



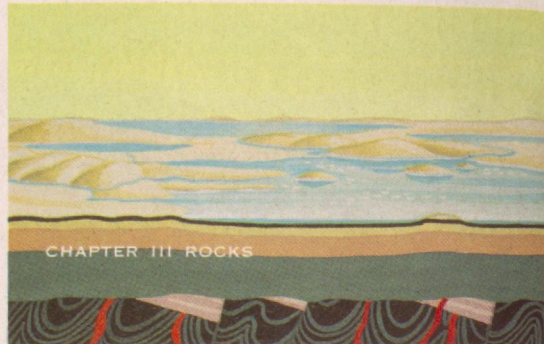
1. (I) Sediments and volcanic lavas accumulated in horizontal layers totalling thousands of feet in thickness.



2. (II) Rock layers were folded and metamorphosed as a mountain range formed. Molten material invaded from below.



6. (II) The mountains were eroded to a plain. Only wedge-shaped remnants forming ridges were left.



7. (III) Layers of sediment 4,000 feet thick were deposited. Erosion intervals occurred leaving gaps in the record.

windblown sand. Another remnant of Mesozoic Era rock forms Red Butte about 15 miles south of Grand Canyon Village. There a cap of Chapter V lava rock protected the softer material beneath from rapid erosion.

The Painted Desert to the east of Grand Canyon is formed in Chapter IV rock, and so are the Echo Cliffs and Vermilion Cliffs to the northeast. To the north Zion Canyon and the cliffs of southern Utah are carved in rock of this age. Is it so hard to believe these formations were once continuous and covered the Grand Canyon area?

The Mesozoic Era is known as the Age of Reptiles. This was the time when dinosaurs roamed the land. Tracks made by these creatures are found in the rocks near Tuba City on the Navajo Indian Reservation today. Chapter IV ended about 65 million years ago.

CHAPTER V — THE CENOZOIC ERA

During all of Chapter V the Grand Canyon region has been above sea level. Some freshwater lake deposits are preserved in surrounding areas but none in Grand Canyon National Park. In southern Utah the *Claron Formation* (formerly Wasatch) was deposited, later to be sculptured into

the colorful and fantastic forms visitors see in Bryce Canyon National Park.

The *Bidahochi Formation* was deposited east of Grand Canyon when the waters of the ancestral upper Colorado River were temporarily ponded. Other lake deposits of limited extent to the west of Grand Canyon also were accumulated during Chapter V. But the dominant process of Chapter V at Grand Canyon is the widespread erosion that has taken place. Thousands of feet of Mesozoic Era rock formations have been stripped away and, in the last few million years, the canyons have been cut and the earth sculptured as we see it today.

One last violent series of episodes took place, however. Starting slightly more than one million years ago, after Grand Canyon was carved to within 50 feet or so of its present depth, molten rock from deep in the earth spewed forth. Vol-

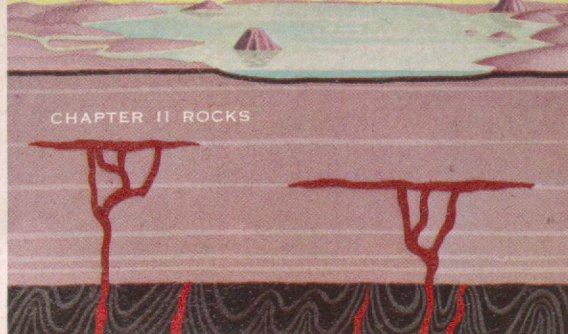
VULCAN'S THRONE across the canyon and the lava flow down the canyon wall were products of volcanism about one million years ago. The canyon has not grown significantly deeper since that time.



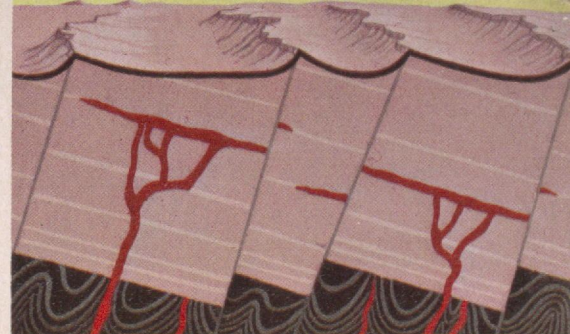
K. C. DEN DOOVEN



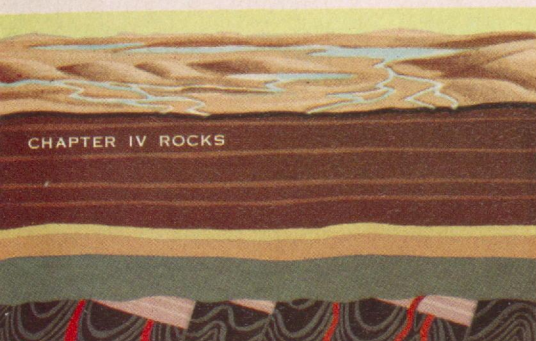
3. (I) High mountains were eroded to a plain near sea level. Only roots of mountains remained.



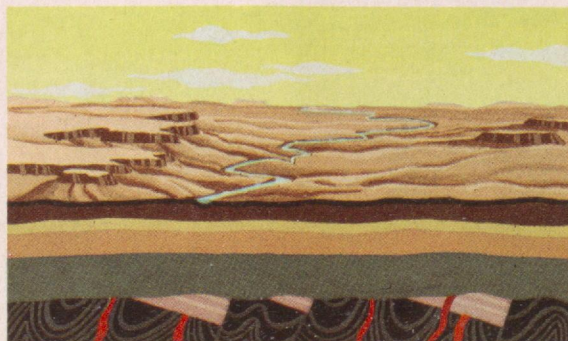
4. (II) The plain submerged, layers of sediment 12,000 feet thick were deposited, and molten material was injected.



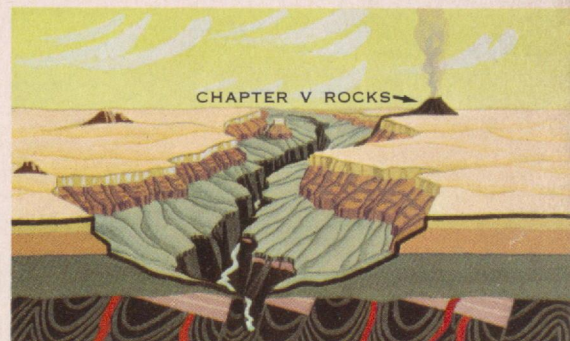
5. (II) Horizontal rock layers were broken and tilted as fault-block mountains were formed.



8. (IV) Sediments 4,000-8,000 feet thick accumulated covering the Chapter III rock.



9. (V) Erosion removed all but a thin covering of Chapter IV rock. Colorado River established westward drainage.



10. (V) Downcutting river exposed ancient rocks. Remnants of Chapter IV rock remained. Volcanism in last million years.

canoes were born; lava poured down canyon walls and dammed the river several times to create lakes. Water impounded behind the lava flows rose as high as 600 feet above the present level of the river. These eroded lava dams persist today as rapids in the western part of Grand Canyon.

Several periods of volcanic activity in this region are indicated by lava flows of different ages. South of Grand Canyon volcanism built the San Francisco Peaks and hundreds of smaller cones near Flagstaff, Arizona. The San Francisco Volcanic Field covers about 3,000 square miles. Indians were living nearby at the time of the most recent eruptions. Cinders and ashes from Sunset Crater covered their homes. The time of this event, determined by tree ring dating of timbers used in construction, was about A.D. 1064.

Chapter V is known as the Age of Mammals. Though evidence is scant we do know camels, horses, sloths and mammoths once inhabited this region and later became extinct. Today many kinds of animals are found in and around the Grand Canyon, but man is the highest form of life and among the most recent arrivals. He dominates the planet earth and turns resources to his benefit with an ever expanding technology.

Lest we think that nature no longer has a place in the scheme of things let us view man's time against the backdrop of 2 billion years of earth history recorded in Grand Canyon's rocks. To make the comparison readily comprehensible, compress the entire 2 billion years into one twenty-four hour day starting at midnight. Man is not

here for breakfast the next morning; the rocks of Chapter I are still being formed. By lunch time Chapter II begins and those primitive water plants called algae appear, but no man. At supper time Chapter III is underway and the seas teem with marine organisms, but no land plant or animal exists. As the evening hours pass, generations of amphibians, reptiles, pines and ferns live and die, and finally the dinosaurs become extinct as birds and mammals appear. The carving of Grand Canyon begins 7 minutes and 10 seconds before midnight. But ancient man does not enter the picture until about one million years ago on the African continent, or 43 seconds before midnight in the very last minute of our 24 hour day! Avoiding controversy over exactly when and where man first appeared, and his subsequent migrations, let us consider only his recorded history which spans the last 5,000 years. This interval makes up the last 1/5 second in an eventful 24 hours. Man hasn't really been around very long after all!

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Fossils

Ancient plant and animal remains or impressions preserved by any natural means are fossils. Even the hardened footprint or trail of an organism is a fossil. Some fossils are extremely small and can be studied only with the aid of the microscope, but others are very large indeed. A good example of the latter would be a dinosaur skeleton. Living things which have hard parts such as bones, scales or wood leave better fossil records than those which are soft.

One of the necessary conditions for fossilization is quick natural burial of the evidence to protect it from weathering or decay. Parts of actual remains may be preserved for long periods of time in some environments. After an organism is covered the process of petrification can begin. Ground water carries mineral material in solution which fills in pores or spaces and gradually converts the specimen to stone. Water may also dissolve the original substance and replace it with a different kind of mineral. Most fossils weigh considerably more than the original organism.

Imprints of leaves or animal tracks are preserved when the softer material into which they were pressed is hardened due to cementing by waterborne minerals and pressure from overlying rock. Pressure and movement in the earth's crust frequently distort or break fossils, making them more difficult to interpret.

A fossil record of life through the ages has been preserved in Grand Canyon's walls. Marine and freshwater sediments provided excellent environments for preserving evidences of life. The rocks at the canyon bottom are about 2 billion years old and have yielded no evidence of ancient life. The younger rock layers above them preserve traces of primitive plants. Still higher up the canyon walls the rock layers are progressively younger and the fossils they contain show the development of life from simple to complex forms.

Part of north wall of Grand Canyon viewed from Yavapai Point.

ERA

PERIOD

Mesozoic

Triassic

Paleozoic

Permian

Pennsylvanian

Mississippian

Cambrian

Late
Precambrian
(Algonkian)

Early
Precambrian
(Archean)

FORMATION



Reptile tracks in
Coconino Sandstone



Productid brachiopod
from Kaibab Limestone



Seedfern leaf and insect wing from Hermit Shale



Bellerophonid snail
from Redwall Limestone



Amphibian or reptile tracks
in Supai Formation



Arthrodiran fish plate from
Temple Butte Limestone



Trilobite from
Bright Angel Shale



Algal reef from
Bass Limestone



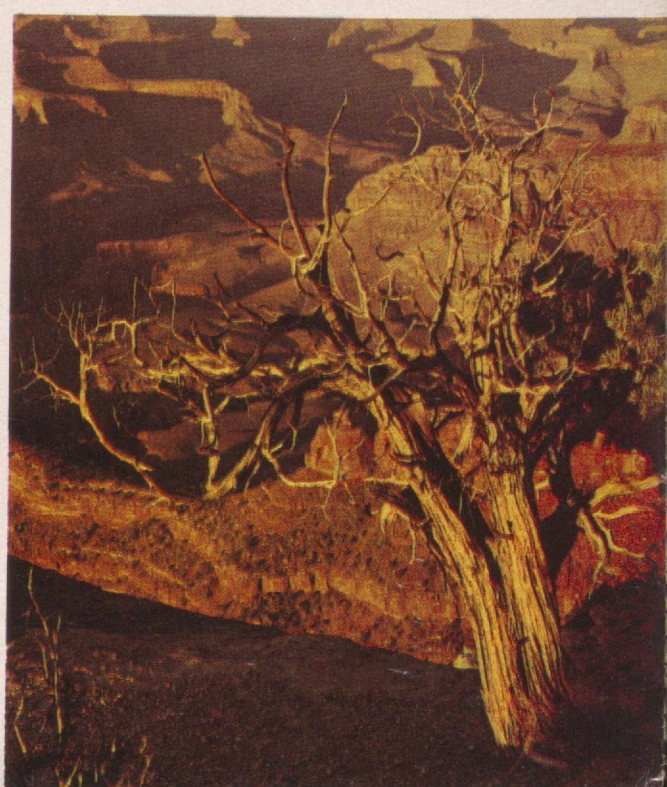
Modern algal reef from
Harpers Ferry, W. Va.

PHOTOS BY K. C. DEN DOOVEN



PHOTOS BY RAY ATKESON

CANYON MOODS vary with time of day, season of year and weather conditions. Scenery is at its best before mid-morning, at eventide, or after a storm. During the middle of the day lighting is rather flat and broken only by cloud shadows. In the evening dark shadows slowly climb canyon walls and an air of mystery and quiet prevails. Fine details of form and sculpture are accented through the interplay of light and shadow.



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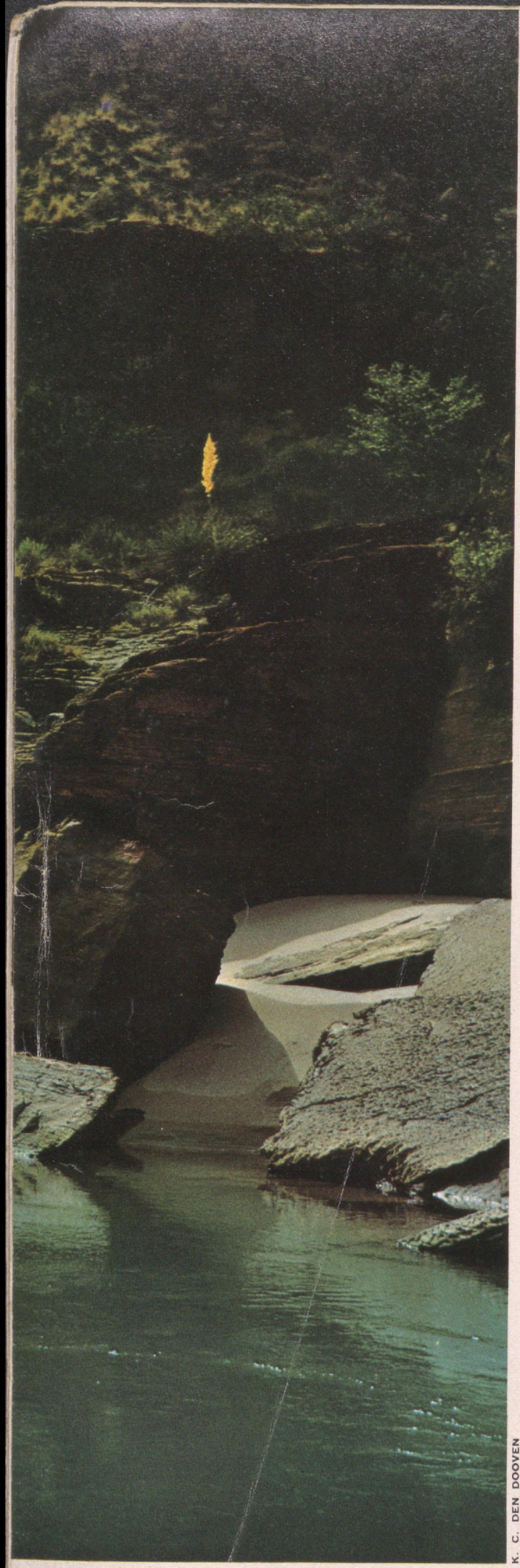
The Canyon Today

All elements of the Grand Canyon scene except the magnificent earth sculpture of ancient rocks are very recent indeed. Plants and animals give the landscape life and show the great diversity in Nature. And what a variety of life there is! A thousand species of plants are found in the park. Such large animals as Rocky Mountain mule deer, desert bighorn sheep, mountain lion, bobcat and coyote are found in the canyon or on the rims. These and smaller squirrels, mice, bats and other forms make a total of 67 kinds of mammals at Grand Canyon. The flashing wings and pleasant sounds of about 220 kinds of birds add interest to the canyon scene. Variety extends to the amphib-

ians and reptiles too, with 32 species listed.

Changes in elevation from plateau heights to canyon floor influence temperature and rainfall, and slopes vary in exposure to sunlight. Different climates or environments are thus created which in turn favor varied plant and animal associations. In the Grand Canyon region a 1,000 foot increase in elevation is roughly equivalent in effects on climate to a move northward of 300 miles with no increase in altitude.

The higher portions of the Kaibab Plateau north of the canyon have annual precipitation of 26 inches and support forests of spruce, fir and quaking aspen. Porcupines and spruce squirrels



A yucca blooms along the river.



Yellow flowers adorn a barrel cactus and also attract insects.

K. C. DEN DOOVEN



K. C. DEN DOOVEN

A watchful collared lizard on the canyon floor.



Mule de



Grand C



Mule deer browsing near canyon rim.

TAD NICHOLS



Female hummingbird at rest.

DAVE BEAL



Wild burros along the Colorado.

K. C. DEN DOOVEN

are common here and at slightly lower elevations where a transition forest of ponderosa pine is found.

The lower plateau and rim areas have average rainfall of about 16 inches yearly. They are covered with a pygmy forest of pinyon pine and Utah juniper. Change in climate is subtle but sure as one descends to the floor of the canyon to find a desert region with less than 10 inches of rainfall each year. Vegetation is sparse, but cactus, agave and blackbrush dot the landscape, and along stream courses willows and cottonwoods grow. The spotted skunk, pink rattlesnake and chuckwalla lizard inhabit the region.

The Grand Canyon region encompasses climates ranging from hot desert to arctic cold if the San Francisco Mountains, maximum elevation 12,670 feet, are considered. The vertical change in elevation from canyon floor to mountain peak exceeds 10,000 feet within a horizontal distance of 50 miles.

NATIVE AMERICANS

Canyon country is Indian country! Both prehistoric and modern Indian cultures are imprinted on this sculptured land. Hundreds of prehistoric Indian sites are found both on the rims and in the canyon. Tusayan Ruin near Desert View housed 25 or 30 people and was built about A.D. 1185.

Today Indians occupy much land around Grand Canyon. The Navajo live on a 15 million acre reservation which adjoins the eastern boundary of the park. The still partly nomadic Navajo are herdsmen who live in small groups grazing livestock over the far reaches of their reservation. Navajo ancestors migrated south from Canada. In



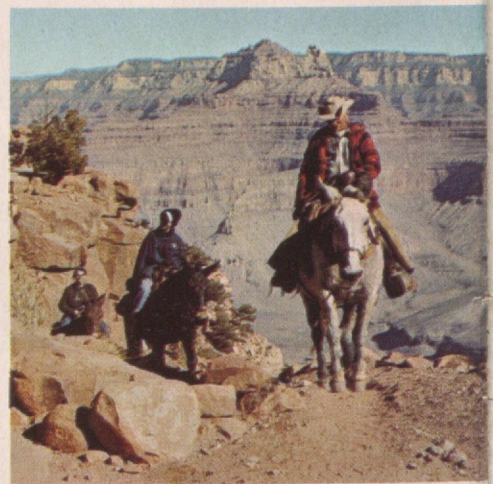
Grand Canyon rattlesnake, a subspecies of western rattlesnake.

F. R. GEHLBACH

NAVAJO FALLS on Havasu Creek in the Havasupai Indian Reservation. Running water carved this side canyon, but the water also carries limestone in solution and deposits it to build colorful travertine formations about the waterfall and in the stream.



MULE RIDERS ascending the South Kaibab Trail on a cool November morning. Hikers and riders find a different world below the canyon rim.



RAY MANLEY

DAVE BEAL

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the center of Navajoland lies the 631 thousand acre Hopi Indian Reservation. The Hopi people are farmers whose ancestors occupied the northern southwest for many centuries. They live together in villages. The Hopi pueblo of Oraibi is about 800 years old.

About 200 Havasupai Indians live on a small 518 acre reservation in a side canyon 35 miles west of Grand Canyon Village. Their steep-walled canyon home is accessible only by trail. Fertile fields are watered from spring-fed Havasu Creek. The name Havasupai means "people of the blue-green water," and relates to the color of the stream. Waterfalls and delicate terraced pools along the creek add to the beauty of this canyon retreat.

EARLY SETTLERS

Explorers made the great canyon known and soon prospectors began the search for precious metal in the ancient rocks exposed by erosion. Real treasure of the kind they sought eluded them.

The first mining and tourist developments at Grand Canyon were made near Grandview Point. John Hance arrived about 1883. He scratched a crude trail to his asbestos claims at the canyon bottom, built a cabin on the rim, and by 1886 was advertising guide service for visitors in the Flagstaff newspaper. His were the first tourist facilities. Only a short time later William Wallace Bass began a similar type of operation at Havasupai Point about 30 miles west of Grandview.

W. H. Ashurst, Pete Berry, Ralph and Niles Cameron and others located copper claims on Horseshoe Mesa in 1890-91. They built the Grandview Trail and hauled out ore with pack animals. Members of this same group of pioneers also improved an old Indian path 11 miles to the west which led to Indian Gardens, and named it the Bright Angel Trail.

A hotel was built at Grandview Point in 1892 and stagecoaches started passenger service from Flagstaff the same year. The fare was \$20. The Santa Fe Railroad reached the South Rim in 1901. New facilities were developed at the railhead and Grandview's popularity waned. Grand Canyon Village became the center of activities.

Opportunities were available then, as now, for visitors to satisfy their desire to see the canyon's moods and features from rim drives and along inner canyon trails. Canyon hiking or mule travel has provided many memorable experiences for adventurous visitors.

In recent years flights over and into the canyon and boat trips down the Colorado River have become readily available. The traverse of Grand

Canyon by boat is a superb adventure requiring about 10 days time and a love of the great outdoors. The unknowns, fears and dangers faced by Major Powell and other river running pioneers are greatly reduced by competent expedition leaders and improved equipment, but the thrills and scenery remain.

ESTABLISHING A PARK

Pioneers gained a foothold at the canyon and worked to develop its mineral, forest and recreation potential, but the movement to preserve the canyon for all the American people started elsewhere.

Senator Benjamin Harrison, of Indiana, introduced bills to make Grand Canyon a National Park in 1882, 1883 and 1886. All failed because of opposition by those who feared economic interests would be damaged. But Harrison was persistent, and in 1893, as President of the United States, he established the Grand Canyon Forest Reserve by Proclamation. The area remained open for mining, lumbering and hunting.

President Theodore Roosevelt visited Grand Canyon in 1903 and was inspired by his experience. Later, in 1906, he established the Grand Canyon Game Reserve for protection of wild animals as well as the land. In 1908 Roosevelt established Grand Canyon National Monument.

An Act of Congress establishing Grand Canyon National Park was signed by President Woodrow Wilson on February 26, 1919. A new Grand Canyon National Monument adjoining the park on the west was established by President Herbert Hoover December 22, 1932.

Far-sighted men have played important roles in making Grand Canyon available to all people as part of our national heritage. After his first trip to Grand Canyon Theodore Roosevelt said: "*Do nothing to mar its grandeur . . . keep it for your children, your children's children, and all who come after you, as the one great sight which every American should see.*"

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- KOLB, E. L. *Through the Grand Canyon from Wyoming to Mexico*, The Macmillan Company, New York, 1914.
- KRUTCH, JOSEPH WOOD. *Grand Canyon*, William Sloane Associates, New York, New York. 1958.
- LEYDET, FRANCOIS. *Time and the River Flowing*, Grand Canyon, Sierra Club, San Francisco, California. 1964.
- LOWE, CHARLES H. *The Vertebrates of Arizona*, The University of Arizona Press, Tucson, Arizona, 1964.
- PEATIE, RODERICK. *The Inverted Mountains*, The Vanguard Press, Inc., New York, 1948.

BELOW the South Rim overlooks, out of sight except for an occasional glimpse, the Colorado enters its Upper Granite Gorge, where stark black walls meet rushing water for forty miles.



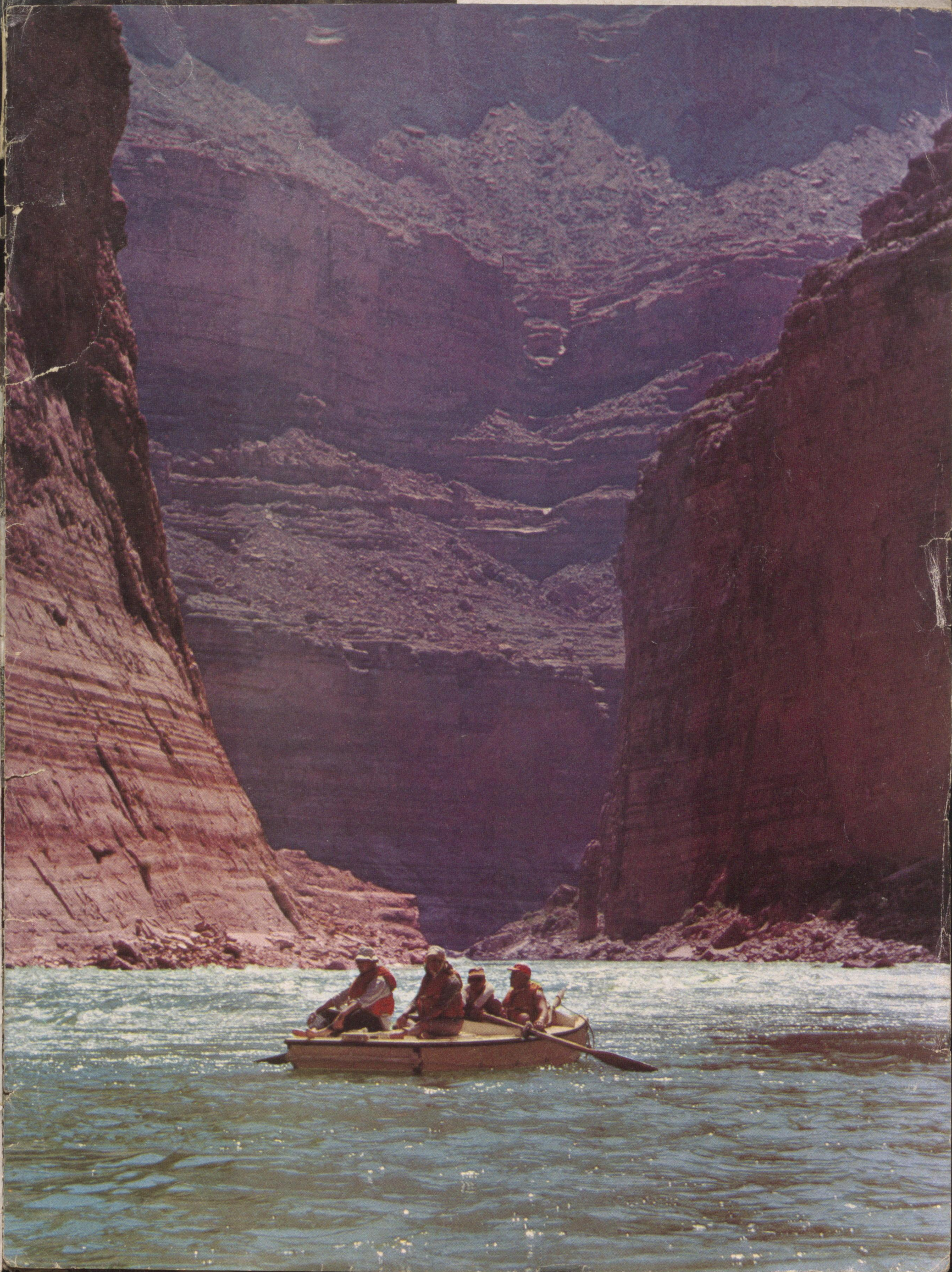
PHOTOS BY K. C. DEN DOOVEN

THE RIVER LIES *in sandstones and limestones along much of its way. Here the rocks, being more easily cut away, impede it less, and it runs still with urgency, but with less turbulence.*

The River Below

Not content with what it has already achieved, the great river rasps and chews the hard floor of the inner gorge in which it has trapped itself, committed to cut away the remaining half mile down to sea level. Tributary drainages bring boulders and sediments into the relentless flow, providing it always with the grinding tools it uses to cut ever deeper. Where these materials cannot be used as fast as they are brought to the river the water tumbles over and around them, forming rapids that offer challenge to venturesome individuals.

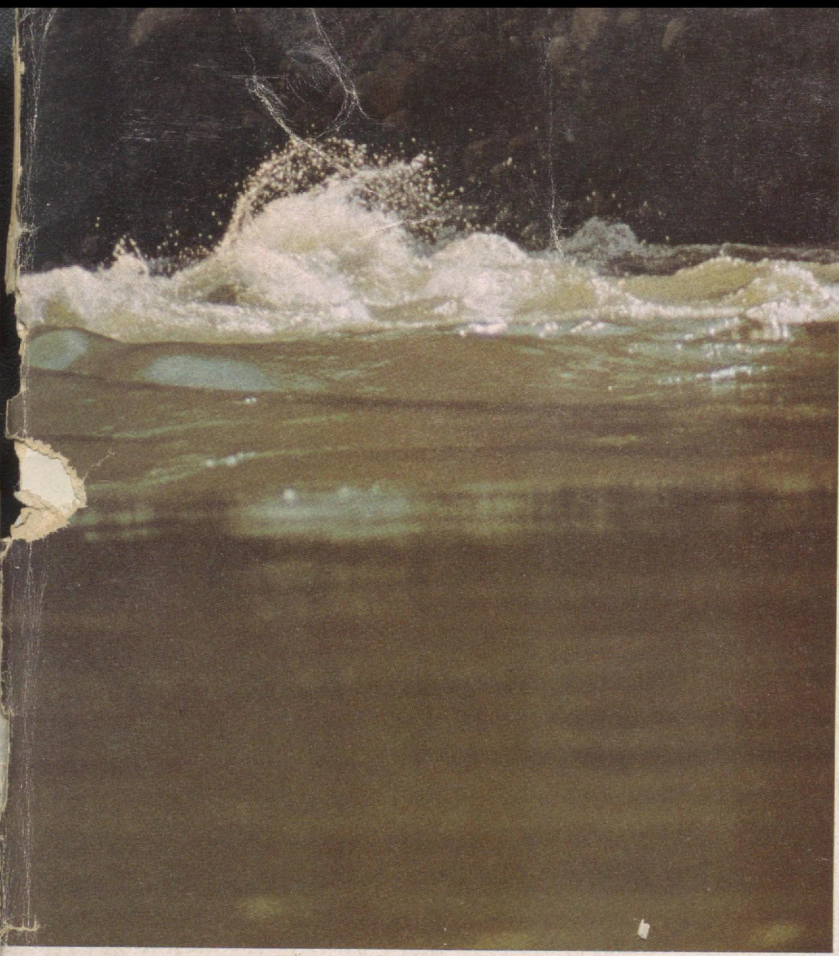
Through the spring and summer months hundreds of men and women join the boating expeditions through Grand Canyon offered by experienced river guides. The depths of the inner gorge offer a perspective of Grand Canyon not attainable in any other way, and a new awareness of the power of the great river.





PHOTOS BY K. C. DEN DOOVEN

THE ALMOST IRRESISTIBLE *force and the nearly immovable object. Grand Canyon thunderstorms change the landscape a particle at a time, carrying it away in rivulets of rain that form tributaries rushing to the river.*



PRESSED AGAINST ITS BED and confined between its banks, the confused water of a rapid can only escape upward in the form of turbulence as it seeks to surge through a boulder-filled channel. Each rapid has its own voice, determined by the width, depth, and speed of the water, and the nature of the obstructions in the river's way.

IN THE SOMBER Inner Gorge the world of a boating party consists only of sky, rock, water, and the sounds of the working river.



IN PLACES THE CANYON has cut through rock layers holding underground watercourses, liberating them to create oases of lushness as they tumble to join the river. This is Thunder River, one of several cold, clear streams that have their origins in the rock layers of the North Rim.



Visitors listen attentively as a park naturalist relates *The Grand Canyon Story* at Yavapai Museum.

K. C. DEN DOOVEN

The People's Heritage

There is still much man can learn from nature if the great outdoor laboratories can be preserved unimpaired. And there is much man can learn about himself. We are told that human judgment is based upon comparisons or matching. Therefore judgment can be no better than the experience upon which it rests. If men are deprived of the opportunity to witness natural beauty, observe native plants and animals, study undisrupted geologic features and processes, breathe clear air or drink unpolluted water, then how good will their judgment of such things be?



Sunset at Hopi Point.

RAY ATKESON

Americans of today must provide coming generations opportunities to experience nature. We are obligated to preserve natural wonders such as Grand Canyon for the people of the world. This wonderful heritage of ours involves great responsibilities towards men of the future as well as great opportunities for us today.

You have seen Grand Canyon, with your mind as well as with your eyes, but do not fail to use other senses while you have the opportunity. Go out along the Canyon Rim alone to watch dark shadows climb the colored walls as the sun drops to the horizon.

Think about the eons of time represented by rock formations exposed to your view, and the fossil record of life through the ages they contain. Feel the bite of the wind on your cheeks and listen for the sound of distant rapids on the river far below. Finally, dwell for just a moment on thoughts about yourself and the role you play on this earth. If you don't come away from such an interlude with a better understanding of nature and yourself you will miss a large part of the precious gift your National Park preserves for you.

A BLANKET OF FOG from the valley of the Little Colorado River flows over Grand Canyon's rim and dissipates as it meets warm air rising from the canyon floor. Flat-topped Cedar Mountain juts up through the fog and the San Francisco Peaks rise in the distance. PHOTOGRAPH BY JIM TALLON

TOROWEAP OVERLOOK in Grand Canyon National Monument offers wilderness solitude and dramatic views of the Colorado River 3,000 feet below. PHOTOGRAPH BY RAY MANLEY

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