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Exploration

REVIEW

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IMPERIAL COLLEGE EXPLORATION SOCIETY

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EXPLORATION REVIEW *No. 6* *1965*

JOURNAL OF THE IMPERIAL COLLEGE EXPLORATION SOCIETY

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FOREWORD

IT gives me great pleasure to contribute a foreword to this issue of *Exploration Review* because, as a member of the College Governing Body, I take a special pride in the achievements of the College Exploration Society. Also, there are few, if any, university exploration societies with a better record of achievement or a wider field of activity.

Looking over the contents, and being somewhat involved in another capacity, I instinctively turned to future events and it was good there to see four expeditions planning to go to Africa. On my own annual visits to East Africa and the Sudan of recent years, I have been struck by the very encouraging welcome given to such expeditions where scientists and technologists are concerned. This is partly because much of the work they do is, or could be, directly helpful. It is also because such expeditions often offer a chance to African students to join in, and because there is the possibility that a member of an expedition, scientifically or technically trained and attracted by a continent in the throes of tremendous and exciting (if sometimes too exciting) change, might be willing to return one day for a year or two to lend a much-needed hand in development plans or university teaching.

But as I said at the start of this foreword, one of the best things about the Exploration Society is the wide field of activity covered by its annual programme. This is fully reflected in this issue of *Exploration Review* into which go all my best wishes for I.C. Exploration 1965.

L. P. KIRWAN
Director and Secretary,
Royal Geographical Society.

EDITORIAL

THIS is the tenth year since the founding of the Imperial College Exploration Board and during this period forty expeditions have been officially supported. The experience and training gained by those who have taken part owes much to the keen interest and support of the Exploration Board and especially to its chairman, Mr. A. Stephenson.

To many members of the College, the Exploration Board has little significance and is often regarded as a synonym of "Exploration Society". To emphasise the difference, a short article on the organisation and functions of the Exploration Board has been included in this issue. It is to be hoped that this will help to convince the would-be expedition organiser of the unique opportunity provided by the College for the support of expeditions.

Last year only two expeditions availed themselves of this opportunity—the Gicce Cokka Ice Cap Expedition and the Cornwall Underwater Expedition—accounts of which are included in the following pages. This represents a considerable drop from the seven expeditions which were supported in 1963, a fact which was commented upon in a memorandum to the Press giving details of the expeditions supported by the Royal Geographical Society during 1964. The Royal Geographical Society has supported many I.C. expeditions and we are indebted to them for their keen interest in student expeditions. It is perhaps significant that Mr. L. P. Kirwan (Director and Secretary of the Royal Geographical Society) has kindly contributed the "Foreword" to this issue.

The problems of expedition organisation cannot be over-estimated and an assessment of the effort involved is given in an article by Andrew Wilson (President, I. C. Exploration Society, 1964-65). Much of this information cannot be included in accounts of specific expeditions which form an integral part of the "Exploration Review". Six articles have been devoted to 1964 expeditions and we particularly welcome those submitted by our guest contributors.

It is this exchange of ideas and experiences that will lead to more successful expeditions in the future. The enthusiasm of the experienced man will stimulate interest in the expedition leader of tomorrow. The "Exploration Review" seeks to convey this enthusiasm to its readers.

PRESIDENT'S REPORT

March 1965

LAST summer saw an all time low in the number of expeditions leaving I.C. for distant shores. Since the inauguration of the Exploration Board at least three expeditions a year have built, brick by brick, I.C.'s reputation in the field of exploration. This year only one expedition left the U.K. — an expedition which did, however keep up the high standard of I.C. expeditions.

This lack of expeditions is not being compensated for by the number of expeditions which are going out this coming summer. Four expeditions are going to Africa, while another three that were talked about last year died in the planning stage. It is interesting to note the shift in emphasis from the Arctic to Africa, and the proposition of new subjects in the history of I.C. expeditions — social geography and sociology. Let us hope that this diversity of interests will continue, without the college losing any of its old fields of activity.

The main objects of the I.C. Exploration Society are to foster an interest in exploration, and to give members an opportunity to meet experienced expedition personnel, and to glean information from these same. To this end, the first meeting was an informal discussion with two expedition leaders talking about one of the main problems of expeditions — travel. This gave new members an opportunity to meet the old lags straight away, and get talking to them.

Since that successful first meeting, the meetings have had mixed receptions. The better-known speakers have had full houses — audiences of up to 150 people, while other speakers, often more entertaining, have had audiences of as little as sixteen. The speech on 'Survival' by the then Captain Young, had the audience enthralled, and I have since met many people that have been bitterly disappointed at having missed a brilliant, unforgettable speech. Those of us that entertained him to dinner, and in the bar afterwards were doubly lucky. The meetings in the first term were made up with an evening of films, a joint meeting with the Underwater Club on the Cornwall Expedition, and another joint meeting with the Mountaineering Club when Malcolm Slessor gave a most enjoyable talk on his experiences in the Andes.

If interest in the Society, and growth of the Society is any gauge to go by, I feel that we may be on the verge of another heyday of exploration in I.C., and the number of expeditions in any one year may soon rise again to the peaks of nine in 1960, and seven in 1963. The College has a good name in exploration. It has the personnel, the organisation and the initiative to obtain an even better one.

IMPERIAL COLLEGE EXPLORATION BOARD

THE Exploration Board was founded in 1955 through the enterprise of a group of students planning an expedition to the Karakoram Himalaya. They approached the Rector for support and he, realising the value of such ventures, persuaded the Board of Governors to make available a grant of £5000 for the support of expeditions. The I.C. Union Council responded with a grant of £1000. The Board was then set up, under the sponsorship of the College, the Union and the Old Students' Association to administer these funds. After the success of the Karakoram Expedition, the Board was established on a permanent basis with the College authorising an annual grant of £1000 and the Union £300 per annum.

Each of the sponsoring bodies is represented on the Board. Its Chairman, Honorary Secretary, and Honorary Treasurer are appointed by the Rector. Three members of the academic staff and one representative each from the Imperial College Union, the Constituent College Unions, the Old Students' Association and the Exploration Society complete the Board's membership. The staff and students are thus represented on the Board in roughly equal numbers. All members are interested in exploration; some are experts in allied topics and many have taken part in expeditions themselves. That the Board's Treasurer is Mr. Annas, the College Accountant, is particularly advantageous.

The Board's functions are to consider proposals for expeditions submitted by members of the College, and, if they are suitable, to recognise them as official College ventures. When studying proposals, the Board is primarily concerned in satisfying itself that the party is capable of carrying out its proposed aims in safety and that the project is feasible and worthwhile. No expedition is allowed to use the College name unless it has the approval of the Board. In most cases, recognition carries with it a grant towards the cost of the expedition, though all members must make a minimum personal contribution of £50. Due to the high reputation that the Board has built up over the years, the hallmark of approval is now frequently taken by grant-giving bodies as evidence of the satisfactory nature of the project under consideration. The Board automatically insures every member against accident and medical expenses and also insures all equipment. The Board also maintains a store of equipment for loan to expeditions. On return, all expeditions produce a preliminary report and later a final report on their activities and project.

The Board meets several times a year to check the progress of expeditions it approves. Recognition of expeditions is made at the December meeting. Provisional approval may be sought before this and provides a useful opportunity to seek the Board's criticisms and advice on a proposed project. These expeditions provide invaluable opportunities for gaining experience in organisation and in living and working with other people in frequently strenuous conditions. When considering proposals the Board takes this as well as the scientific value into account. On the whole, the Board aims at supporting something between straightforward scientific research on the one hand and adventurous travel on the other.

The Board is now almost 10 years old and in that time it has approved 40 expeditions.

A PERSONAL SURVIVAL KIT

You'll never need this, of course . . . *however.*

By Major Keith D. Young, U.S.A.F.
Commander, Combat Survival Centre, Ramstein A.B., Germany

IT is true, of course, that on any well-planned expedition or journey there should never be those departures from the normal or routine which are sometimes spoken of as adventures. Nevertheless, these unplanned happenings occasionally do take place, with sometimes disastrous results. In the military it is the constant task of all commanders to anticipate the unusual or unexpected, and to make adequate provision for it. Similarly, any expedition which sets out with utter faith that nothing whatever could possibly go wrong may indeed find that faith upheld. It may, on the other hand, discover that while it is Man who proposes, it is God who in fact disposes.

As one who has discovered this fact the hard way perhaps I may be permitted to help others profit from my experiences? The very plural I deliberately choose to employ in the foregoing sentence may be taken as evidence that it sometimes requires more than just one experience before the lesson is learned. In fact, it has been my observation that a genuine ability to learn from experience — one's own, or that of others — is really one of the rarest of human characteristics.

My purpose in this article is to suggest a number of items which may be compiled into a small, light and extremely portable kit for use in certain terrestrial emergencies. Such emergencies may never occur, of course. Still, how much better to *have* a kit to cope with such emergencies and not be required to use it, than not to have it and most desperately need it.

Container

Seems obvious, doesn't it? Yet this is one item that demands considerable forethought. Even the most primitive races, when they had painstakingly gathered a few pitiful possessions together, found it essential to devise some sort of container in which to carry their treasures. It may have been the carefully removed and treated hide of some small animal. Or it may have been a similarly treated internal organ, perhaps a stomach or bladder. But, the need being present, the container had to be created. If the twin aspects of size and lightness are borne in mind when procuring this basic ingredient for a fully portable Personal Survival Kit, it is best to settle for something which is no larger than perhaps a cigar box (not recommended as a container, by the way) or an average novel. That is to say, having dimensions of no more than 8 inches by 6 inches by 2 inches. Anything larger than that (such as the backpack beloved of some), and bang goes much of the desired lightness and portability. Frankly, the best container I have found which conforms to most of the above desiderata is an extremely common (in Germany, anyway) aluminium sandwich container into which, though there are much less than 50 cubic inches of space, I have contrived to pack some 30 items which I hold to be either essential or highly desirable. Let me list some of them.

Matches

If we accept that the answer to the usual survival problem is rescue we must also understand that the key to rescue is communications. Since it is most unlikely that the ordinary civilian survivor will have with him at the time of his emergency any of the sophisticated, electronic devices which are today an integral part of the combat flyer's survival kit, it becomes apparent that some simpler form of communication ought to be carried at all times. Fire is one of the simplest forms of communication; fire which is most usually created by matches although there are, of course, a number of other methods of inducing combustion. Since most of these depend on the possession of not easily acquired skills, it is infinitely simpler to carry matches. The matches carried should be waterproofed and should be carried within a container inside the main container. It is by means of the survivor's ability to procure fire that he gives himself the best chance of survival in most situations. In most survival tragedies it was not starvation or thirst which killed the survivor but most usually exposure. Thus, the matches you have with you furnish you not only with the means to communicate, but also with the most simple means of protecting yourself from killing exposure. Never, even if you are a non-smoker, be without matches.

Communications

Although fire is the answer to most communication problems in survival situations, there are certain other means of signalling which are sufficiently small to be included in a Personal Survival Kit, and which ought to be mentioned here. The first of these is the Pen Gun Flare Pistol, now a standard item carried on the person by most U.S.A.F. aircrews, as a supplement to the larger Day-Night Flares carried in their seat packs. The Pen Gun, which is illegal in a number of countries, is an amazingly compact signalling device which shoots a flare (red, white or green) approximately 300 feet in the air. Its size (about the same as a fountain pen) permits it to be carried within a Personal Survival Kit and it is simplicity itself to operate. Another most useful signalling device — so useful that it is credited with the rescue of more than 60% of peace-time aircraft emergency survivors — is the signal mirror. The R.A.F. has one of the best of these, and they may be available in some Army-Navy Stores; however, failing this, either a stainless steel shaving mirror or the small glass mirror from a woman's compact should be included in your kit. Still another signalling device worthy of inclusion is a whistle; plastic, steel or brass, it doesn't really matter which, just so long as it makes the shrillest and most penetrating noise possible.

Knife

This is one of those items in daily use to which we have grown so accustomed that we tend to take its possession for granted. You doubt this? Very well then, try this little experiment. Try to get yourself through an entire day (24 hours) without using a knife of any description. If we extend the word 'knife' to include *any* cutting edge you'll probably find yourself in trouble almost from the moment you get out of bed. For the first thing to go by the board would be your razor, electric or conventional. It's a cutting edge, isn't it? Next, breakfast. No trouble with the cereal, of course, but let us see you convert that bread into manageable slices without a knife. It comes sliced from the baker. All right then, kindly demonstrate how you propose to go about spreading your slice of bread with butter and marmalade, or even helping yourself to a suitable pat of butter from the half pound block. With your fingers, you say. How disgusting! Still, you are probably coming to realise at this point just how necessary a knife (or cutting edge) really is. No need to belabour the point. Though you cannot eat a knife, or steer a course with it, or sleep under it, a good knife is an absolutely necessary item in any survival kit. It need not be one of those multi-bladed horrors beloved of Boy Scouts. Neither does it even have to be a large and heavy sheath knife, (which is all too often misused as an axe and thus soon ruined). For a portable, pocket-fitting survival kit my strong recommendation would be for a simple two-bladed knife of the folding variety, manufactured by a really reputable cutler and containing only the finest steel, something, that is to say, that will take an edge time and time again. It is this ability which distinguishes the useful from the useless, for most, if not all, of the cheap blades can never replace their pristine cutting edge once it is lost. One last word. Purchase, with the knife you select for your Personal Survival Kit, a commercially manufactured sharpening stone — and learn how to use it properly.

Compass

Although in the majority of genuine survival situations rescue provides the solution to the survivor's problems, there may be occasions when the possession of a compass could quite simply prevent any given situation becoming a survival situation. Remember though, should you become lost, no compass, no matter how expensive, can tell you precisely where you are or exactly which way you should go. What it can do, however, is enable you to proceed in a straight line — assuming that the terrain permits such — which is an almost impossible feat for the compass-less survivor. It is not within the scope of this short article to treat the matter of navigation, but rather to urge the inclusion of an appropriate compass in any survival kit. By appropriate is meant simply a magnetic compass of a size sufficiently large to be easily read, and of responsible manufacture. Commonsense will suggest the most convenient size for inclusion in your kit. Suffice to say that it ought not to be too large, but neither should it be too small. The temptation to slip an Escape and Evasion button compass, a ¼inch or so in diameter, in your kit must be resisted. These are much too difficult to read under field conditions. I would suggest therefore the smallest practical size be not less than the diameter of a shilling. As to reliability, let your local jeweller be your guide in this matter, not the proprietor of your neighbourhood toyshop where "compasses" may also be purchased.

Food Procurement

Although I have mentioned earlier that seldom if ever do survivors — U.S.A.F. survivors of aircraft emergencies, that is — perish from food or water deprivation, it would be fatuous to pretend that these are not problems. Of course a man must eat and drink if he is not to die. But procuring these comestibles and potables under survival conditions is usually something of a problem. However, outside of true desert or the Polar ice cap itself, there are very few places in this world which are not capable of furnishing subsistence of one sort or another to those who are determined to obtain it. Among methods of food procurement commonly employed by survivors, are trapping, snaring and fishing. Again, for reasons of space, I shall not go into actual techniques — though any number of publications, Boy Scout Handbooks etc., contain a lot of useful information in this connection — but will confine myself to urging that in this Personal Survival Kit ought to be a simplified fishing kit made up of such things as hooks, lines, flies, sinkers and spinners. Also a small roll of flexible brass or copper wire for the manufacture of simple snares should be included. Do keep these simple. And do take into account the habits as well as the habitats of the particular small game you are out to get.

Self Medical Aid

It should be quite obvious that in a container no larger than a cigar box it will not be possible to pack more than just a few essential medical items. The question, therefore, is what is essential. Or, stated another way, what is not essential. Since the pros and cons of this could be argued indefinitely, perhaps my most useful contribution might be to list some of the things I carry in my own kit. Among these things are a small bar of soap (not for the cleansing of my body in a survival situation but for the cleansing of small scratches and cuts which, if uncleansed, particularly in the tropics, rapidly become infected); a square of camphorated ice (with which to inhibit the formation of cold sores on the lips or of fissuring of the lips under certain weather conditions); a combined surgical dressing and bandage (for the better control of open, more serious wounds than the cuts and scratches earlier mentioned); water purification tablets (just one proper case of dysentery is more than enough to make a believer of most people); surgical needle, sutures and tweezers (for repairs to the epidermis requiring a bit of stitching. The tweezers? Two reasons for their inclusion: (1) so that asepsis may be preserved by boiling both needle and tweezers (in the aluminium container, naturally), and (2) because the human epidermis is so extraordinarily tough that tweezers would most likely be essential for the actual needlework. Salt tablets (for use in the tropics mainly, where a salt deficiency induced by copious perspiration can have rather drastic effects) and a tooth brush (a morale item, really, but included here because there just isn't any adequate substitute for a toothbrush) are also included. Now I do happen to carry a few other items, analgesics and so forth, but since I have no wish to prescribe without a licence to do so, may I suggest that you obtain from a medico of your acquaintance a few suggestions as to what might be usefully included in your own kit?

Now this by no means exhausts the subject of what constitutes the most practical sort of Personal Survival Kit. The few items I have mentioned above will do, however, as a starter to nudge you along the road to making up your own kit. Do try and keep its contents down to essentials only, stark necessities, as it were. This means there is no place in your kit — though these may of course be carried elsewhere on your person if you so desire — for such unessential items as, for example, cigarettes, sweets of various descriptions and, if I may be pardoned the indelicacy, rubber contraceptives (which always seem to be included in the kits of enthusiastic amateurs, "for the storing and carriage of water, of course," but in which capacity they are quite useless).

Anyway, do make every effort to keep your kit simple. Resist staunchly the temptation to stuff into it any of a number of colourful, attractive, but not strictly essential items. This would include the cigarettes, sweets and so forth mentioned earlier, though I ought to mention that I have no objection to such things (packets of cigarettes, slabs of chocolate, etc.,) being carried elsewhere on the person. Your kit has room for essentials only, not comfort items which are nice to have but contribute little if anything to safeguarding, if not actually saving, your life. And saving your life is really the whole purpose of the kit. Remember that when you boil it all down what it amounts to really is this: only a few items are really essential in any survival situation — but how essential those few items really are!

To sum up, I would urge you not to plan too far ahead but rather allow the terrain, climate and availability of local knowledge of the particular area in which you propose to field your expedition, determine more exactly what ought to be included in your kit. To be prepared you must, of course, go prepared — as I am sure you all will.

STUDENT EXPEDITIONS AND GLACIOLOGY

By G. R. Elliston

DURING the last thirty years there has been something of an "Expedition Explosion", following one of those now familiar exponential growth rates, during which the number of student expeditions has risen from an average of three a year in the early 1930s, through ten a year in the early 1950s to forty a year at present. Most student expeditions begin during a conversation over coffee when two or three friends decide to visit some area in which they have a mutual interest. But although the flippant statement "Because it is there" may seem sufficient justification for the trip to them, and makes a convenient retort to silence an importunate newshound, it is too self-centred an aim to attract financial support from charitable trusts and industry, without which the journey would be impossible. So the search begins for a "scientific programme". Expeditions visiting high altitudes or latitudes may consider including glaciology in their work but probably have only a hazy idea of what work this entails, and this article is aimed at helping them in the early stages of planning.

The first point to realise is that glaciology is not one scientific discipline but the meeting-point of many. Even if we ignore permafrost, sea-ice and ice-sheets, and limit our attention to valley glaciers, the problems that remain involve the skills and tools of not only the geographer, geologist and meteorologist but also the mineralogist, metallurgist, physicist, chemist, botanist and some branches of engineering. It is precisely because it is such an all-embracing subject that contributions can be made by "amateurs" working from their own special disciplines.

The meteorologist begins by measuring the precipitation which feeds the glacier, but because of the uneven deposition of drifting snow on an undulating accumulation area, very many measuring points must be taken to get a true picture. Also, accurate measurement of snow densities must be made down to values as low as .005 gm/cm^3 for freshly fallen snow. In the northern hemisphere the season of greatest accumulation does not coincide with our long vacation, but it is otherwise in the southern hemisphere, and very special problems arise on glaciers close to the Equator which are subject to two Monsoons a year.

It is not necessary to live on a glacier for a whole year to ascertain the net accumulation (that which is left after melting) in the snowfields; deep pits or cores taken with boring tools can be used to expose the layers of snow deposited in previous years, usually separated by identifiable layers of wind-blown summer dirt. The density of the snow can be determined, and a botanist may be able to use entrapped pollen grains to establish the season in which a given layer of snow was deposited; even the particles of rock dust may be usable, particularly if they contain volcanic ash which can be identified as emanating from a specific eruption, giving a precise date from which the age of deep layers can be fixed.

The meteorologist is also concerned with the problem of ablation (loss of ice or snow). Even if his visit to a glacier is too short to measure the total net loss of ice in one summer, he may be able to ascertain the rates of loss for different altitudes

and aspects at different months, which is not too difficult for inexperienced men.

The snow crystal is transformed into an ice grain, which itself grows at rates dependent on the temperature, the degree of stress present in the ice and its age: from an initial size of perhaps 0.1 cm it may reach 20.0 cm across in old stagnant ice at the end of a long glacier. Because of grain behaviour being dependent on temperature and stress, it has been studied by mineralogists interested in the slow changes that take place in a crystalline material near its melting point. The movement of the glacier is made possible by the re-arrangement of the grains, their deformation by sliding along the basal planes within the crystal and the growth of some crystals at the expense of others where the stress-pattern is uneven over a short distance, and some metallurgists have used glaciers as examples of materials creeping under heavy loads at high temperatures.

Geologists find a comparison useful between the deformation of rocks over a long time scale and the faulting, overthrusting and folding measurable in glaciers. In an area of strongly deformed ice the geologist, physicist and metallurgist may combine to map the structure and compare it with the orientation and size of crystals at each part of the pattern, and measure the movement and rate of strain at many points. The pattern, size and depth of crevasses can be compared with the measured strain-rates to test current theories on crevassing and the tensile strength of glacier ice.

Geographers and engineers with training in surveying can map both the position of the terminus and the snow line, and can level profiles across and up the centre line of the glacier to establish the surface height. It is of the greatest importance that these measurements be linked to at least three permanent reference points so that in later years the measurements can be repeated to discover changes in the glacier's behaviour and add to our climatological knowledge. Even photographs should be taken from recognisable points and should include identifiable natural features in the foreground so they too can be repeated years later and measurements taken from them.

Survey techniques are also needed to establish the speed of flow of the glacier, whether for an overall survey of several points down the centre line from snowfield to snout, or for detailed studies of the movement in three dimensions of stakes on part of a glacier one hundred yards square at the margin of the glacier, or to find out by repeated daily observations if the flow of the glacier is steady or varies with the temperature, amount of rainfall or total daily ablation. Conventional survey techniques can sometimes be supplemented by time-lapse photography every twelve hours of features such as icefalls and calving ice-cliffs at the terminus of a floating glacier, where movement is rapid (probably several feet a day) and yet the ice is inaccessible because of deep crevasses and the danger from falling seracs. A keen amateur, elevated to the status of "expedition photographer" to record the life and work on monochrome and colour slides for lectures and publications, might well make his scientific contribution by collaborating with surveyors on this type of project.

Currently there is great interest in what happens to the meltwater which is formed daily on the surface of the ablation area. Practically nothing is known of its mode of travel in and under the glacier on its way to the terminus, but experiments with dye to establish the duration of the journey plus accurate measurement of the hour-by-hour discharge of the glacier river at a gauging station set up a short way below the terminus should provide some indirect evidence as to the sort of channels the water flows through on its way. At the same time detailed records of discharge can be used to measure the total daily ablation on the glacier, and hydrological information of this kind is of great value in countries such as Pakistan which are dependent in part on glacier meltwater for power and irrigation.

No article of this length can do more than hint at the scope of glaciological work and the breadth of studies waiting to be undertaken. Any expedition interested in pursuing matters further should contact the Glaciological Research Committee, set up eight years ago to advise on fieldwork, which has contacts with glaciologists in all parts of the world and gives assistance to an average of fourteen expeditions or individual research workers annually. The secretary is Dr. J. W. Glen at the Physics Department of Birmingham University.

The type of work which can be undertaken by a student expedition is limited by several factors. The members of the party are unlikely to number more than eight, and there may be no-one with previous experience of work on glaciers. The glaciological programme may have to be built around a couple of members with specific skills, for whom the others act as unskilled helpers, but work of great value can be done under these conditions and undergraduate parties should not overlook the possibility of having a graduate research student or senior member of a university amongst their party as director of the scientific programme.

The next limiting factor will be the amount of time that can be spent on the glacier. Climbing expeditions often choose to do glaciology during their period of acclimatisation and between climbs, but because they usually go very far afield, much time is spent in travelling and only three to five weeks may be available for fieldwork, of which at least half may be ruled out by bad weather or by major climbs involving all members of the party. Expeditions choosing glaciology as the main object are able to work nearer home, in Iceland perhaps, where as much as twelve weeks can be spent at the glacier, allowing time for a more interesting and varied programme with the occasional week off for long exploratory trips in the surrounding area.

Finally comes the problem of finance. Because of the "Expedition Explosion" the competition for available funds is stiff and has not been entirely offset by the increased aid donated by industry and charitable foundations for sponsoring expeditions. Many grant-giving bodies have to limit their support to between £75 and £150 for a long vacation expedition, whereas the cost of a three-month expedition to Iceland may be £750 and to the Andes and Himalaya around £3000. Larger grants have been given by the Mount Everest Foundation but the terms of the trust limit support to climbing or scientific work in high mountain areas, and they have had to restrict their support to expeditions going to the most remote, and expensive, areas — Greenland, the Karakoram etc.

Nevertheless an expedition with a well-planned scientific programme can still raise enough money to go. But there are two requirements that should be borne in mind when planning the programme. Many expeditions still attempt to do too many jobs and as a result return with only a fraction of their work completed and of value. It cannot be emphasised too strongly that two, in exceptional cases three, scientific disciplines are the most that should be included by the average student party and that projects should be allocated a definite order of priority in case of delays due to bad weather or mislaid men and gear. A climbing team might well

concentrate on glaciology and find plenty to occupy their time, though some expeditions have also successfully included high-altitude human physiology when they had a tame doctor in the party. A party which has glaciology as its main aim can find room for a related science — such as botany on the slopes around and the study of the sequence of recolonisation by vegetation of ground left bare by retreating ice — but as most glacier work needs to be done in good weather it would be unwise to include many other subjects which would compete for attention when the weather is fine. Besides, as I have shown earlier, glaciology itself is wide enough to include workers in many different disciplines, who will gain mutually by sharing and comparing their findings.

Second, the demands for glaciological work have been changing in recent years. Just as one cannot learn how a car works by stripping down isolated parts from vehicles of very different design, but must examine one car in toto with all its components working in conjunction with each other, the collection of masses of miscellaneous data about many glaciers is not of great value. We need to concentrate on measuring as many properties as possible on a small number of glaciers, one or two "type examples" in each area. This has particular relevance for student expeditions as no one party, with the limitations mentioned earlier, can take enough measurements to yield all the required basic information desirable. But if a sequence of expeditions can be directed to the same glacier each will be able to build on the work already done. This has the great merit that a comparatively unskilled and inexperienced student party may be able to visit a glacier studied previously by another expedition, whose results will help them to plan their own programme in the knowledge of some of the conditions they will meet.

This degree of direction need not limit the freedom of choice of the party as several "type" glaciers already partly studied lie in the heart of areas of potential interest to climbers — the Lyngen Alps, the Karakoram, East Greenland — and members of an expedition will find more interest in their own work when they can add detail to what had previously been known in outline or when they can compare the results they are getting with those of other workers who went there before. Many observations, such as studies of the accumulation, ablation, surface height and position of the terminus, are of greatest value when they can be measured repeatedly at intervals of from five to twenty years to reveal changes in the climate and in the response of the glaciers.

In conclusion, we on the Glaciological Research Committee are often asked; "We are running an expedition to so and so, what useful glaciological observations can we make?" While this is a reasonable request and we do all in our power to help, we would like occasionally to hear "We want to plan an expedition to tackle a worthwhile glaciological problem, can you suggest suitable projects for people with our skills and interesting locations in which to study them?" In either case glaciological work can be done which is intriguing and exciting, and often leads to a member of an expedition later taking up a glaciological problem for graduate work in such centres as the Scott Polar Research Institute in Cambridge, the Department of Polar Studies at Durham, the British Antarctic Survey, or in one of several American universities. The way is open for a lifelong interest in an unusual and fascinating subject.

ARCTIC NORWAY EXPEDITION 1964
GICCE COKKA ICE-CAP

By Anthony White

IT may seem to many that the formation of expeditions from this College is a closed shop. How, they might ask, can an ordinary, ignorant undergraduate get on an expedition? The answer is either to lead it or to be invited to join it, and it was by this approximately democratic method that this expedition was formed.

The actual geographic position to which the expedition would make its way was decided before almost anything else. This was achieved by writing to the Norsk Polar Institut and asking them to recommend a suitable place. The Gicce Cokka ice-cap, they informed us, had last been visited cursorily by surveyors in 1893, and information and accurate maps of the ice-cap were lacking.

Gicce Cokka then was our objective, and this remained the only definite thing about the expedition until Christmas 1963. Leadership changed hands, numbers rose and fell and the programme swelled ambitiously before being chopped to size. The team eventually comprised Bob Davis (leader), Roger Blunden, Steve Dexter, Tim Hartshorn, Roger Parker and myself. The programme was to be headed by a survey of the six-mile square ice-cap with a larger scale plane table of the main glacier and surrounds. A colour film was to be taken of the expedition, and a continuous meteorological record and ablation measurements were to be made. An ambitious extra was a wind profile measurement using smoke generators and the cine camera.

The lack of experience of the team was very apparent. Only Bob Davis had been on an expedition and that to the Mediterranean. He was moreover the only person who could survey. Some snow and ice climbing practice under Hamish McInnes was therefore undertaken during the Easter vacation in Glencoe, and Steve Dexter went on a surveying course in addition to this.

Our transport plan had some headaches for the Exploration Board since we wished to travel by van from Oslo to Drag, some 850 miles. This had the overwhelming advantage that General Motors agreed to support us to a great extent and besides overhauling our van, provided all the colour film we required. After many vicissitudes the expedition finally got onto a firm foothold and on June 16th five members of the expedition inside a fully loaded van, pulling a fully loaded trailer, left Imperial College for Newcastle. The sixth member, myself, caught them up in Oslo on Friday June 19th having flown out that morning.

From Oslo we commenced the journey north. In Trondheim we made a stop of two days and borrowed a truck from a General Motors' agent to assist us in filming the journey. Soon after Trondheim the roads degenerated to hard packed mud with a lot of surface dust. The verges however were extremely soft, as we found to our cost when Steve Dexter backed the van and trailer onto it. Fortunately a passing lorry hauled us out before our machinations caused the van to topple over.

On Thursday June 25th, we left the van and trailer at Drag and, as prearranged, were picked up by a local boat which took us down Tysfjord. Halfway down is the small town of Kjopsvic which boasts a cement factory where an Imperial College student was doing vacation training while we were on Gicce Cokka — a small world indeed! At the end of the fjord we disembarked and with the help of the few local inhabitants and an aerial runway rising 1,500 feet into the mountains, we found ourselves in a very comfortable hut at the edge of a man-made lake supplying electric power to the cement factory in Kjopsvic. The hut contained one or two mod. cons. such as an electric stove and bunks, and it was with reluctance that we rowed our equipment across the lake to a more rudimentary hut, and sent scouting parties up into the foothills of Gicce Cokka to find a passable route and establish a halfway camp. News of the fact that six foreigners with a tendency for distributing cigarettes, whisky and beer, and whose sole tape recorder was given to emitting 'Beatles' songs had travelled fast, and we were soon entertaining the local female inhabitants!

Halfway camp was a good deal less comfortable, as by now we were all under canvas. In the almost snowfree valley were groups of reindeer, but further up, the snow was less patchy though melting fast. We still had over six miles to go to base camp and this meant crossing a valley full of deep melt streams under the snow, and surmounting a ridge, the other side of which was nothing but snow and ice covered lakes. Davis, Blunden and Parker pushed on to establish a base camp with our Rafma tent, while the other three carried food and equipment to a cache at the ridge. Rain was our worst enemy, for once wet, there was little hope of drying out until a spell of fine weather turned up. Good weather always seemed to be accompanied by a strong and cold easterly wind, but was welcome nevertheless. Portering for long periods we saw a good deal of the midnight sun, and we never experienced proper darkness for the whole time we were on Gicce Cokka.

By Saturday July 6th, we were all at base camp which was situated on the only visible lump of moraine, just by the main glacier flowing east into Sweden. This had receded by about three hundred feet from its approximate position mapped in 1893. The met. station and ablation readings were put into operation immediately, and the surveyors trekked over the ice-cap erecting cairns round its circumference. A rough kitchen shelter was constructed and a stone wall was built round the pyramid tent to shelter it from the usual west wind whipping rain clouds over the ice-cap.

Working in good weather, of which we had a fair amount, the filming and surveying continued, whilst playing poker for diced carrots whiled away the bad spells. Slipping down a crevasse and falling off the sledge were the author's only star parts in the film. Tim Hartshorn, on the other hand, had the dubious pleasure of being filmed taking the met. readings in his pyjamas as was his invariable custom, except when it was snowing. Ice holes and ice caves were investigated in the course of duty, but the magnificent scene as a herd of over one hundred reindeer cooled themselves in the snow went unrecorded, as the only camera the party had refused to function properly.

The snow on the surrounding mountains melted fast, and the chains of ice blue lakes unfroze, presenting a magnificent picture. The programme was drawing to a close when the camera broke down, and the smoke programme had to be abandoned. Although Steve Dexter managed to get the camera working again, it was later found that it had not been functioning properly for the whole of the expedition, and our film was a failure.

Leaving ourselves a week to retrace our steps to the end of the fjord, we again

Continued on page 20.

GLERARDALUR MID-NORTH ICELAND

By Paul W. Sowan

THE highest mountains of middle-northern Iceland rise to about 5,000 feet some few miles south-west of the country's second-largest town, Akureyri. The whole of the mountainous peninsula between Skagafjordur and Eyjafjordur which contains them is geologically and scenically inviting, although the brittle nature of basalts and rhyolites — the predominant rocks in the area — make climbing for climbing's sake inadvisable or, if sane safety rules are to be adhered to, impossible.

The following description is based upon three visits to adjacent areas in the region of Vindheimajökull, which is in fact a group of small corie glaciers, and not the small 'cap' shewn on some maps. The first visit was as geologist and quarter-master with the outstandingly successful Chelsea College Expedition to Iceland led by William Stevens in 1961. Geological investigations in that year in Baegisardalur revealed the presence of a major geological disturbance in the flood basalt succession in the nearby valley, Glerardalur. It was to examine this valley that I returned to Iceland in 1963 (alone) and 1964 (in the company of an amateur botanist).

On each occasion, camps were made in the hanging mountain valleys and contact with the farms and townspeople was infrequent. Visits were made to Akureyri for provisions, post, a civilising browse in the bookshops or library, or a very welcome bathe in hot-spring water at the sundlaug.

Such wild and desolate mountains and ice-fields so close to town, farms, and the main routes from Reykjavik make this area, indeed the whole of the peninsula, excellent training ground for first expeditions, and possible territory for lone wolves and small groups. A further, and not inconsiderable, attraction is the dearth of accurate, detailed knowledge of all but a minute fraction of the peninsula's geography, geology, glaciology and botany. A nucleus of work of previous expeditions exists, as is shewn on the sketch-map, centred on Vindheimajökull. This work, in most fields of enquiry, could very profitably be extended.

The flat-topped peaks of the mountains of the peninsula conform to a regular altitude of about 4,500 - 5,000 feet. The landscape is a result of the marginal dissection of the central Icelandic plateau by many glacially modified valleys, some retaining corrie glacier remnants.

My own visits have been confined to Baegisardalur, about 9 miles long, and Glerardalur, about 12 miles. The Chelsea College camp in Baegisardalur had to be carried up to about 1,600 feet over two or three miles of rough ground. Sheep tracks were used where they could be found, although these run along the edge of a 150 — 200 feet gorge and ravine in places. In Glerardalur, camp was made at 1,250 feet at the head of a rough track which took us five miles into the valley. The Baegisardalur camp-site was chosen before we were aware of the importance of choosing either the left-bank or the right-bank of a stream with some deliberation. Most of the mountain streams and rivers in the main valleys can only be waded high in their courses. Thus, in 1961, we found ourselves on the geologically dull western side of the valley. The botanists of the party were able to work within a few miles of camp, but the geologists, rather than add eight or 10 miles to each day's tramp, set up two advance-camps, one nearer the head of the valley and one almost opposite the

MID-NORTH ICELAND

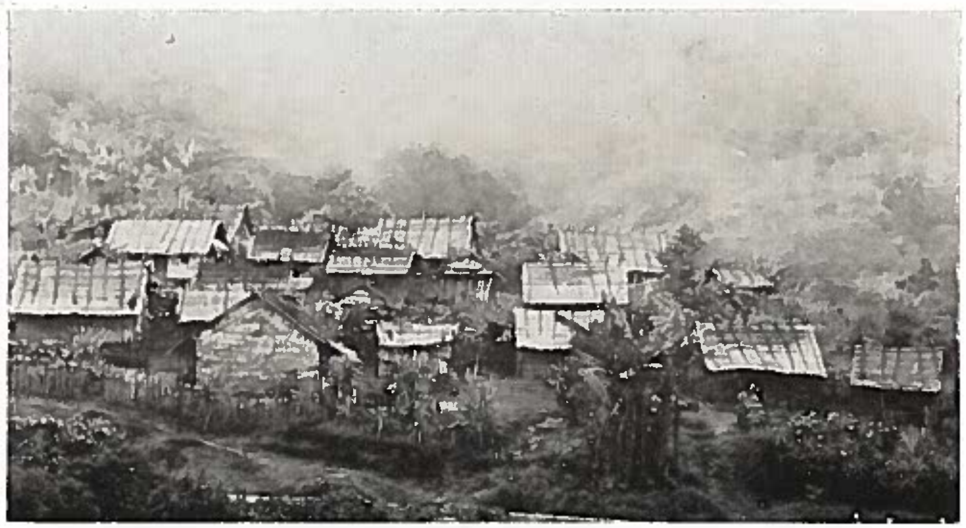
STRITA — Basalt Lavas at 4,800 ft. View looking north from Kista; Eyjafjordur in background.

GLERARDALUR — the wild area east of Tröllafjall is shewn; note 140 ft. dykes on spur, and prominent tuff layer.

ARCTIC NORWAY

Parker and White view Sweden from the ice-cap.

FERNANDO PO



Bubi village, near Moka.

base-camp on the eastern bank. This seemed slightly absurd. While on the subject of choosing camp-sites, it is as well to mention that the 1:100,000 topographical maps of the area, produced by the Geodetic Institute at Copenhagen, cannot be relied upon to give any adequate account of the nature of the mountainous areas. Major and minor watercourses and craggy slopes are not well distinguished. Prints of air-photographs of U.S.A.F. or R.A.F. origin are preferable. The U.S.A.F. prints are more recent, clearer, more expensive, and available from the Icelandic Survey Department (Landmaelingar Islands) in Reykjavik.

Travel and camping in the valley bottoms present no problems, although minor difficulties arise. The postglacially rejuvenated streams have been noted as a hindrance by several expeditions. Tributaries are generally negotiable, though occupying deeply incised gullies in very loose debris on the valley floor. Talus fans, floi (boggy areas) and thufur (frost heaved grass hummocks) combine to make porting slow and camping difficult.

Geological work is executed principally by the examination of stream sections and of aretes. In either case a great deal of unstable scree and shattered cliff is met with. In Glerardalur there are considerable quantities of rhyolite, and crags and screes of this material are especially mobile and unpleasant to cross on account of the sharp angularity of the fragments, although shattered columnar basalt cliffs are the more dangerous. Sizeable pinnacles disappear from one year to the next, thunderous rock-falls are heard once or twice a month and the only noise in the high corries is the falling of stones. Most of these obstacles lie at about 4,500 feet. Once passed they give way to the flat-topped summits and interconnecting ridges, where easy walking and only occasional danger spots are found. The principal tablemountains Kista, Tröllafjall and Kerling are bordered by near-vertical sides rising from such small corrie glaciers as Vindheimajökull, Baegisarjökull and others invisible from the main areas of habitation and therefore un-named. Where bergschrunds are absent or inconsiderable, which is not often, the firn may offer an easy route to the summits. But more often than not, not only do bergschrunds and quite handsome crevasses bar the way, but the last few yards turn out to be made up of ice-cemented scree and rubbly arete, waiting on the rapid melting of the ice, and the incautious disturber of the delicate equilibrium to send a few more tons of rock down onto the glacier, and into the bergschrund. It will be appreciated that this is not climbing — it is something requiring the care of a cat walking over a chessboard. One more unsavoury feature of attaining the summits is the occurrence of glazed surfaces on snow slopes banked against north-facing cliffs. Step cutting is essential. Disturbed ravens have several times displayed their inhospitality at psychologically unfortunate moments during traverses of this kind of ice.

This year's most successful day is, perhaps, worth recalling. After a few miles tramp along the valley floor the botanist, Mr. Payne, and I started the long slog up the stream Heimari-Lamba to a corrie holding the easternmost element of Vindheimajökull. Geological observations, and collections, were well advanced by the time the main moraine was reached. We noticed that, as usual, most of the cloud was below about 2,500 - 3,000 feet, and most of the mountain tops were in brilliant hot sunshine. The corrie ice here was found to be intact, and we made the coll at 4,700 feet between Strita, a perfect step-pyramid of basalt lavas, and Kista, a steep-sided table-mountain. The corresponding corrie beyond the coll harbours a part of Vindheimajökull reckoned to be up to 500 feet thick. Two successive warm winters have brought about some impressive changes in this ice. In 1961 the greatest crack seen barely exceeded 6 ins. in width — crevasses now reach widths of 8 to 10 feet, and depths of at least 30 - 40 feet.

LEGEND TO MAP

The whole of the country represented is mountainous, with the exception of fertile straths inland from the major fjords. The motorable roads are shewn, as are towns and villages (population 885 to 8,570) with stores and public transport services.

Investigations within the area include the following:—

1. Geological observations (now discredited) in the Ljosavatnsskard area. Pjeturss (1910)—Handbuch der Regionalen Geologie (Heidelberg).

3. Oskarsson (1930)—'The Vegetation of the Islet Hrisey in Eyjafjordur, North Iceland'—Rit Visindafelag Islendinga VIII. (Reykjavik).

4. Oskarsson (1932)—'Some Observations of the Vegetation of Eyjafjordur and Akureyri'—Rit Visindafelag Islendinga XIII (Reykjavik).

6. Davidsson (1946)—'Notes on the Vegetation of Arskogastrond, North Iceland'—Acta Naturalia Islandica Vol 1, No 4 (Reykjavik).

7. Barth (1950)—'Volcanic Geology, Hot Springs and Geysers of Iceland'—Carnegie Institution, Pub. 587 (Washington). Describes thermal activity near Akureyri, Siglufjordur and Saurdarkrokur etc.

9. Einarsson (1959)—'Studies of the Pleistocene in Eyjafjordur, Middle-Northern Iceland'—Rit Visindafelag Islendinga XXXIII (Reykjavik).

10. London University Geological Expeditions to Skidardalur, 1960 and 1961—Reports to the Royal Geographical Society. (London).

11. Chelsea College Expedition to Iceland, 1961 (1962)—Report to the Royal Geographical Society (London). Gives details of flora and geology of the area around Baegisardalur.

12. Einarsson (1962)—'Upper Tertiary and Pleistocene Rocks in Iceland'—Rit Visindafelag Islendinga XXXVI (Reykjavik).

13. Glasgow University Vindheimajokull Survey, 1962 (1962)—Report on the Glacier Vindheimajokull to the Royal Geographical Society (Glasgow).

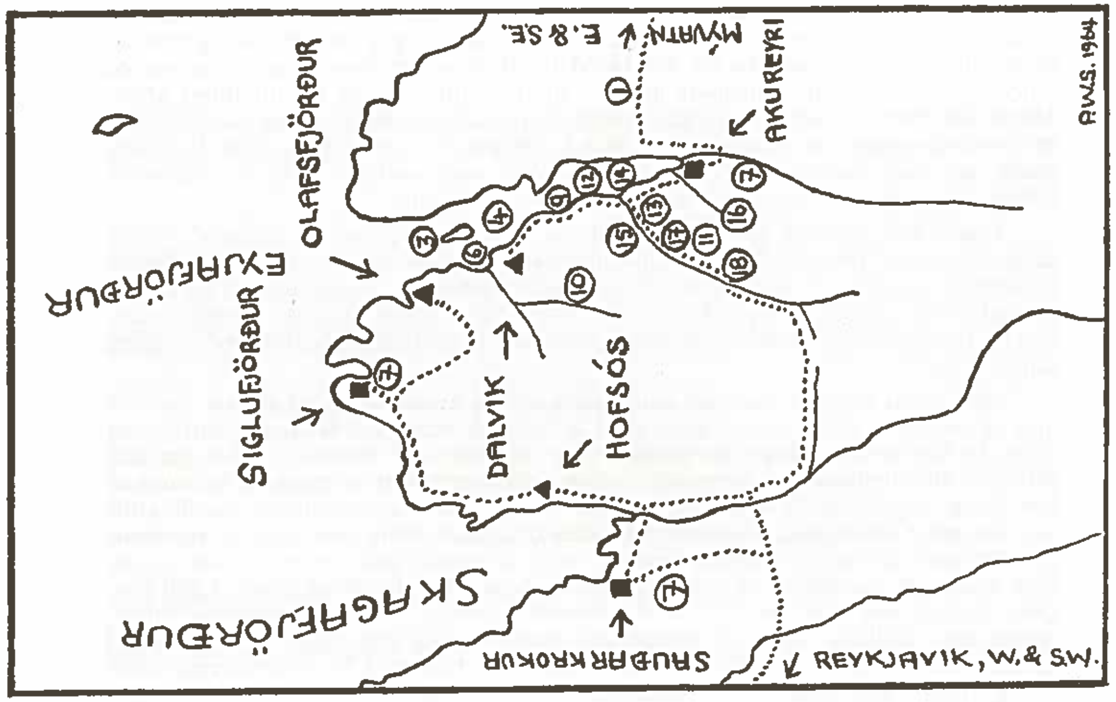
14. Steindorsson (1962)—'On the Age and Immigration of the Icelandic Flora'—Rit Visindafelag Islendinga XXXV (Reykjavik). Proposes that many species overwintered the last glaciation on nunatak areas within the peninsula.

15. Leeds University Icelandic Expedition 1963 (1963)—Report to the Royal Geographical Society (Leeds). Geological, geomorphological, glaciological and botanical work in the area around Baegisa in Horgardalur.

16. Sowan (1963)—'Geological Investigations in Glerardalur, Mid-North Iceland'—Report to the Royal Geographical Society (Croydon). Sowan (1964)—'Glerardalur'—Report to the Royal Geographical Society (Croydon). Full account of the geography, geology and botany of Glerardalur and the contiguous mountains, with topographical and geological maps.

17. Dudley Teacher Training College Icelandic Expedition 1963 (1964)—Report to the Royal Geographical Society (Dudley). Sociological, botanical and geographical work in lower Horgardalur near Baegisa.

18. Hadwen—Mr. Peter Hadwen is currently investigating the geology of the east side of Oxnadalur, around Fagranesfjall and Gloppa.



Scale, 1: 1,250,000

Investigations in the Area of the Skagafjordur – Eyjafjordur Peninsula, Middle-Northern Iceland.

Our ascent of Kista was well worth-while, not for any geological reason — there is nothing but stone-polygon patterned ground on the flat rubbly summit — but for the views. Seventy or eighty miles away, in the central Icelandic desert, could be seen the long, low outlines of the greatest ice-caps of Europe — Vatnajökull, Hofsjökull and Langjökull. In the east the impressive volcano Herdubreid and in the north the open Arctic each held our attention for a while. To the west was the whole mountain range of the peninsula, hardly explored.

A difficult, delicate descent via the south-eastern arete and a welcome soft snow slope brought us to 'Obsidian Coll', where the black volcanic glass is continually being polished by windborne ash and dust. Eight hours, in all, above 4,000 feet took us to the north face of Tröllafjall, a daunting edifice tackled at a later date. We then turned back down into the valley along a shoulder from which fine views of Tröllafjall's 2,000 feet sheer east face were had. A lucky find, a gully still full of remnant winter snow as late in the year as early August, took us to within a few hundred feet of the valley floor and a few miles of camp.

Geology (the main purpose of the expedition) apart, other notable features of this year's work were the free-standing dykes weathered out of soft volcanic breccia and forming a pair of walls up to 140 feet high, a very active ice-fall over a cliff, and an exceptional spell of bad weather which, incidentally, prevented one of our main plans from being fulfilled.

Normally, in Iceland, one reckons on losing an average of one day's fieldwork a week through rain heavy enough to justify staying in camp. This August over two weeks passed with hardly a break in the sunshine. Knowing that the rain must come sometime, we had no choice but to work flat-out for the whole time. Taking advantage of the late sunsets of early August at this latitude to run to 20 mile geological treks, contributed to the early completion of our geological map of western Glerardalur. However, the moment we started to move to the eastern side, and middle-northern Iceland's highest mountain, Kerling, the rain started, became heavier, and changed to snow. Our camp was thus immobilised at the valley mouth (where a bridge at Akureyri allows the river to be crossed), being a fairly fully equipped standing camp rather than a light mobile one. We could negotiate some of the land around Kerling, and the Sulur Thriklakkar ridge leading to the mountain, but could not attempt the summit.

During the last week of August our programme took us to Myvatnssveit, where we examined postglacial volcanoes and solfataras in near-blizzard conditions, and to a number of places in south-west Iceland. One day, just after the snow, was spent on Mr. Hadwen's research area on Fagranesfjall in Oxnadalur. Here, the only serious climb of the summer was possible on the exposed face of a large rhyolite dyke.

Our scientific programme included solid geological mapping, geographical observations and studies of lichen ecology. The geology, in particular, was quite successful. We found and mapped in outline a large, complex, acidic volcanic centre and its associated tuffs, and obtained good evidence for a second such centre under the northeast corner of Kerling.

To sum up, this completely uninhabited and very rugged mountain area provides as many dangers and difficulties in the way of geological research as can be wished for, and more spectacular peaks and ice-fields than can usually be hoped for. Such a geologically worthwhile area, so close to civilisation yet so divorced from it, is worthy of the consideration of any party of geologists thinking of visiting Iceland. It offers a remarkable contrast to the Icelandic scenery more usually seen by the visitor to this country — the barren inland plateaux, lava fields, subglacial fissure-eruption ridges and tablemountains and postglacial craters. Although the geology is more difficult to unravel, the results are more rewarding than in the central areas.

I shall be extending my own investigations further and further south every year. I would be only too pleased to help anyone who might like to try working to the north, east or west of me.

Paul W. Sowan,
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It is a pleasure to thank several very good friends for the support and en-
Consul in Akureyri, and Svavar Gudmunnsdson have often extended their hos-
work described above. Peter R. Payne, who accompanied me this year, provided welcome companionship and a useful 'other point of view' on day to day movements. Dr. George P. L. Walker of Imperial College has been very kind and helpful in numerous ways. In Iceland, Mrs. Irene Gook Gunnlaugsson, British Vice-Consul in Akureyri, and Svavar Gudmunnsdson have often extended their hospitality. The expedition was supported financially by the Royal Geographical Society, and undertaken in co-operation with the Icelandic National Research Council in Reykjavik.

ARCTIC NORWAY EXPEDITION *Continued from page 15*

split into two groups of three and ran a shuttle service to the ridge dump. Davis, Dexter and myself remained on the ice-cap, and during a period of fabulous weather with the temperature up to 20°C, we decided to do some climbing. Gjettind, nine miles away, was our main objective, but on arrival there we found that it had already been climbed. A day trip into Sweden, which looked much like Norway, was all we had time for, as the weather suddenly broke. From trekking across the ice-cap in our underpants (and getting extremely sunburned) one day, we were suddenly tent bound in a white-out the next. The thermometer was stuck below zero for several days and after doing last minute jobs in the periods of visibility, we packed and made a rapid departure on Saturday August 15th. Down below at the hut it was still fairly good weather, but the local people in Sorfjord agreed that summer was over, and on Monday August 17th, we left for home. We had postponed our bookings so that we could stay another week on the ice-cap, and therefore had a three-day wait in Bergen. We must have found the only three days in the year that it does not rain there, and had an enjoyable time auctioning our spare teabags to the tourists in the camping site. Roger Parker obtained a temporary passport, and on Sunday August 23rd, we set sail for Newcastle.

The expedition was not a complete success owing to the failure of the film, but it was undoubtedly a most enjoyable and worth-while experience.

ORGANISING AN EXPEDITION

By Andrew Wilson

A UNIVERSITY expedition usually comes about in one of two ways. A group of friends may decide amongst themselves that it would be a good idea to spend the following summer vacation in the back of beyond, no matter where or doing what—just away from civilisation. However, it is now extremely, difficult to get any support, especially financial, unless the expedition has some aim. (By aim I do not mean the "try to drive from A to B" type, but rather some serious or scientific object to the expedition.) Alternatively, one or two students (or staff) will seize upon some project that would either be an extension of their normal fieldwork, or some other important or interesting piece of research.

The choosing of personnel is often a basic problem. The leaders may have to scout around for additional members to supplement the main research team or to act as dogsbodies. The whole success of an expedition depends on the complete co-operation and co-ordination before, during and after the expedition. Consequently, since 'co-opted' members are rarely conducive to good spirit, they should be avoided if at all possible. All members of an expedition should be able to live and work in harmony, be enthusiastic about the expedition, be willing to do their share—and more—of the work and also to recognise the leader. The necessity for these qualities is largely self-evident, though I would like to stress 'leadership'. The need for *one* leader, *one* person to make the final decision (especially in the field) is often disastrously underrated. Although all personnel should be prepared to make snap decisions, one leader is needed to co-ordinate the expedition.

As to the place of work, this will be limited by a number of considerations, mainly financial and geographical. Mountaineering and Underwater expeditions spring to mind as examples where the region to go to is limited by finance. In the case of the general explorer, he will limit himself to a certain area, e.g. desert, arctic, etc. Botanists often have to restrict themselves to areas where conditions are favourable to the proposed visit.

Having chosen a suitable region or country, a basic working area (or areas) has to be decided upon. Here, one of the main factors is accessibility. It is no use choosing a working area which can only be reached by packhauling for two to three weeks before the work can begin. Nor would one want to go surveying in an area where a perfectly good 1 in 25,000 map exists.

So far so good! But the group may well have decided where they wish to go, but have no idea what to do. Obviously, a zoologist, botanist or geologist has no real problem here, whilst an engineer can, if he so wishes, usually fall back on surveying. But what, if anything, can a pure scientist find to do that is both constructive and rewarding? He has to find some subject that does not need much specialist attention, so that it is within his scope but also worthwhile.

Mountaineering tends to be an aim in its own right, whilst archaeology and meteorology can be done without too much previous knowledge. Some aspects of geography, sociology and anthropology can also be tackled. In arctic climates glaciology can be considered, and the ease with which a glaciological problem can be found and tackled has led to a predominance of arctic expeditions over the past few years.

Up to now, everything said has been commonsense. Now we have the nucleus of an expedition — the personnel, the place and the work. It is here that the real work of the expedition starts. Methods and programme of work have to be sorted out, modes of travel have to be looked into and an estimate made of the total cost. At this stage, the Exploration Board should be approached with an outline of the proposed expedition. They will discuss it and make suggestions as to where and how further assistance can be obtained.

The financial problem is always the bugbear of expeditions, and numerous items of expenditure have to be considered. Food generally costs 30s. to 50s. per man week, and can easily be calculated. Scientific equipment can often be borrowed or hired and expendable items that have to be bought do not usually represent a large sum. Similarly photographic and general equipment should come within reasonable limits. For the average expedition, the cost so far should be in the region of £60 to £80 per head, barely the compulsory £80 insisted upon by the Exploration Board. However, the most expensive item has yet to be considered—travel. Since most expeditions have to transport personnel and equipment for considerable distances and often to inaccessible places costs inevitably rocket. In each of the 1963 I.C. expeditions, the cost of travel was over 60 per cent of the total, and in the case of the Beerenberg expedition, amounted to over £200 per head. Cheap travel has to be gone into very thoroughly—the 1963 Sierra Leone Expedition had to travel over 200 miles by taxi, as their cheap deck passages which they had arranged from Lagos to Freetown proved to be for 'Africans only'.

At this stage of the expedition, delegation of work is, if not essential, desirable The final details of the scientific programme (commonly undertaken by the leader), food, travel, general equipment and scientific equipment should be meted out to include all the personnel. At Imperial College, a special food committee is set up each year to deal with all the expeditions' requirements. This is designed to reduce the work each expedition has to do, and indicates the efficiency of organisation, thus obtaining maximum assistance from the firms approached. This is one of the many reasons why the I.C. Exploration Board is held in such high esteem. Recognition by the Exploration Board usually means recognition by the Royal Geographical Society, which is often a prerequisite before many firms will allow any concession on their products.

I.C. Exploration Board recognition will be given to an expedition once its programme has been approved and it is deemed to have a reasonable chance of raising the money it requires. It is virtually senseless writing begging letters before the Board has given its backing. For maximum benefit, this backing needs to be given in the December before the expedition is due to leave. It is, therefore, advisable that the preliminary programme of the expedition be handed to the secretary by October, and preferably by the previous May.

I know that more than a year in advance seems a long time to have to plan an expedition, but all expedition leaders will agree that it is desirable. For one thing, it gives the expedition members a chance to get to know one another thoroughly before the expedition leaves. For another, it gives plenty of time to go into the various possibilities of working area, programme and travel, leading to a more successful expedition. (Ethiopia 1965 found that they had to move their working area by 400 miles in January this year. This, because of inaccessibility, after they had been studying the routes and the area for six months!) Moreover time is needed to see to all the details that an expedition entails—the leader will be kept busy from the previous December until the final Expedition Report comes out, up to two years after the expedition returns to the U.K.

By now, an expedition should have the support of the Exploration Board, food and equipment should be under control and letters should have been sent out seeking financial assistance. (The Exploration Society has a Directory, which is available to members, giving details of grant-giving bodies.) Now one can only wait for money to trickle in, when items of equipment can be purchased.

Some sort of expedition trial camp in the Easter Vacation is advisable to accustom the personnel to living together under field conditions, and to check the equipment. Travel documents, inoculation, currency requirements, customs regulations and so on, must all be looked into carefully.

A suitable place is necessary for the storage of food and equipment prior to packing. Once packing does start, the time seems to fly past and it is soon too late to do this, to get that, or to see so-and-so; the departure day arrives and the expedition is off.

In the field, unforeseen problems inevitably arise. The meeting and solving of all the minor problems in the field add to the thrill of the expedition. The completion of the expedition programme is either extremely fortunate or an indication that the programme was not sufficient. I do not wish to dwell on the expedition proper, as any expedition account in this or similar journals will give details of past experiences.

I hope this article has not deterred anyone from organising or taking part in an expedition because of the amount of work involved. (Two expeditions for 1965 had to be cancelled in the planning stage for this reason). No expedition is a joy-ride, it is a challenge—an exacting challenge that requires time, patience and the determination to turn a drawing board dream into a successful *fait accompli*.

EXPEDITIONS 1965

FOUR expeditions, which have been approved by the Exploration Board, are in the field at the time of writing. All are working on the African continent.

Ethiopia

A party of four are visiting Lake Tana in N.W. Ethiopia where they are carrying out an ethnological study of a little-known fishing community, the Waito Fishermen. The work will also include general survey, botanical, zoological, meteorological and anthropological projects. The scheme has the recognition of the University College of Addis Ababa and the party will be joined by two Ethiopian students in the field.

Ghana

A joint Imperial College-University College party of five is travelling to Ghana by land-rover across the Sahara Desert. Six weeks are then being spent studying the effect of the disturbance caused by the creation of the new Volta lake on the housing and agricultural methods of two settlements on the Kwahu Plateau bordering the lake edge. The project was conceived with the help of the University of Ghana who are arranging for two Ghanaian students to join the expedition.

Uganda

In conjunction with Makerere University College, Kampala, a six-man team is accurately locating the positions of several ancient forts in Uganda, some of which will be surveyed in detail. These include those built by Emin Pasha, when he was Governor of Equatorial Province. Material assistance is being provided by the University, who have also arranged for two Ugandan students to join the party at Kampala.

Morocco

Off the Moroccan coast, eleven divers from the Underwater Club are carrying out marine zoological and surveying studies, whilst on land, a further party of four are pursuing an independent zoological programme. The marine studies are being conducted from a special diving vessel, the 'Boy Mark', equipped with laboratory, darkroom and workroom facilities, which has been chartered by the expedition.

July 1965

U.C. EXPEDITION TO FERNANDO PO 1964

By John Oates

FERNANDO PO, a tropical island in the Gulf of Guinea, West Africa, lies three degrees north of the equator and about twenty miles from the African mainland. Few, if any, of the six members of last summer's University College zoological and geographical expedition had heard of the island at the beginning of 1964. Nor, it seemed, had anyone else—a fact which had both advantages and disadvantages.

The expedition was prompted by a brief article published in the *Geographical Magazine* in January 1964. Between then and our departure in July there was a great deal of organisation to be done since there was no background of expeditions to Fernando Po on which our plans could be based. However, despite the postal strike which badly hampered our preparations, we were finally able to leave Victoria Station at 9.30 a.m. on Sunday, July 26th bound for Africa. Our train journey across Europe was not without its difficulties, and we eventually arrived in Cadiz in two separate groups. From here we sailed on July 29th. Magellan had set out from Cadiz in 1519 to circumnavigate the globe. We had slightly less ambitious plans. The Spanish mail-cum-cargo boat in which we travelled third class paid fascinating (but all too brief) calls at the Canary Islands, Monrovia and Lagos, and then on August 14th we entered the harbour of Santa Isabel, Fernando Po, with a frigate escort.

The island is part of a volcanic chain made up of Mount Cameroon (13,352 ft.) on the mainland, Fernando Po, the Portuguese islands of Principe and São Tomé, and Annobon, another Spanish isle. Fernando Po is roughly 40 miles north to south and 20 miles wide and the main volcano, now extinct, rises to 10,190 ft. above sea level. This mountain, the Pico de Santa Isabel, with its summit usually shrouded in mist and low cloud, forms a wonderful back-drop to the town of Santa Isabel on the north coast. Santa Isabel has a good harbour—a palm-fringed volcanic crater breached by the sea—and some notable buildings, including a fine cathedral. The island takes its name from its discoverer, the Portuguese explorer Ferñao de Po, who arrived there in 1471. The Portuguese called the island 'Formoso'—beautiful. From 1778 the Spanish used Fernando Po, as it was now called, as a base for obtaining slaves, but most of the early settlers died of yellow fever and the island was evacuated in 1781. A memorial to these Spaniards now stands on the edge of the beautiful bay of San Carlos on the west coast where the Atlantic breaks on a beach of black volcanic sand. The British controlled the island between 1827 and 1844 and from a naval base at Santa Isabel, then Port Clarence, they operated against slave traders along the Niger delta, but Spanish control then became more effective, and the Spaniards have been there ever since. Santa Isabel is now the administrative centre of Spanish Guinea, this colony consisting of Rio Muni on the mainland, Fernando Po and a few other small islands in the Gulf of Guinea.

We were delayed in the town for several days because the boat bringing our stores from England was behind schedule. However, the local District Manager of the United Africa Company very kindly provided accommodation in the town until the boat arrived. During this period we collected lizards in the cocoa plantations which surround Santa Isabel and clothe all the lower parts of the island in its northern half.

Eventually we were able to load everything on to a lorry and travel through the plantations, past Santa Isabel peak and San Carlos Bay before climbing up into the cool mist forests and grasslands of the Moka Valley at 4,500 ft. in the centre of the island. Here we were to spend the next four weeks in a bungalow, generously put at our disposal by the Government, which was to be the base from which we were to study the animals and geomorphology of the Moka area. From U.C. there were four zoologists, Graham Dunn, David Holberton, Allan Rostron and myself, and one geographer, Michael Bovis, whilst the sixth member of the expedition, John Reckless, was from Bart's. Hospital Medical College. Allan and Michael were in their second year, the rest of us were first year students.

The animals of Fernando Po are a little different from those of the mainland Not all the lowland rain forest species are represented and those that do occur are now restricted mainly to monsoon forest, mountain rain forest, and grassland. Climate divides the island into north and south. The northern half, where most of the island's 40,000 population lives and where most cultivation occurs, has a fairly typical equatorial climate with a continually high temperature and rain in every month (although some months are wetter than others). The southern half, however, has a monsoon climate with pronounced wet (very wet) and dry seasons. Moka is just about in the monsoon region, and we were there in the second of the two rainy maxima. Towards the end of our stay we were having two inches of rain in one day, which made work pretty well impossible. The southernmost habitation on the island, Ureka, has the phenomenal annual rainfall of 400 in., most of it concentrated in the rainy season. We did not visit Ureka. Cocoa and coffee plantations have replaced the true lowland rain forest on Fernando Po, but the natural vegetation prevails above 2,500 ft. in the north, and in the monsoon southern half. The exception is around Moka, where the mountain rain forests have been partly cleared to make way for pasture land for beef cattle. In Moka we could therefore study the animals of the grassland, of the forest around and below the pasturelands and choking the river valleys, and of the peculiar heathland of bracken, flat-topped tree-ferns and giant lobelias which occurs above about 5,000 ft. on the volcanic cones.

Compared with the mainland, little work has been done on the island's fauna. The British Museum had very few specimens of Fernando Po reptiles and amphibians, and those that they did possess were collected at the turn of the century. This then was our main object—the collection of snakes, lizards, frogs and toads. While in Santa Isabel we had been able to catch (to the astonishment of the local inhabitants) some of the skinks, geckos and gaudily-coloured agama lizards which live in and around the town. Moka was not an ideal place for reptiles because of the dampness of the climate—if it was not actually raining there was usually a low mist everywhere. Some chameleons were brought to us by the Bubis, the original inhabitants of the island, and by Nigerians, who come to the island in the first place to harvest the cocoa crop. We found skinks in some unusual habitats—a couple in the thick moss covering some large boulders in the middle of a marsh, and one in our living room! Snakes were quite abundant, and particularly so were Green Tree Vipers which had a nasty habit of dropping at our feet from odd bits of vegetation. An area supposedly rich in snakes was the crater lake of Biao above Moka at 6,000 ft. We had a painful climb, in our untried boots, up to this cold, misty crater on our first day in Moka. We saw nothing but a few frogs and a miserable, and very strong-smelling musk shrew. A few years ago a Roman Catholic priest died of exposure at the lake, and this has given it a sinister reputation with the Bubis. Perhaps because of this our guide could not take us down through the tangled forest to the marshy margins of the lake, or perhaps it was because of the stories we heard of trees there dripping with snakes. So we ate our luncheon-meat sandwiches on the rim of the crater and began the long journey back, cold and completely soaked; for by now it was raining hard. Later in our stay, hunters brought us three magnificent specimens of the giant Rhinoceros Viper over three feet in length and at least six inches in girth, from the region of the lake. These are amongst the world's deadliest snakes, so we dispatched them with great caution using euthanasia drugs.

The lake is one of the wonderful natural features in the Moka region; the Iladyi falls, about five miles from where we were, is another. Here the Rio Iladyi, draining most of the Moka valley, plunges about 200 ft. straight into a thickly forested gorge. Unfortunately mist and rain rather spoiled what would have been a magnificent view from the top of the falls, but the thundering cascade of water was exciting enough in itself. A little way upstream from the falls we found some marshes containing abundant amphibian life. Frogs' calls filled the air and one step would flush perhaps half a dozen of the small animals from the vegetation filling the shallow marsh where we found at least five different species.

The forests around Moka came alive at night and the bush echoed with insect noises, and the cries of owls, tree-hyraxes and galagos. Galagos, or bush-babies, became one of our chief interests and we went out at night with powerful torches with which to catch the amber reflection of their eyes as they moved through the trees surrounding the grasslands. Three species of bush-baby occur on Fernando Po and we were lucky to find two of these near Moka. The small Demidoff's bush-baby was mouse-like in looks and movements, but the other species we saw, Allen's, was considerably larger, about the size of a small cat, and progressed through higher vegetation in a series of leaps. Allen's bush-baby is a rather attractive animal with reddish fur on the sides of its legs and body, a grey chin, a long, black, bushy tail and enormous ears and eyes. We watched these bush-babies almost every night once we had located their habitat in Moka. They descended from the forest to feed in the lower vegetation near paths, to which the insects they feed upon may have been attracted. We managed to shoot specimens of both species for the British Museum.

Allen's bush-baby is a lower primate with a rather restricted range. It is found only on Fernando Po and in the forests of the Gabon and Cameroons on the mainland, and its habitats are not well known. For this reason we devoted much effort to capturing one alive. The Bubis methods for this depend upon the use of snares which badly injure any capture. We eventually succeeded in the none-too-easy task by surrounding one in a tree and driving it into low growth where it was unceremoniously grabbed by the tail. Our bush-baby, a male, fed on an unlikely combination of dead birds, bananas, and digestive biscuits. It thrived however, and can now be seen in the new bush-baby house at the London Zoo—the first member of its species the zoo has had for 25 years.

After four weeks we had to leave Moka and re-acclimatise ourselves to the tropical heat of Santa Isabel. After a few days of packing and passport-checking we sailed from Santa Isabel on September 24th. We repeated the train journey from Cadiz across a Europe growing cold with the approaching winter, and were landed on the platform of Victoria Station at 6.30 p.m. on October 9th.

LURISTAN 1964

By Clare Goff

"SLOP" said our guide, pointing forward through the window. "Deh injast." Of course he meant 'Stop', but having left his teeth behind in the Kuh-i-dasht he was at a disadvantage when trying to speak English. Otherwise he always managed to look the picture of respectability in pale blue, double breasted suit, pointed shoes and grey Homburg. It was odd to think that his family, with whom we were due to spend the night, were still nomadic tribesmen living in black tents.

Mr. K. had risen to his present eminence from the highly illegal excavation and sale of Luristan bronzes, and it was the presence of these same bronzes that explained why Kay Wright and I, students from the Institute of Archaeology, were now bumping along in a Land Rover over the rutted tracks of an isolated mountainous province in western Iran. The fourth member of the party was Hoshang, a local schoolmaster, who had been pressed into chaperoning us by the authorities and was now nursing a cold and thinking wistfully of his home and his girl in Khorramabad. A larger team was considered impracticable in view of the extent to which we had to rely on local hospitality.

The bronzes came from a series of prehistoric cemeteries dating from the end of the second millenium B.C. to about the middle of the first. They included a wide variety of objects—weapons, jewellery, horse trappings and, most characteristic, figures of some legendary hero strangling a pair of monsters with either hand. Since these objects were invariably beautifully made and decorated they were much sought after by millionaires and museums—both domestic and foreign —and since the cemeteries were relatively easy to find it was not long before most had been completely robbed out by such enterprising locals as our Mr. K.

In the thirties several foreign expeditions had attempted to do some salvage work in the area but usually their results were inconclusive—the Lurs having got there first. Then came the war and Dr. Mussadeq, so it was only within the last few years that it became possible to revisit the province. The previous year I had been lucky enough to work with a Danish team in W. Luristan, and this year had returned to survey the area further East.

The trip we were on at the moment was rather typical of the expedition as a whole. We were endeavouring to reach the valleys just below Sarkashti—the huge range stretching diagonally across Luristan and separating the summer pastures of the Lurs from their winter retreats. There was a track marked on the map and when it petered out Mr. K. assured us that we should have no trouble in finding horses—he knew everybody, but everybody in the area. He crooked his two first fingers together in an expressive gesture.

Of course nothing went as planned. The track ran in a totally different direction to that on the map. Periodically it disappeared altogether, leaving us to negotiate ploughed fields, boulder strewn river beds or mountain sides with impossible gradients. Our four wheel drive packed up and we wondered uneasily if the rest of the transmission would follow suit. Finally, towards evening on the second day, we found ourselves with only five miles accomplished in the previous six or seven hours, over half our precious supply of petrol consumed, and apparently no way out of the present valley except that by which we had come. Attempts to hire mules, or even donkeys were met with blank refusals. There had been an unusually dry spring following a terrible winter and everyone was desperately short of fodder and was conserving the strength of his beasts as carefully as possible. Eventually Kay prospected a route out through a series of gullies which would have been tiring to negotiate on foot, and here we were, late in the evening, rolling up to yet another nomad encampment from where, Mr. K. informed us brightly, everything would go differently.

Being used to such assurances by now, we were not too optimistic. The encampment certainly was the same. Children were already swarming round the Land Rover touching everything in reach, dogs barked furiously until driven off by stones, women pressed close to inspect our clothes. Appearances however, were deceptive. Mr. K's family welcomed us warmly and very soon we were sitting round the fire at one end of a long black tent, sipping tea from medicine glasses and discussing plans for the morning.

We made an early start. Kay, Hoshang and I were given horses while our equipment was made up into bundles and slung across the back of a mule which also carried Mr. K. and our escort. No wonder it looked bad tempered! Before leaving, our hosts insisted that we drive the Land Rover into the shelter of their tent, where it now sat, looking slightly apologetic, in the middle of their 'drawing room'.

Hoshang seemed to have recovered and went cantering up the hill making hunting noises and twirling the end of his halter. The rest of us followed more sedately—the horses had no bits or stirrups and would have been quite impossible to control had they decided to 'take off'. After about half an hour we reached the summit of the range. A huge panorama spread out before us. At our feet the mountain side fell almost sheer away to the floor of a long narrow valley with a river crawling along its far side. Beyond, range after range, rose the barrier of Sarkashti, whose remote passes were said to hide some of the richest grave yards. Several other sites, possibly no less exciting, were now visible on the valley bottom and it was with impatience that we dismounted to lead our horses down the precipitous stream bed that did duty for a path.

The first site was disappointingly late, with fragments of Islamic blue glazed pottery scattered over the surface. I was eager to get on but as usual we had to stop and accept an invitation to tea. Bokh-mi-Bagh, the next site on was more rewarding. On one side of a spring rose a high bluff with a mound on top. The pottery from this showed it to have been occupied from the fifth millenium onwards and we began to collect samples, helped by a crowd of small children from some nearby tents. Across the stream a second bluff was crowned with the familiar scatter of large, flat boulders which showed where the Lurs had ransacked a graveyard. I sat down to take a photograph and was immediately faced with a long line of ragged little boys all dying to be included!

Presently, the children's parents arrived with offers of lunch which we

accepted. As we tried to swallow a rather greasy omelet I passed round a book containing pictures of the various bronzes, and asked our hosts which types they had found there. This method had often been successful in the past but here the locals were more cagey and we could find out very little. After drinking yet more tea—we usually managed to average between fifteen and twenty glasses each a day—we rode on up the valley.

We investigated five more sites before evening and eventually stopped for the night in yet another encampment. As usual we were made comfortable in the small ceremonial end of the tent which was tastefully furnished with rugs and cushions, and separated from the women and animals' quarters by a reed screen. As we sipped our tea I noticed a row of black eyes peering over the top of the central partition. I grinned at them and they vanished to the accompaniment of much feminine giggling. I lowered my eyes and back they came. I turned to Mr. K.

"Can I go next door?"

He nodded assent and we went round the partition.

The second room was much longer than the first and considerably less civilised. In a group around the fire squatted nearly a dozen women and children. Some of the young girls were really beautiful with dark lustrous hair, clear skin and perfect teeth. They wore long, flowered tunics that reached their feet, velvet, coin edged waistcoats, and fringed turbans—in complete contrast to the men who tried to be 'western' in pyjama trousers and shabby double breasted jackets. An old matriarch sat by the fire dismembering a chicken into a huge stew pot. Her wrinkled face and hands would have suggested an age of around sixty had she not still been suckling a child. Older children squatted on the pile of dried sheep's dung that fed the flames. Beyond the limit of the lamp light the sound of steady munching accompanied by small bleats proclaimed the presence of livestock, while sheep dogs lurked in the half light between.

We sat down and began conversing in a mixture of pidgin Persian and signs. They were intensely interested in Kay and me. What were we doing here? Why weren't we in England looking after our husbands? We didn't have any. No husbands! What on earth were our families about? I had already had this one out with Mr. K. who explained that the Englishmen were sensible people who expected their wives to earn money after they had married. When my education was complete I would become a teacher and then take a man. There was a pause while they digested this—then asked what the bride price for such an obviously valuable woman would be. I explained that such things did not exist in England and they shook their heads. Truely Englishmen had an easy time of it!

At this stage in the conversation one of the girls appeared with a large pan of dough and a convex tin tray which she placed over the hearth to heat. Scooping up a handful of dough she patted it into a neat pancake. Then, in a single uninterrupted motion, she picked it up, rotated it rapidly between her palms till it became the size of a wheel and paper thin, and flung it over the heated tray to cook. It was one of the deftest manoeuvres I had ever seen and I watched, fascinated, until offered a chance to perform myself.

Continued on page 39

GEOPHYSICAL AND GEOCHEMICAL MARINE SURVEY OF CORNWALL

By Nigel C. Kelland

Personnel :

Research workers: W. N. Li, J. Wheildon, P. Ong.

Diving team: N. C. Kelland (*diving leader*) D. Durney, Miss L. J. Dunn, E. Sigurdson, R. Wiley, M. Weeks, F. Davey, D. Welch, R. Warton, B. White, R. Pullin, A. Kingwell, J. McKie, P. Jenkins, R. Powell, J. Love.

Introduction

Ever since the advent of civilization man has had many uses for the mineral wealth to be found beneath the surface of the ground. In by-gone ages the search and exploitation of these various resources was generally ill-planned and inefficient. It would often rely on either discovering surface evidence of mineralization, or on intuition and intelligent guess work by the miner.

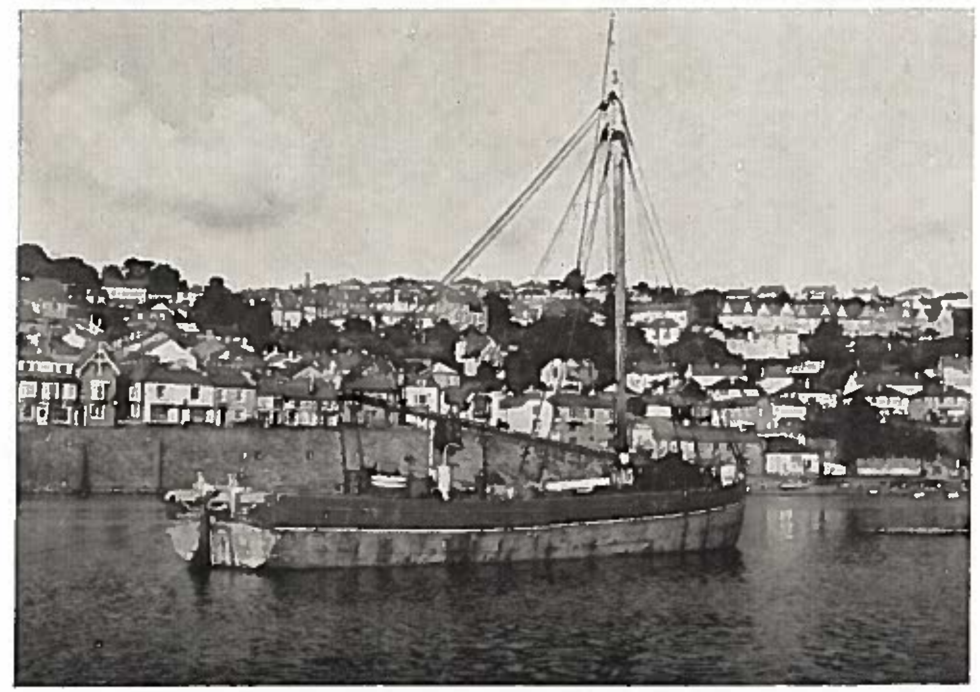
The present century has seen the introduction of the various methods of geophysical and geochemical exploration in the search for new mineral resources. These methods are unable to indicate the exact location, quality and quantity of any given ore, but they can be used to indicate the most likely areas of mineralization. Further, a proper analysis of the results can, sometimes, give the depth and extent of an ore body. Thus it is possible to plan the optimum location for trial drillings, and eventually the main mine shafts.

This type of work is being carried out successfully today in many land areas of the earth. However, such exploration is confined to the land areas of the earth's surface, an area covering a mere 29 per cent. of the total surface. Consequently it is of interest to extend the various exploration methods to continental shelf areas. Unfortunately, the techniques of geological, geochemical and geophysical prospecting which are applied to sub-aerial geology are unsuited to the underwater world, and it is necessary to devise new techniques.

Within the last four years the Geophysics Department of Imperial College has been engaged in various research projects related to developing exploration techniques for marine areas. Their investigations have involved the Sparker method, various electrical methods, and the use of a towed magnetometer. This work has been carried out, in the main, off the coast of Cornwall. This summer the work was continued, and the Geochemistry Department also decided to launch a research project related to marine exploration.

Geophysical measurements, however, are insufficient in themselves due to the ambiguity inherent in their interpretation, and must be correlated with geological

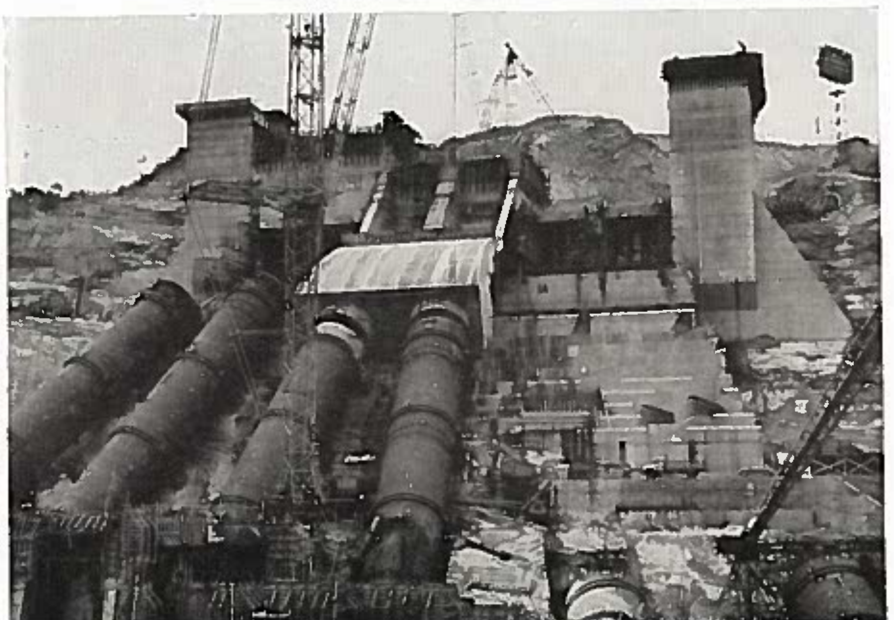
Above: *Percussion chipping hammer.*
Left: *Air line diver prepares to go under. Note: safety bottle; air line; telephone line.*



Diving vessel 'Shamrock' *in Newlyn Harbour*

OVERLAND TO GHANA

The expedition sheltering from the intense sun — Beni Abbes, Algeria.



The penstocks and turbine hall under construction at the Volta River dam project, Ghana.

sampling. Geochemical exploration depends on the laboratory analysis of samples taken in the field, whether rock or sand, and also relies on some form of sea-bed sampling. It is in this very important problem of sampling techniques that, in waters down to 200 feet, the aqua-lung diver comes into his own. Also, further techniques of both sciences rely, for their efficient usage, upon some form of monitoring, and it is again in this connection that valuable work can be carried out by the aqua-lung diver.

Work Programme

In previous work done by the Geophysics Department in Cornwall, all the sampling work required could be performed by relatively few divers. This year the introduction of a geochemical research programme, together with the geophysical work, called for a much larger team. Also, the work continued from the end of April until the beginning of August. To fit in with the requirements it was necessary for the divers to work on a rota basis. From the end of April to the end of June two divers were available. From the end of June until the middle of July eight divers were in Cornwall, and from the middle of July the divers steadily decreased such that the final work was carried out by one diver. In all, 14 divers from the Imperial College Sub-Aqua Club were involved throughout the period.

Accommodation for the research team and two divers was provided in Lelant for the whole of the summer. The main diving team was accommodated in St. Ives from the end of June onwards. Transportation of equipment and personnel was provided by the Geophysics Department Landrover, and work would commence at about 7.45 a.m. when the Landrover arrived in St. Ives to collect the divers.

Diving Operations

The first diving work was in connection with Sparker observations in St. Ives Bay. This geophysical technique involves the production of a shock wave by a high voltage spark discharge below the sea surface. The acoustic energy is reflected by the sea-bed and any sub-bottom layers present and detected by a towed hydrophone. It is important to have an exact knowledge of the depth of floatation of both towed devices. The work of a diver entailed being in the water and gauging the floatation depth of the towing cable and the device, relative to a marker line.

Other work at this stage was mainly devoted to establishing an efficient method of carrying out sampling and temperature measurements. This work was performed, in the main, from a boat called 'Shamrock'. She was ideally suited for diving purposes, being a large (70 ft.) barge with a shallow draught and flat bottom, giving a large deck and cabin space and a low free board. An extra useful facility was a 30 ft. boom, which proved to be indispensable in the loading of various heavy pieces of diving equipment.

Three types of sampling can be effected underwater: sand or mud, seaweed and rock sampling, each with its own peculiar problems.

Sand sampling

In this case problems arise due to the continual sea water movement, and a consequent unknown factor in the degree of sand migration. Would a sand sample taken in any one area be accurately representative of that area? To investigate this problem it was determined to collect samples from the surface using a shovel and polythene bag, and to compare the analysis (grain size and composition) with the samples taken using a grab sampler and a geochemical auger. The first device was controlled from the surface, whereas the second required the use of a diver who would collect a sample about one and a half feet below the sea bed.

Using a shovel proved very easy and initial work was performed by divers equipped with air cylinders. The grab sampler was operated from the surface, and in the beginning its performance was checked by a diver. The augering proved a far more difficult task and required about 10-15 minutes of hard physical work to twist it to the required depth. The analysis of the sand samples showed that the diver or grab collected sample was sufficient.

Rock sampling

Analysis of in situ rock samples is more diagnostic of the presence of any anomalous distribution. Three types of rock samples were collected; Killas or slates, a harder metamorphic diabase called blue elvin, and a very hard granite. The initial collecting work was carried out using a geological hammer. This proved suitable for sampling the softer rocks, but it was impossible to obtain any granite. For this purpose we were fortunate to have the use of a low pressure percussion hammer, on loan from Holman Brothers, Ltd., of Camborne. This hammer was tested in depths up to 110 ft. and an efficient sampling system was worked out.

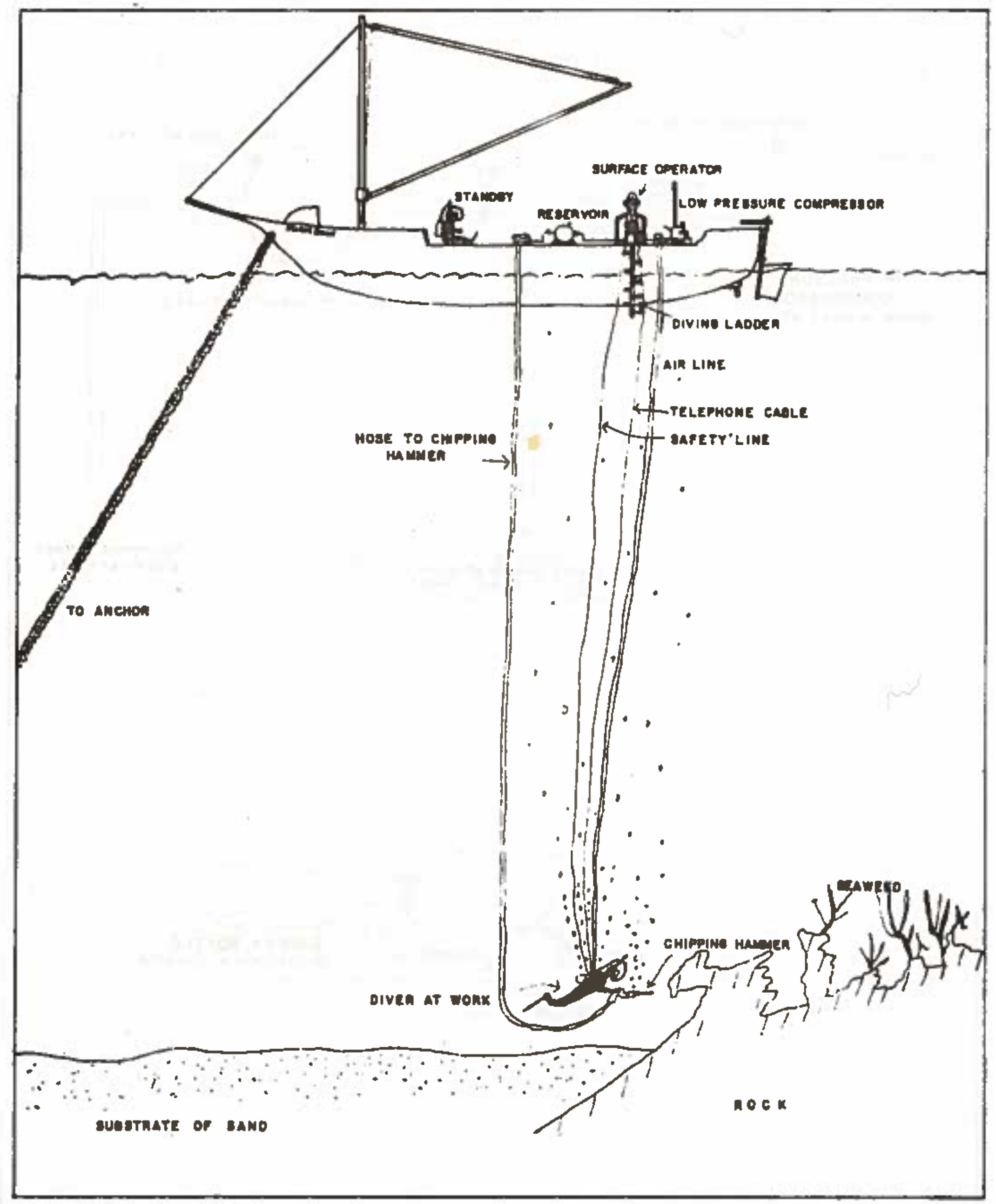
Other work involved the development of a thermal technique for detecting changes in rock type, or the presence of sulphide mineralisation. The early work led to the development of a weighted device which automatically forced the temperature measuring heads about six inches into the sediments. However, analysis of results showed that a penetration exceeding one and a half feet was required. This could only be achieved by divers who could knock the probes the required distance into the sediments.

Throughout the summer divers were further employed in monitoring the underwater performance of such devices as dredges and corers. In fact this latter work, although unsuccessful, proved to be the most exciting, and even hazardous, of the whole summer.

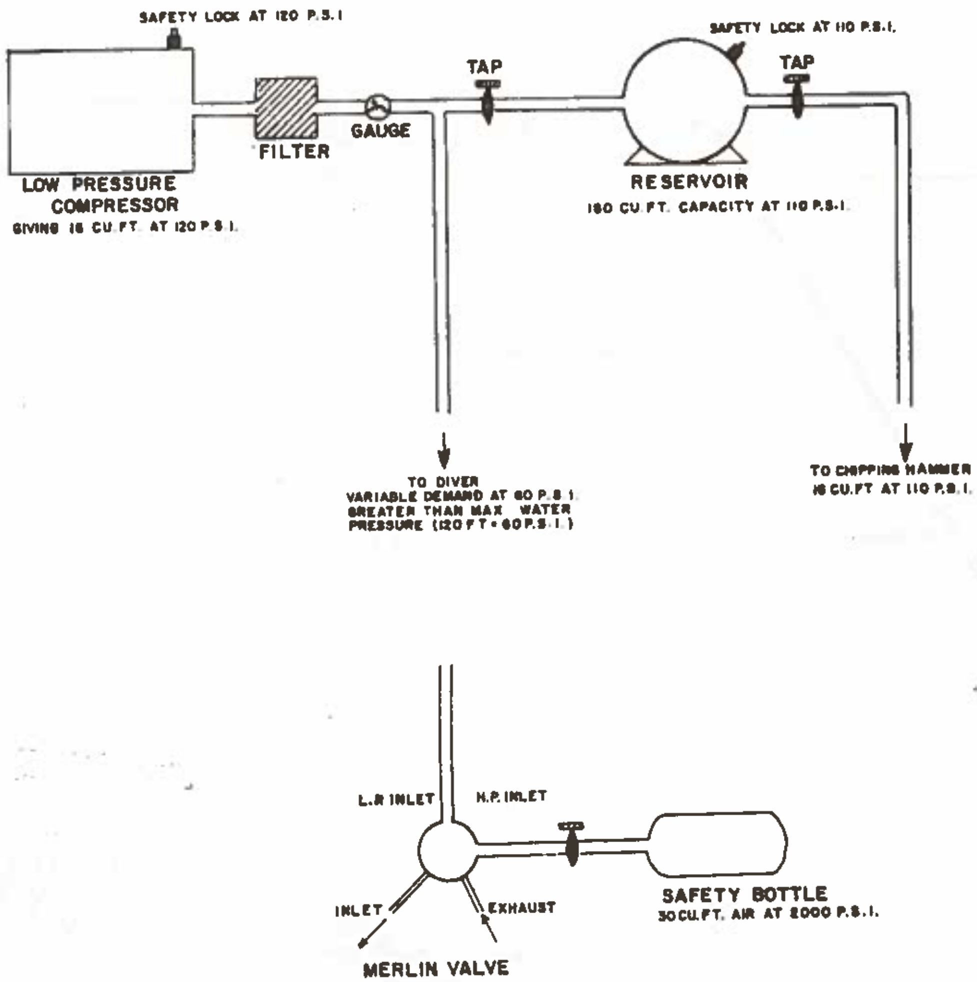
Diving equipment

Initially all work was carried out by divers equipped with air cylinders. However, air cylinders seriously limit the duration of any dive, especially in deeper waters. Further, they are awkward and heavy, and must be refilled regularly. This last factor was especially annoying at the beginning when the only supply of high pressure air was provided by a bank of British Oxygen cylinders. Later, the Club high pressure compressor was mounted on board 'Shamrock'. This was used to refill the bottles immediately after the completion of a dive, and greatly added to the efficiency and ease of the survey.

However, much of the rock sampling did not require the mobility provided by the diver wearing air cylinders. Consequently, a diving system was introduced utilising a low pressure compressor. This could supply unlimited quantities of air, via an air line, to a diver down to depths of 120 feet. As a safety precaution the diver carried a small reserve high pressure cylinder on his back. Every diver was trained in its use by the simple expedient of stopping the compressor when he was about 40 feet below



Air line diver at work from 'Shamrock'



LOW PRESSURE AIR SYSTEM ON 'SHAMROCK'.

the surface. Such a system was seen to allow the most efficient usage of the diver, with the minimum effort, as well as being more economical.

However, an important limiting factor in diving is that of decompression. When a diver is working in deep water his system accumulates nitrogen, and should he remain under water for any excessive length of time he must stop, whilst ascending, and decompress. The decompression time increases with the time of dive and the working depth. Also, excessive physical exertion under water increases the respiration rate, and compensation must be allowed for this. Thus, although the air line allowed the diver as much time as he desired, his physical and physiological limits now dictated how long he might dive. Such considerations as these, coupled with the very real limitation of a low water temperature, made the early divers look forward to the arrival of the main team.

The low pressure air compressor was also used to provide the air required for the percussion hammer. One test with this instrument demonstrated its working limit to be 115 feet, this being 95 per cent. of its calculated maximum. A second carefully controlled experiment demonstrated that, provided a large reservoir was in the air circuit, it was possible to provide sufficient air for the percussion hammer and the diver simultaneously. As a result of these experiments, subject to the proper working of the percussion hammer, this system was used in obtaining nearly all the rock samples. In fact it was obvious that without such a system, the required rock sampling work could not have been successfully carried out. However, considerable maintenance difficulties arose due to the severe corrosive action of the sea water on the percussion hammer, and necessitated it being thoroughly cleaned every few hours. (Other difficulties were those associated with the high noise level, although this could be overcome with practice.)

An exceedingly important aspect of any diving operation is the level of safety precautions. During this past summer circumstances showed that the precautions taken were adequate and satisfactory. At all times a safety diver was "kitted up" on deck ready for any emergency. The actual working diver was connected to the surface via a safety line and a telephone line. Further, when working off the low pressure compressor, he had an additional air line connection with the surface. This last connection provided a convenient safety precaution as it was possible to "hear" the diver breathing from the variation in the compressor revolutions.

The most efficient and satisfactory safety link was that of the telephone. A surface operator wore a conventional head set and a transistorized amplifier strapped to his belt, and could listen to the diver breathing at all times. The diver wore a bone conduction transceiver against his head. Communication from surface to diver was very simple, but, due to the impediment of the mouth piece, it required considerable practice for the surface operator to fully understand the diver. The advantages of a telephone were demonstrated during the experiment determining the feasibility of supplying both the diver and the percussion hammer simultaneously from the low pressure compressor. It was possible for the surface operator to hear the diver and to inform the diver continuously of the outlet pressure gauge readings as he descended. In the instance of a telephone failure conventional diving signals were used.

Manner of work

When working from 'Shamrock' one diver was dressed by tenders in the low pressure apparatus, and then completed two or three dives—the exact number depending on his total dive time as recorded by a surface control. If he reported sand on the telephone he would proceed to fill a polythene bag with sand using a shovel tied to his wrist. He would note such facts as the presence and characteristics of ripple marks. If rock was reported the chipping hammer was lowered gently on top of the diver's bubbles, and he would proceed to obtain a sample. Sometimes it was necessary to collect three or four samples along a traverse line planned to intersect, say, a granite-killas contact. In such an instance, using the telephone and ship's compass and noting the position of the diver's bubbles, the surface control could guide the diver, who also wore a compass, in the desired direction. This technique radically increased the diver's efficiency as a rock sampler because it removed the necessity of his returning to the surface after each sample, in order to retake his bearings.

Preliminary geochemical analysis of sand samples taken on a half mile grid covering practically the whole of Mounts Bay as far as Porthleven, revealed two areas as locations of possible mineralisation, and it was decided to implement more detailed bulk sampling in both areas. In this work a weighted line, approximately 1,500 feet long, was laid along the sea bed from the ship's gig, and anchored at both ends.

A diver, wearing air cylinders, swam down one anchor line and filled a polythene bag tied to the anchor, with sand. He then swam along the line 100 feet to where a second polythene bag was tied, and proceeded to fill it with sand. This was repeated at intervals of 100 feet along the whole length of the line. The diver was connected by a telephone and a life line to the gig, and reported to the surface control his depth, the state of the bottom, and his position along the line. Thus it was an easy matter for the surface control to maintain the gig exactly over the diver.

When a line was finished it was pulled in, the sand samples transferred to proper sampling bags, and the complete procedure repeated for a second traverse. Meanwhile, the air cylinders, which were now empty, were refilled aboard 'Shamrock' from the high pressure compressor.

During the final two weeks the divers worked with the temperature probe method. This was performed from a very sea-worthy fishing vessel in St. Ives Bay. Such a boat was not really suited to diving, and a day's work was preceded by a prayer for fine weather and a calm sea.

A diver, wearing air cylinders, swam to the bottom carrying a long probe, which he would knock about one and a half feet into the sea bed using a mallet. After each dive, when the probe had come to equilibrium, the temperature was measured. The diver then re-entered the water and attempted to knock the probe a further one and a half feet into the sand. The divers found the effort required so great that it took up to twenty minutes to knock in the last six inches.

Thereafter, measurements were taken at different Decca points in the bay. Great difficulty was experienced in this work due to the severe ground swell of St. Ives Bay which swept the diver away from the probe such that only one in three hammer strokes connected.

Achievements

The total diving time logged throughout the summer was 69 hours and five minutes. In this time 879 samples were collected, 79 dives made in connection with temperature measurements and 20 monitoring dives. The working depth varied from 0 to 155 feet, although the majority of work was in water not exceeding 100 feet.

All the work carried out was 100 per cent. successful, and detailed scientific results will have to await publication of the various theses. One member of the expedition has been summarising all the information in a geological map of Mounts Bay, but this is, as yet, incomplete.

Perhaps the most important outcome of this work has been its value in pointing out the advantages to be gained by employing the aqua-lung diver in marine geophysical and geochemical work in this country.

LURISTAN 1964 *Continued from page* 31

Like a coward I refused. I was very tempted, but remembered a disastrous occasion formerly when I had tried my hand at spinning, thinking it looked easy. Never had the prestige of the British Empire fallen so low in one evening. Moreover, the matriarch kept offering me choice bits of chicken's innards . . . I escaped back to the men's side and began marking today's new sites on the map which was already becoming gratifyingly spotty. Tomorrow we would go on to Sarabgar. The next day get the transmission repaired. Afterwards . . .

I turned to Mr. K. "What's the area like here?" I mentioned a village a little way to the north.

His eyes lit up. "Very good. We found many, many bronzes. Fifty kilos!"

Kay, who had been dosing, came to life. "How many sites?" she asked unbelievingly.

"One or two".

"Only two? With those many bronzes?"

"Well perhaps three or four."

"And the roads. Do you know them?", Kay asked warily.

Mr. K. started to protest, caught her eye, and subsided. "Better than today" he announced eventually.

"Are you sure?"

"*Bali, bali,* I know everyone there. All brothers!" He crooked his two fingers together and beamed at us toothlessly and triumphantly.

Q.M.C. OVERLAND EXPEDITION TO GHANA 1964

By J. Keith Nelson

ON June 24th 1964, the five members of a team from Queen Mary College, London, set out in a long wheel base Land Rover to attempt one of the most treacherous journeys in the world — the Tanezruft crossing of the Sahara Desert in mid-July.

The expedition, composed of four engineers and one chemist, took the overland route across north west Africa in order to reach Ghana, where a survey of the electricity distribution system was carried out with the co-operation of the Ghanaian government. Before the departure date, many months had gone into planning, equipping and catering for this expedition, as well as the ground work undertaken for the survey. One of the reasons for choosing Ghana as the country in which to undertake such a survey, apart from the lack of any language barrier, was the vast Volta dam project. When the dam is completed it will produce a lake of about 3,300 square miles in area, the power from which will revolutionise the economy of the country. We were fortunate in being able to obtain a vehicle already equipped for expedition work, having a power driven winch, many reinforcements and almost enough spare parts to build another vehicle! We were also indebted to a large number of industrial firms and other concerns who gave either direct gifts or concessions without which the expedition would never have been possible.

After the University examinations, two weeks were spent in final preparations and in overhauling the Land Rover. With the paperwork behind us, we drove to Dover and took the night ferry to Calais. Although many hundreds of pounds overweight, the Land Rover performed very well, and it took the expedition just under a week to make the journey through France and Spain to Gibraltar. A one night stop there enabled us to avail ourselves of some cheap, high quality petrol, before crossing to the north coast of Africa. This crossing was made, not from Gilbraltar, but from Algeciras in Spain to Ceuta in Morocco.

Once on African soil the vehicle, as if in protest, began to lose oil from the engine at the rate of about half a gallon a day. This meant that the mechanics had to spend two days in stripping the engine down and replacing an oil seal. At this point the temperature and extreme dryness of the climate reminded us quite suddenly that the fringe of the desert was not far away, and the true value of water was at once appreciated by all. On driving further inland the vegetation began to give way to scrub and eventually to sand. This was Arab country and anything that was bought had to be bartered for, and nothing could be left unguarded for an instant. Strolling wide eyed, hand upon wallet through the teeming back streets of a Moroccan town with the unlikely name of Oudja, we passed the melon seller's stall crowded with soft, green water melons and fat, well-fed flies. We also came across a man trying to sell a Gourba — a goatskin bag used by the native people for keeping their water cool. After bartering for it, we bought it, and for weeks it hung decapitated, upside down on the side of the Land Rover. It wasn't very successful however, and eventually it was decided that it was only good for radiator water.

Colomb-Bechar was the next place on the map and in fact it was the last town of any size before the great desert was to challenge us. It was here that we made our pre-arranged rendezvous with a medical team from University College, London, who were to have crossed the desert with us, taking readings and observations to ascertain the way in which the human body will perform and react when subjected continuously to elevated temperatures. It was here also that we realised that our overweight problem was going to be greater than was originally anticipated and, in order to be able to take on further reserves of fuel and water, it was found necessary to make a dump of all non-essential items with the French Army stationed there. On crossing over into Algeria, the expedition was faced with multiple rows of electrified barbed wire at the frontier, and there was still a mined area as a result of the Algerian war, to pass through which, we had to enlist the services of a local guide. At this point the road disappeared, and the route continued as a rough track across an immense dish-shaped plain of sand. Mirages could be clearly seen floating in front, and a thick curtain of dust arose behind the Land Rover. Occasionally, a solitary antelope would bound away over the naked tufts of grass shimmering in the heat.

The party had chosen the Tanezruft or westerly crossing of the Sahara. The other crossing, usually called the Hoggar, is often considered less dangerous, especially during the summer months, by virtue of the fact that there is more water available and less sand with which to contend. However, the crossing was being attempted at a time of year when the rainy season prevails in West Africa, and it would have been little use if we had succeeded in making the easier eastern crossing of the desert but failed to reach Ghana due to flood water, which often makes the southern end of that route impassable. That is the irony of nature! On reaching Adrar, the party was held up and also learned that since the French Army had moved out of Algeria, the petrol dumps in the desert were now a thing of the past, and it would be necessary for us to carry 100 gallons of petrol and about the same volume of water for the 1,000-mile crossing of the hottest stretch of the desert. Due to the delay in Adrar, the medical team decided that they would not have sufficient time to make the crossing worthwhile and so retraced their steps after we had agreed to continue their investigations on body reactions in Sahara temperatures (about 130°F in the shade). Essentially this meant carefully monitoring both solid and fluid intakes and outputs for each member of the expedition each day. Accounts were also taken at quarter of an hour intervals of everyone's activities — sleeping, sitting, labouring etc. Urine samples were also taken daily, and these were brought back to London for analysis.

We eventually decided to take the risk of the difficult stretch of the crossing, and we set out from Adrar with the vehicle 2,000 lbs overweight but with morale high. Since there is no road, the sole means of navigation is to follow the tracks of vehicles that have gone before, and for the most part this is satisfactory. However, since few, if any, vehicles had used this crossing in the two months preceding our crossing, the wind had smoothed over the tracks in places making them difficult to follow especially at night. This problem of getting lost, coupled with the obvious perils of breakdown and lack of fuel and water, comprise the main hazards to life which are encountered. Although as a whole the expedition was fortunately free from illness, one member did suffer from a mild form of dysentery and another was affected with heat stress for about a week. However one thing was common to all the party and that was the ill and inert feeling caused by salt deficiency. It was found necessary to take about 15 gm. of salt a day to replace that lost through perspiration. This was not the only problem, however. The wheels of the Land Rover often stuck in deep drifts of sand, even with the power of the engine fully utilised in four wheel drive. In these circumstances there was nothing for it but to get out and dig the wheels out, using sand mats to provide added traction.

It is certainly a journey that is the experience of a lifetime and not to be regretted by anyone who succeeds in making it. Nevertheless, the memory of unquenchable thirst, sweat-caked shirts and the intense heat and glare is enough to make any man examine his senses. It is easy for those who have made the journey to recount how difficult it was, in the knowledge that the people to whom they talk are never likely to go and find out for themselves. Certainly it is a difficult journey in mid-July and the desert is a place to be respected, but for a well equipped party it is far from impossible.

At the southern end of the desert, the expedition came across a convoy of lorries travelling north, and after this more and more signs of life, both animal and human, were encountered as the sand gradually gave way to vegetation. On reaching Gao in Mali, the danger was over, and the problem became one of too much water! In places the track was completely flooded, often up to considerable depths, and here again the Land Rover proved invaluable. The experience which we had gained with the Arabs stood us in good stead for knowing how to approach officials in West Africa (many of whom cannot read or write), and as a consequence much of the trouble promised us was avoided.

Within a week the expedition was on Ghanaian soil. The journey from Gao to Ghana was relatively easy after conditions experienced in the desert although, of course, there were no proper roads. As we journeyed through the small African states of Mali, Niger and Upper Volta, we were at once struck by the complete lack of any development and in most places little evidence of much civilisation. Mud huts and naked bodies were the order of the day. Ghana itself is a much more organised country which is developing fast and making education at all levels available to increasing numbers of its population.

The party at once made its way to Accra which was to be the base for the first ten days of the survey work. These first days were spent acquainting ourselves with the distribution networks in the regions of Accra and Tema. Much time was spent talking to engineers and touring power and sub-stations, as well as investigating the main areas and applications of consumption. In most areas, electrical power is used for lighting only and so most of our attention was directed towards its use in industry — the steel works and oil refinery at Tema being two of the most important consumers. We were also particularly interested in the nature and extent of the problems facing the supply industry in Ghana which are not encountered in this country. Problems in this category include centralisation, the effects of humidity, lack of engineers etc . . .

At the end of this preliminary period, the expedition drove north to visit the vast new Volta River project which, when completed, will provide the power for almost all the country. Following this, the rest of our month's stay in Ghana was spent touring all the major consumer areas in the centre and south, with special reference to those places which are projected sites for sub-stations on the proposed new grid which is being set up to distribute the power provided by the dam. This tour also included visits to the two major gold mining areas in Ghana as well as a thorough study of the electrical aspects of the two main harbours. However all these material and technical advances have to be viewed alongside the mud huts,

Continued on page 48

BOOK REVIEWS

THE NAGA KING'S DAUGHTER

By Stewart Wavell

GEORGE ALLEN & UNWIN LTD., 1964. PRICE 42s.

According to legend, the Naga King's daughter founded a civilisation which dominated South East Asia for nearly 2,000 years and left behind a culture, remnants of which have survived into the 20th century.

This book is a result of the Cambridge University Expedition to South East Asia in 1962, a short account of which appeared in the *Exploration Review* in 1963. The expedition was made up of anthropologists rather than archaeologists and its aim was to film and record the cultures of the east coasts of Malaya and South Thailand in an attempt to trace the remaining vestiges of the old civilisations. The personnel included Stewart Wavell, the author of the book, who is at present Programme Organiser of the Burmese Section of the B.B.C.

The book is an informal account of the expedition's travels and it makes absorbing reading. The author has a very easy style and has succeeded in making the book detailed but not too involved, the descriptions of dances and shadow plays being particularly fascinating. Another interesting aspect of the book is the underlying current of mystery, and in parts it reads almost like a detective story. Among the conquests of Funan, the kingdom founded by the Naga King's daughter, were the legendary kingdoms of Tambralinga and Langkasuka but their history is surrounded in mystery. For example, the ancient capital of Tambralinga was said to be one month's journey by river from the sea, yet the Malayan peninsula at its widest would not take a month to cross. The location of the capital has thus been a matter for conjecture and it is not until the last page of the book that the author is able to suggest an answer to this puzzle.

There are only two small criticisms to be made of the book. Firstly, there is room for improvement in the maps. It is essential for maps in a book such as this to include all place-names mentioned in the text. This would make it far easier to follow the journeys of the expedition. Secondly, a glossary would have been very useful. These are, however, minor criticisms of an otherwise excellent book and it is to be hoped that its publication will help to stimulate greater interest in the history of South East Asia.

PAUL ROGERS.

ANTARCTIC RESEARCH

A Review of British Scientific Achievement in Antarctica.

Edited by Sir Raymond Priestley, Raymond J. Adie and G. de Q Robin

Butterworths, 1964, price £10 10s.

This remarkable volume of over 300 pages forms the most recent authoritative journal of the Antarctic continent. In many ways the book resembles an

GUEST CONTRIBUTORS

G. R. Elliston is a geographer (now at Hull University who, as a Cambridge undergraduate took part in glaciological expeditions to Norway (1956) and Iceland (1957). Later, as a research student, he worked in the Alps — principally on the Gornergletscher, on which he spent a total of eighteen months investigating seasonal changes in the speed of flow.

Clare Goff graduated in history at Edinburgh University in 1958 and then tried teaching for a year. To her intense relief she was accepted as a draughtsman on a 'dig' in Turkey and remained there for the next eighteen months, alternately teaching English and digging. She then obtained a Wolfson Fellowship at the newly created British Institute of Persian Studies at Teheran for two years. Clare is now at the Institute of Archaeology, London, studying for a Ph.D. on the results of field work started in Teheran and completed during the expedition described.

L. P. Kirwan is the Director and Secretary of the Royal Geographical Society and Editor of the *Geographical Journal*. His interest in East Africa is shown by the following activities in which he has taken part:—Assistant Director of the Archaeological Survey of Nubia (Egyptian Department of Antiquities), 1929-1934; Field Director, Oxford University Expeditions to the Sudan, 1934-1937; Exploratory journeys to Eastern Sudan and the Aden Protectorate, 1938-1939. Since 1961 he has been President of the Governing Council of the British Institute of History and Archaeology in East Africa, and in the following year he became a Governor of Imperial College.

J. Keith Nelson is in the final year of a degree course in Engineering at Queen Mary College, London. He is president of the Q.M.C. Exploration Society (1964-1965).

John Oates is in his second year reading Zoology at University College, London. He is on the committee of the University College Exploration Society and is chairman of the Zoological Society. He is amongst zoologists planning an expedition to Rio Muni, Equatorial Africa, for next summer.

Paul W. Sowan is a schoolmaster teaching general science at a south London secondary modern school. He graduated in geology, is a Fellow of the Geological and Royal Geographical Societies and Honorary Secretary of the Croydon Natural History and Scientific Society and the Anglo-Icelandic Field Research Group. His particular interests, apart from volcanic geology, are further education and the introduction of young people to field studies.

Major Keith D. Young was not meant to have an uneventful life by any means. Other than military service his occupations have included three years as a stunt pilot with an Australian flying circus, pearl diving, screen acting and directing, crocodile shooting, buffalo hunting, yacht racing, and leading an expedition to New Guinea. He is considered by the U.S.A.F. to be one of their foremost survival authorities by virtue of his experience which includes survival of two shipwrecks and five air crashes. As O.I.C. Combat Survival Center, Ramstein Air Base, Major Young is adequately qualified to write on the subject of a 'Personal Survival Kit'.

IMPERIAL COLLEGE EXPEDITIONS

Up to the present time, the following expeditions have been supported by the College:—

1938 Jan Mayen Island Expedition—Greenland Sea.

1956 Eastern Iceland Expedition.
Carmargue Expedition—Rhone Delta.
Norway Expedition—Allfonbreen Glacier.
Swiss, Himalayan Training Expedition.

1957 Karakoram Expedition—Led by Eric Shipton.
Ghana Expedition.
Arctic Norway Expedition.

1958 Ghana Expedition.
Norway Expedition—Voss.
Eastern Iceland Expedition.

1959 Apolobamba Andean Expedition—Bolivia.
Azores Expedition—underwater.
Greece Expedition—biological.
British Guiana Expedition.
Eastern Iceland Expedition—geological.
Jan Mayen Island Expedition—Greenland Sea.

1960 St. Kitts Expedition—all women.
Around the Atlantic Expedition—Africa and the Americas.
Iran Expedition.
Eastern Iceland Expedition.
Central Iceland Expedition.
Cornwall Expedition—underwater.
Spitzbergen Expedition.
Ghana Expedition.
Kashmir Expedition—overland.

1961 Beerenberg Expedition—Jan Mayen.
Oksfjordjokul Expedition—Arctic Norway.
Malta Expedition—underwater.

1962 Hornsund Expedition—Spitzbergen.
Sicily Expedition—underwater.
Southern Ethiopia Expedition.
Nigeria Expedition.

1963 Beerenberg Expedition—Jan Mayen.
Ibiza Expedition—underwater.
Lanka Expedition—Ceylon.
Malta Expedition—underwater.
Sierra Leone Expedition.
Stauning Alps Expedition—Greenland.

1964 Gicce Cokka Ice-Cap Expedition—Arctic Norway.
Cornwall Expedition—underwater.

Q.M.C. OVERLAND EXPEDITION TO GHANA 1964 *Continued from page 42*

poor sanitation and tribal ways of the majority of the population. Nevertheless, the Ghanaians are a very hospitable people who are rightly proud of their country. However, at present, although Ghana has three universities and is doing all within its power to educate its population, it is still dependent on many Europeans out there in administrative and technical aid capacities.

The expedition was forced, mainly by lack of time and partly by mechanical trouble with the vehicle, to return to the U.K. by sea. The Land Rover was put aboard a boat sailing from Takoradi with three members of the expedition, and the other two followed on another vessel the following week.