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WORKING IN THE FIELD

An overview of field work

This chapter covers the operation of field data collection programmes in general terms. Although measurement practices covering rainfall, streamflow and evaporation will be mentioned as examples of field activities, each of those areas will be discussed in more detail in the chapters that follow. The focus here is on three important aspects of working in the field:

- field programme operation, including working with field teams and observers
- the operation of vehicles, including what equipment to carry in them
- fieldwork safety.

Although it is sometimes necessary for field teams to camp out in tents at remote field stations, the equipment and operational needs of camping itself are not dealt with in this chapter.

Part 1: Field programme operation

Introduction

In addition to travelling in vehicles to and from remote places, the management of field hydrology programmes presents many challenges, including:

- organizing and motivating field teams to work in remote, inhospitable and sometimes dangerous areas
- supporting and motivating observers based in those remote areas, many of whom may not be direct employees of the data collection organization
- training and supervising all field staff so that instruments are read correctly at pre-

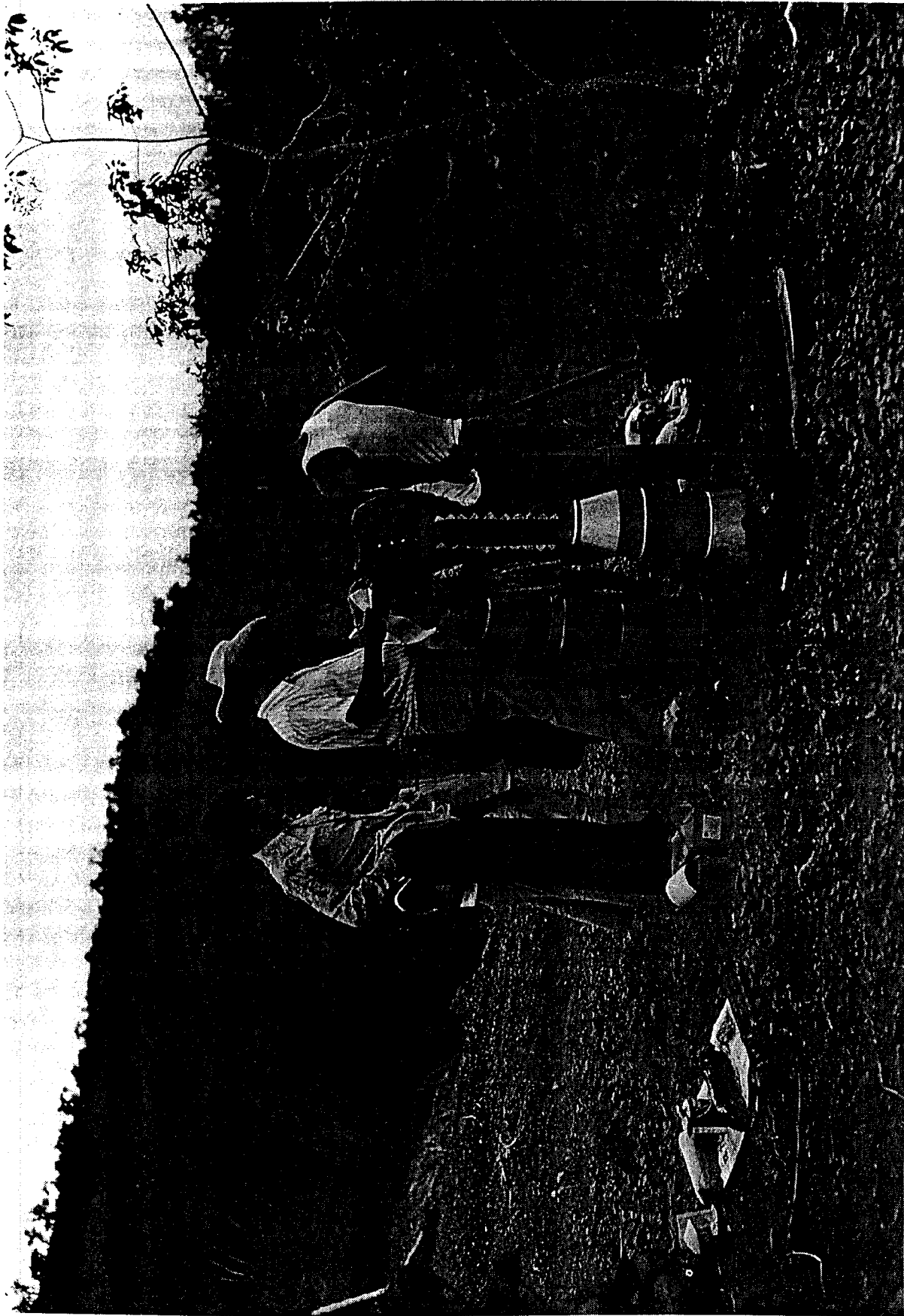
cise times each day and the data are correctly recorded

- encouraging observers and field teams to continue working (within safety limits) during extreme rain and flood events, when they may be asked to take additional readings under difficult conditions at any hour of day and night
- organizing instrument maintenance and the supply to observers of renewables such as charts, data recording forms, field notebooks and sunshine recorder cards.

Some field stations are operated by an observer who lives nearby. Others have no observer and the instruments operate unattended during periods between visits by field teams. Some observers will be full-time employees of national hydrological or meteorological departments. Others may be farmers or schoolteachers who have volunteered to read a raingauge once a day, and who may or may not receive formal payment for doing so. Data collection programmes for a group of field stations are supervised by hydrological field teams. The members of these teams are usually based at the headquarters, or at a regional office, of the national hydrological organization.

Regular inspection visits to field stations

It is essential that field stations are visited regularly so that records can be collected, equipment checked and operations discussed at first hand with the observer. There is a danger in putting off field inspection visits, especially when station record sheets arriving by post at headquarters look satisfactory – or when there



A woman observer being instructed in operating a long-term storage raingauge (Ecuador).

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is a shortage of vehicles available for field teams to use. However, it is most unwise to allow a timetable of regular field station inspection visits to be changed.

The whole purpose of field hydrology is to produce continuous, unbroken records of good quality data. If you can identify and solve a possible instrument problem during a routine field inspection *before* the instrument fails to operate correctly, you have helped to maintain the unbroken record of data from that site.

Will the observer be there when you visit?

Except at important meteorological stations, such as those at airports, even observers who are full-time employees are likely to have duties away from the field station during the working day. Part-time observers who only read a rain gauge each morning obviously have other commitments. It is therefore most important to confirm with an observer that he or she will be on site at the time when a field team wishes to visit the station. It can be very frustrating to arrive at a station towards the end of a morning, only to be told that the observer will not be back until the evening. However, if there are no station reading responsibilities in the afternoon, and if the inspection visit was not arranged in advance, you cannot blame the observer for not being on site. Either agree a definite date and time for a next visit each time you are at the station, or use telephone or letter post to advise when the field team plans to visit.

Never rush a site visit

Always take time to talk with the observer, and listen for any comments on unusual readings or hydrological events. A field team leader must always check through any completed data sheets and other records which are ready to be sent to headquarters, and discuss them with the observer before leaving the field station.

The more distant a measurement value becomes, in time or place, from the moment

and the site at which it was taken, the more risk there is of any errors in it passing unnoticed.

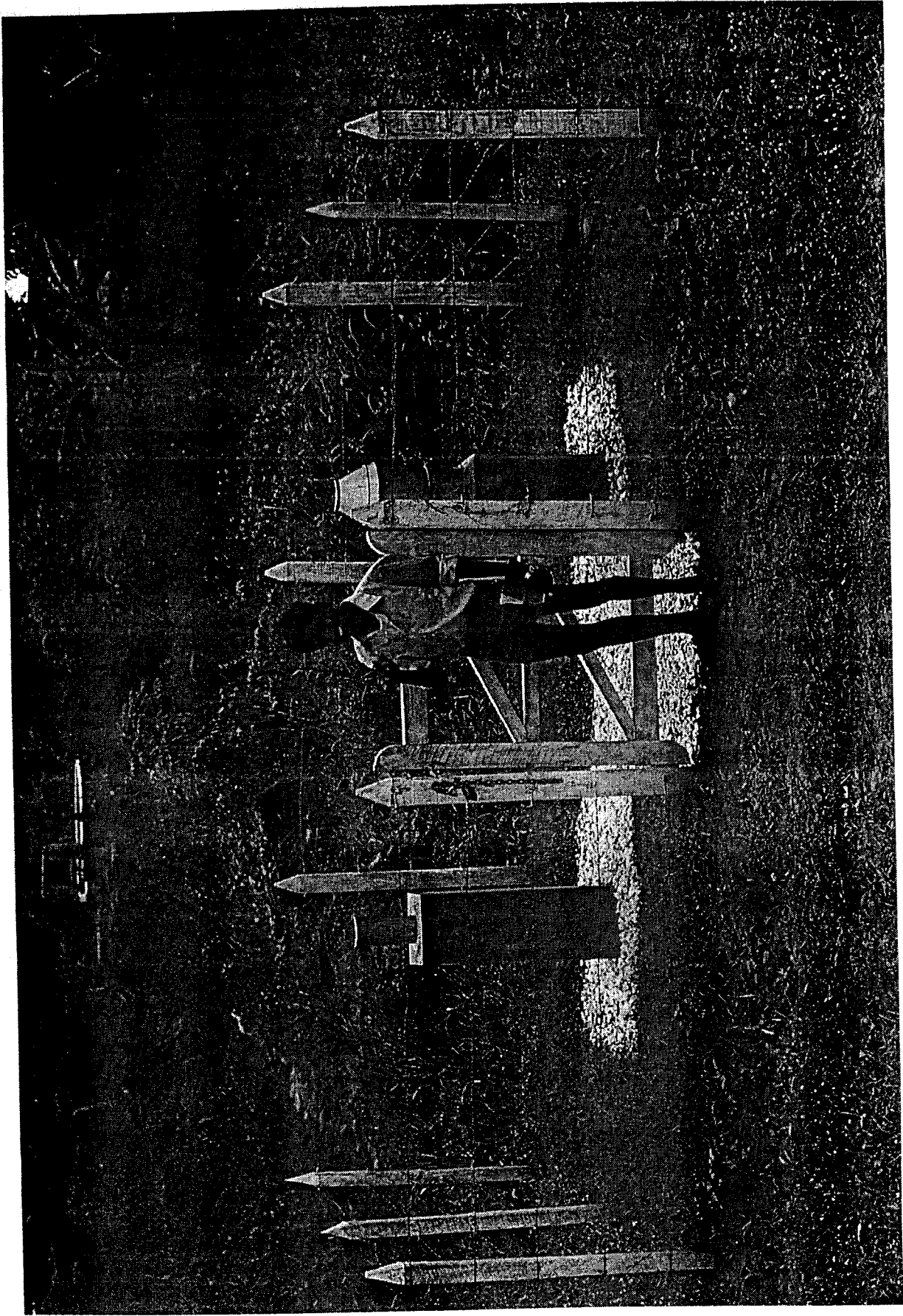
Take time to visit all the instruments on site and to discuss with the observer how well they are operating. By visiting the instrument the observer may be reminded of some problem which has not been noted down in the station record book.

Station record books – essential support to numerical records

Many of the instrument readings taken by an observer at a field station will be written directly on to standard data collection forms or field books. Examples are daily morning readings of rainfall, river water level and air temperature. However, a great deal of information on hydrology and instrument operation at field stations does not come in a form that fits neatly on to the standard data recording sheets. Examples are:

- When a flood occurs, lines of material carried by the flood waters are often left along river banks, indicating the highest level that the flood water level reached. The observer should record their position after the flood.
- The free flow of wind across a meteorological station (and therefore the correct value of evaporation estimates) is affected by any trees growing nearby. On which day were the trees cut back?
- Older designs of rainfall and water level recorders contain clocks which move the drums that carry the charts. When was each recorder clock last serviced or replaced?
- On which day did the elephant break down the meteorological station fence and drink from the evaporation pan?

Make sure that observers are provided with station record books in which to record this vital extra information. Discuss with them the sort of extra details which need to be noted, and tell them how important it is to write down the information as soon as possible, before it is forgotten. Observers should be encouraged to use these record books as a station diary, although



Daily and recording raingauges in fenced enclosure, with enthusiastic observer (Sri Lanka).

they need record information only on days when there is anything significant to record. Do not remove the record book from the station unless it is completed, and properly replaced by a new book.

Check everyone's handwriting – including your own!

Emergency! There has just been a peak flood on a major river and it is essential to know the value of the highest water level. An observer was on site and was able to read the river level gauge – but no-one can read the entry that has been written on the field data form. . . .

Make sure that all field hydrology information is written clearly on record forms and in field notebooks, using block letters if necessary. Look out for a 2 that looks like a 7, and a 3 that looks like a 5, and vice versa.

Remember that the staff who enter field data into computers at headquarters are usually not hydrologists. When punching large quantities of numbers into computers, the process becomes almost automatic. This means that if a number is mis-read from a field form because it has not been clearly written, the false value may go unnoticed into the data archive.

If an observer does not write clearly (especially numbers), discuss the matter and make a point of commenting favourably later if it improves – or unfavourably if it does not!

Can others read *your* handwriting?

Timekeeping for observers

A correct record of the time when an instrument is read is often as important as the numerical value of the measurement itself. An observer must therefore have a reliable watch or clock on site to ensure correct timekeeping. If the department is not able to provide a watch or clock for the observer officially, it may help to arrange a personal loan so that a watch can be bought and the cost paid back in instalments.

Whatever timekeepers observers use, check that the time they are keeping is correct. Time

checks provided by radio and television stations are very useful for checking clocks and watches each day.

Checking stocks of renewable items at field stations

A wide range of renewable items is required to keep data collection progressing smoothly at field stations. Requirements linked directly to measurements of rainfall or streamflow will be covered in detail in the following chapters, but examples include:

- data recording forms and notebooks
- charts and ink for recorders
- sunshine recorder cards
- batteries and data logger memory modules for electronic reading instruments
- pens, pencils, writing paper, diaries and wall calendars
- expense claim forms for observers.

The full list of renewables needed for an extended trip to visit a number of field stations will contain many items.

Where stations are staffed by observers, a regular stock of renewable items must be maintained on site, and a minimum number of each item to be kept at each station must be set. Field teams must carry stocks of renewable items and during every field station visit the team leader and the observer must together check the stock of each item. Minimum numbers can then be made up from the stock carried by the field team.

Field notebooks for team leaders

In the same way that permanent record books are needed at field stations, field team leaders must always carry a field notebook to record additional information, for example:

- The river level gauge board has been damaged by a large tree trunk carried down during a flood and must be replaced – check the station record book for the date when the damage occurred.

- How many water level recorder charts and sunshine recorder cards will need to be delivered on the next field team visit to maintain the minimum stock at the station?
- Over what period does the observer wish to be on leave and what alternative staffing arrangements must be made?

The field notebook can also be used to transfer important information from the station record book to the station record files at headquarters.

What if you lose your field notebook? Out on site there is a risk that your field notebook (and all the vital data in it) will become lost, dropped into a river or left behind in some remote place. Always have this risk in mind, and ensure that fresh information is 'downloaded' from the notebook as soon as you return to headquarters, as described in the next section.

Routing the notes from field trips at headquarters

The vital information collected in field notebooks is of no lasting value unless it is routed by field teams to the right destinations back at headquarters. There are three main routes to follow:

- Information related directly to quantity and quality of data being collected goes to the station record file which will be kept at headquarters for each field station.
- Information on repairs, work to be done and supplies needed at the station goes on to a Field Team Action List so that preparations can be made before the next field team visits the station.
- Information on personal matters raised by observers (some of which may be confidential) will be discussed with their line managers and the personnel department, as appropriate.

As mentioned in the last section, information from field notebooks should be transferred as soon as possible. Not only is it more efficient to sort out matters from a field trip as soon as possible,

but if a field notebook is lost on the next trip, valuable information will not be lost with it.

Keeping the observer's goodwill

An observer is required to read a river level, a raingauge or a meteorological site in a proper manner at regular hours. To do this, he or she not only needs good equipment, but also the motivation to do the job properly. Working in remote places can produce a sense of isolation. To an observer, headquarters seems far distant. It is probably in the country's capital city, where everyone seems far too busy to take any interest in his or her work or life.

The leaders and other members of field teams therefore have a special responsibility to win, and to keep, the observer's goodwill. Remember that the quality of the hydrological records taken at the station depends on the observer's motivation, unsupervised, to collect them properly. His or her motivation, in turn, is dependent on the amount of enthusiastic encouragement received from members of visiting field teams.

'My salary has not been paid'

Observers, like all of us, become upset if salaries and allowances have not been paid promptly. For staff based at headquarters, access to accounts and personnel departments is comparatively easy when personal salary and allowance problems need sorting out. Distant observers, however, may need visiting field team leaders to argue for them at headquarters if they have not been paid. For payments due other than salary, if the sums are not too large, it can help if the visit team leader makes the payment in cash direct to the observer (and obtains a signed receipt) during a field station visit.

Pay serious attention to any pay problems of observers. Isolation can magnify grievances against headquarters and produce disillusionment which shows up through poor quality work. Where the observer is officially due other

supplies, such as foodstuffs or wellington boots, as part of terms of employment, make sure those supplies are correctly delivered as well.

Personal loans

If observers are in a difficult financial position, possibly due to delayed payments from headquarters, they may ask field team leaders for personal loans. As hydrological departments usually have no formal method of making loans, these are an individual matter between the visiting team leader and the observer. It is essential that the terms of the loan are written down, with both those involved having copies. Personal judgement, tested over time, will establish those who work hard to repay loans, and those who do not!

'How are your crops and cattle?'

The discussion so far has mainly focused on the circumstances of observers who are employed full-time by the hydrological department. However, there are also many part-time observers who may be paid small sums (or sometimes nothing at all) to make one or more daily readings of rainfall or river level. The hydrological value to the department of the measurements these people take is very high, and every effort should be made to encourage and support them.

Always remember that although hydrology may be first priority in your working life, to a part-time observer who is a farmer or a school-teacher, taking the readings is only one of many priorities in a busy working day. Once again, do not rush a site visit. Take a little time to discuss matters such as:

- How are the crops growing this season?
- How are things at the school this term?
- Is the allocation of irrigation water satisfactory?
- Are the school pupils interested in the rainfall readings?
- How are the cattle doing?

As with full-time observers, make sure that any payments due to the observer are settled

promptly. Once again, direct cash payment by the field team leader against a receipt from the observer is often the simplest answer. If no formal payment can be made, think of other ways in which the field team can help. Can you transport something which is needed from the town on your next visit? Perhaps a sack of food too heavy to be easily transported by bicycle.

New equipment – and lost screws

Two final points on working with instruments in the field:

New instruments

If you are involved with introducing a new piece of field hydrology equipment into your country, make sure that it is fully tested before being placed in regular network use. If it is planned to replace existing network instruments with those of the new design, keep both types in operation at field stations operating for at least a six-month trial period – or through the next monsoon season. Remember the appropriate field hydrology approach, and give up using the old instruments completely only when you are fully satisfied that the new ones will provide reliable, continuous data sets.

Don't lose the screws

A danger when servicing instruments in the field is that screws, nuts and other small parts will fall to the ground and get lost among stones and grass. Carry a flat tray with raised sides on which to service instruments, and some flat bottomed tins (plastic pots can be knocked over) into which you can put screws and other components as you remove them from the instrument. Do the job on a flat raised surface – the back floor of a four-wheeled drive vehicle can be ideal for this type of work.

Part 2: Operation of vehicles

A basic rule

There is a basic rule of field work: to control the job, control the transport.

Well organized transport arrangements are essential, not only to get the work done but also to prevent field teams being stranded in dangerous circumstances with broken-down vehicles.

The African highway code

A very good, well-illustrated introduction to driving in tropical countries has been produced by United Nations Economic Commission for Africa and the U.K. Transport and Road Research Laboratory. Entitled *The African Highway Code: A guide for drivers of heavy goods vehicles*, two versions are available – one for countries where vehicles drive on the left and the other where driving is on the right. Although some sections of the text focus especially on driving heavy goods vehicles, most of the guidance given applies to all classes of drivers and vehicles. Details of the Code appear in Appendix 1.

Team leaders must control all vehicle movements

Drivers are key members of field teams, and team leaders must have good relations with them. However, it must be clearly understood at the start of any field trip that although the driver may have charge of operating (and probably maintaining) the vehicle, where and when it moves is entirely under the team leader's control.

If a driver has to be sent with the vehicle away from where a field team is working, the team leader must give clear instructions as to the driver's duties, and agree a planned time of return. At remote river gauging station sites, team safety can be at risk if the driver does not return at the expected time, due to having misunderstood the instructions given. Field trip vehicles carry all the team's equipment (including the first aid kit), so if the team becomes stranded, problems can arise:

- Lost time upsets field trip planning.
- Not all the maintenance tools and equipment needed on site may have been unloaded on arrival.

- Food, drink and first aid equipment have probably remained in the vehicle.

Don't lose your driver!

If a field station visit is planned to take a long time, the driver may wish to take a break to get food and drink, to do some shopping if there is a town or village nearby, or to visit a relation. The same operating rules apply as when a team leader sends a driver on official business. The team leader and driver must clearly agree a time when the driver has to be back at the station, with the vehicle ready to move on.

Keeping the vehicle rolling

The vehicle is the team's lifeline while on a field trip, so team leaders must check out its operating state with the driver before the trip starts. Do not be afraid to delay the start of a trip, especially when travelling to remote areas, if you are not fully satisfied that the vehicle is in proper working order. Breakdowns in remote areas can be annoying and possibly dangerous, so it is very helpful if at least one member of the field team, in addition to the driver, has a working knowledge of vehicle maintenance. Under field conditions a full repair may not be possible, but it will help greatly if the team has the skills to keep the vehicle moving so that it can be driven to the nearest vehicle mechanic's workshop.

Emergency drivers

Although many organizations in tropical countries insist that official vehicles should always be driven by official drivers, it is very useful if another member of the team can drive in emergency – the official driver may fall ill during a field trip.

Keep friends with the transport manager

In most hydrological organizations the responsibility for keeping vehicles in good running order lies with the transport manager, with whom the wise field team leader maintains good personal relations. Always remember that there are 'good' vehicles and 'not-so-good' ones

in any transport pool – you wish your field teams to be allocated the good ones!

What to carry in the vehicle

Before starting on a field trip, it is essential to check the equipment carried in the vehicle, which will include:

- equipment needed to carry out the field hydrology work
- equipment needed to keep the vehicle running
- first aid and safety equipment
- drink, food and the team's personal belongings.

Equipment for field hydrology

This can be divided into:

- renewable items to maintain the data collection programme
- tools and equipment for servicing instruments
- equipment and materials for any extra repair and installation work planned during a particular field trip.

Renewable items

The supply of renewable items required at field stations for data collection, such as data recording forms and sunshine recorder cards, has been discussed earlier. In the section on routing field notes at headquarters, the need for a field team action list was mentioned. This list should include details of the likely requirements of the various renewable items which the field team will need to carry on each trip to make up minimum station stocks.

Tools and servicing equipment

The tool kit required for each field trip will be built up from experience with the particular instruments installed. It will include:

- a general tool kit
- tools and spare parts needed for routine servicing of each type of instrument
- additional tools needed for any extra repair

and installation work planned during a particular field trip.

The general tool kit will include various sizes of screwdrivers and pliers, wire strippers, a medium sized hammer, spanners (fixed sizes and adjustable) and plastic electrical insulating tape. Specialist tools will include those required to service individual instruments, including hexagonal Allen keys of various sizes and any non-standard tools.

Requirements for extra work

The field team action list provides a reminder of any special requirements for extra work at a particular field station during the next field team visit. In addition to the renewable items already discussed, there is a need for a field team to carry a range of replacement items for station equipment which may have become damaged. Examples are:

- clocks, pens and clock keys for chart recorders
- thermometers for temperature screens – carefully packed for field travel
- bottles and watertight inner cans for daily raingauges.

Equipment to keep the vehicle running

Field trips are often made to remote sites, far from vehicle mechanics. Field team leaders must therefore check with drivers not only that the vehicle is in full working order, but also what equipment, tools and spares are carried in the vehicle. Once again, ask questions:

- Is the spare tyre fully inflated, without any punctures, and is it worth taking along a second spare wheel?
- Are the jack and wheel nut spanner in full working order?
- What does the vehicle tool kit contain?
- What spare parts are being carried?
- It is normal to carry one can of water – is there a need to carry extra cans?
- Is there a need to carry extra fuel?

Remember to check all cans, whether carrying water or fuel, for leaks before starting. Be very careful when taking petrol in cans in a vehicle. It is unwise to carry cans full of petrol over the front bumper of a four-wheel drive vehicle, as they could burst during a collision, presenting a very serious fire risk.

Detailed answers to the questions listed above will not be given here, but it is far better to obtain answers to them before leaving the headquarters transport yard, rather than end up sitting in a broken-down vehicle which has suddenly attracted the attention of a large, aggressive elephant!

The need for extra tools and spares will depend on the length of the field trip and the remoteness of the stations to be visited. It is always useful to carry the belts which drive fans, water pumps and alternators, as well as spare radiator hoses. With petrol-engined vehicles do not forget to carry spark plugs and contact-breaker sets. This is only an initial list of spares – particular types of vehicle need particular spares. Discuss these matters with drivers and transport managers.

Punctures

Always carry tyre inner tubes and levers to remove the outer tyre casing. For trips across rough country or in any remote areas, a second spare wheel and tyre also should be carried. My own experience is that fitting a spare wheel or a fresh inner tube provides a far better cure for punctures in the field than trying to use puncture repair kits. That does not mean, however, that inner tubes with only small puncture holes (as opposed to tears) cannot be repaired in garage workshops and used again. Always repair a punctured tyre as soon as possible.

Call at the first village or town garage workshop you reach on the field trip after the puncture. Do not wait until the vehicle returns to headquarters. Remember that the most likely time to get a second puncture always seems to be when you are travelling (even for a brief period) without a serviceable spare tyre!

First aid, water and food

First aid skills and equipment are essential for field teams, and they will be discussed in the next section. Drink, food and the team's personal belongings have also been mentioned. When the weather is very hot, especially if travelling to remote areas, it is essential to carry plenty to drink. It is safer to carry drinking water in separate containers from those used to carry water for vehicle and washing use. Large clean plastic bottles are best for carrying water. Plenty of drinking water must be carried, not only to cope with heat during the normal field programme, but as a safety reserve if the vehicle fails in a remote area and some team members have to stay with it. Field team members are normally expert at organizing their food, combining supplies brought from home with food bought at markets and shops along the route. If timing is tight, however, team leaders need to be sure that shopping expeditions do not take too long. (A visit to a bar for a 'quick drink' in the middle of a hot day can seriously delay the field trip timetable!)

Part 3: Safety during field work

Introduction

Field hydrology can be dangerous. Safety precautions are especially important because accidents in remote places are much more difficult to deal with than those that occur in towns, where doctors and hospitals are near at hand. Field team leaders and other team members must be trained in first aid, and a properly stocked first aid kit must be carried in the field team vehicle.

All team members, and especially team leaders, must be always on the alert for possible dangers during field trips. The location of the nearest dispensaries, hospitals and doctors' surgeries to the route of any field trip must be known to both the team leader and driver, especially if the route is one that field teams use regularly.

Road travel always carries risks. Accidents can happen as easily on rough tracks, with no

other vehicle around, as they can on busy trunk roads. The need for field team leaders to supervise drivers has already been mentioned, and over-speeding or any other reckless driving must be dealt with severely. Taking vehicles across rivers in flood can be particularly dangerous. If a team member cannot safely wade across the river ahead of the vehicle to check the depth of the water, it is not safe to attempt to take the vehicle across. Further guidance on safety aspects of road travel, including first aid, is given in *The African Highway Code*, which was mentioned earlier.

A more general handbook, *Site Safety in the Water Industry*, has been produced in the UK. Details appear in Appendix 1.

Safety in river work

Although work at hydrological field stations is not usually dangerous, staff must be careful when working close to rivers that are too deep to wade across, and when working from small boats. There is always a risk of death by drowning.

Fast-moving rivers, especially when in flood, are particularly dangerous. All staff who need to carry out river work must be clearly made aware of the risks involved. Particular risks arise from:

- wading to carry out current metering when the river is running too deep (or too fast) for this to be done safely
- carrying out maintenance on staff gauges and water level recorders when a river is flowing fast – especially during flood flows
- any boat work (it is easy to capsize small boats, even in calm river conditions) – again, especially during flood flows.

All staff who are required to work in or around deep rivers must be able to swim. There is also need for staff to be fully aware of the risks linked to river work. In many countries professional safety and first aid instruction is available for those working on, or close to, deep water. Staff involved should be given appropriate training in rescue and resuscitation techniques.

Travelling through politically sensitive areas

Groups of anti-government activists, and gangs of thieves, sometimes establish bases in the more remote areas of tropical countries. Movement of government employees (including hydrology field teams) through areas where these groups and gangs operate may well be controlled by national security forces. If field teams are allowed to operate in these politically sensitive areas, strict attention must be given to any operational guidelines given by the police or other security forces. Lives and equipment should not be put at risk, however important it may seem to collect hydrological data from these areas.

Emergency radio communication

It is obviously an advantage if field teams travelling and working in remote areas can be in radio contact with headquarters or a regional centre when emergency action is needed. However, remote areas usually have few centres of population, and they are often mountainous – neither of which circumstance makes for easy radio communication. The police and other national security services may have the resources to provide radio communication to their patrols in remote country, but national hydrological services do not usually have the funds to do so.

The best advice is to consult the police, other government departments and parastatal bodies (such as national park and hydropower authorities) and explore what use can be made of the existing communication links which they have in case of emergency. Even if there cannot be a transmitter/receiver in the field team vehicle, it is very useful to know the sites of police posts and other offices where emergency messages can be sent and received.

Dangers from wild animals

Wild animals, however dangerous, usually choose to avoid contact with humans. However,

care must be taken where dangers are known to exist, as in rivers where alligators, caymans or crocodiles are active. Hippopotamuses can be dangerous, especially mothers that feel that their young ones are in any way threatened. Hippos on land do not like their routes back to water to be obstructed, so avoid getting in their paths when working on the river bank.

Risks from larger wild animals away from river banks have to be judged with advice from observers and other local residents. The author has worked in a National Park in Africa where the likelihood of meeting buffalo, elephant and other potentially threatening animals was much higher than it would have been in farmland in the same region. Definite rules are difficult to apply, except the need to be on the alert at all times, especially when the team is working outside, and away from, the vehicle. Buffalo have a reputation for being aggressive even when unprovoked, and male elephants (or females who feel that their young are threatened) must be treated with great respect.

Snakes

This is a difficult topic. Local advice may be unreliable, and based more on rumours of dangerous snakes than on actual experience of confronting and dealing with real snakes. It is estimated that worldwide at least 30 000 people die from snake attacks each year, but the statistical risk to a careful field worker is still low. Care must be taken if there is a need to walk across ground which is covered by scrub or other dense vegetation, or when disturbing dark, sheltered places in which snakes might choose to rest. It is only really possible to tackle the potential problem of snakes in the context of the local situation. This applies particularly to advice over using anti-venom treatments.

Keep a good lookout also for scorpions and columns of soldier ants. In addition, rivers in marshy and forested areas often provide good homes for leaches.