defined, as were sets of operating principles and schedules of future activities. By 1972 over 60 agreements had been signed between contiguous provinces and states to arrange for assistance in emergencies. Then in 1972 formal bilateral activities ceased, a development due in part to the restructuring of national civil emergency organizations on both sides, reduction of civil defence funding, and, to the extent that wartime protection was included in the programme, a reliance on the concept of mutual deterrence for the prevention of nuclear war [30]

In 1982, moves were being made to reactivate the joint planning process.

5. Communications

If information is indeed the lifeblood of an emergency management system, then communication channels are the arteries through which it flows. It follows that steps must be taken by the emergency planner to make sure that the arteries are kept in good repair and that no clot is allowed to obstruct them It is worth asking, then, where the danger points are likely to be found, and to devote particular attention to them

Figure 10 shows in simplified fashion the essential communications links for a major disaster which calls for international assistance, and the degree of reliability which may be expected in those links in the immediate aftermath of the event. It is clear that priority attention must be given to the "field" links at the disaster site, for without information about what has occurred, it will be impossible to mount a sensible relief operation. Note that in this diagram it is assumed that the disaster site is at a distance from the national capital and that it is not foreseen that communications with, for example, United Nations bodies will bypass the national capital This accords with the insistence by Governments (exemplified in operative paragraphs 2 and 8 of General Assembly resolution 36/225 of 17 December 1981)[31] that they should retain a control over relief activities generally. In practical terms, too, there would be a tendency to confuse the co-ordinating machinery, rather than to clarify it, if requirements for international assistance were transmitted direct from representatives on site to their headquarters.

The nature of a Local Emergency Operations Centre (L E.O.C.) will depend upon the kind of organization adopted by the country for disaster response. It may be, initially at least, a police station or military headquarters in the main town or city in the disaster area. It may even be a mobile "command centre". For planning purposes, it should be assumed that any existing communications will be cut, and that temporary (portable) equipment will have to be installed or provided for the use of the emergency services.

In designing an emergency communications system, a planning group, consisting of emergency managers and communications specialists (particularly any from the relief services themselves), will have to take into account.

(*a*) The distances over which communication will be needed;

(*b*) The nature of the terrain;

(*c*) The type of the communication product desired (e.g voice, morse code, hard copy);

(*d*) The degree of reliability essential (including the need for external power supply);

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[30] "United States/Canada Civil Emergency Planning", by W J. Yost, *Emergency Planning Digest*, April-June 1982, published by Emergency Planning Canada, Ottawa

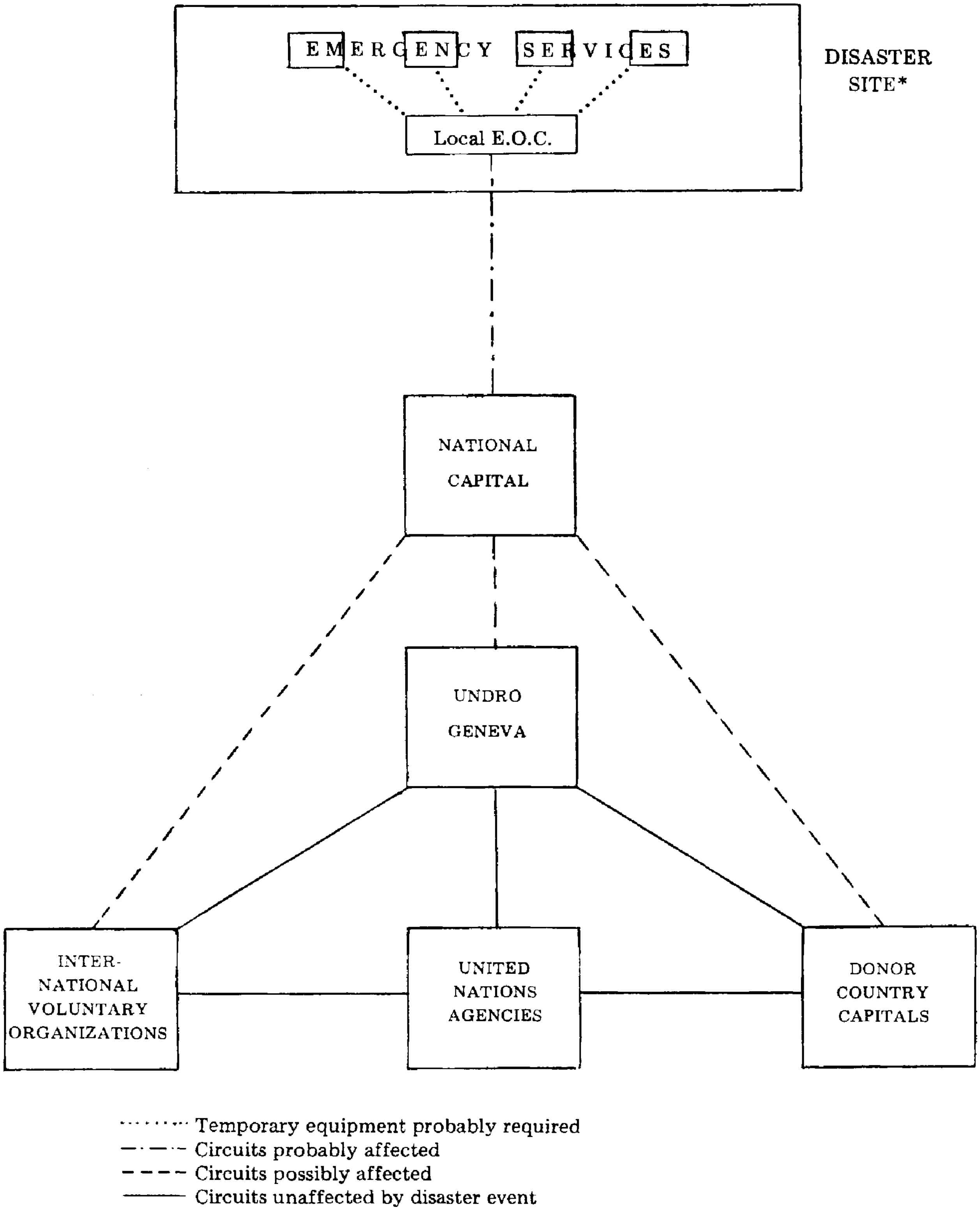
[31] The texts read as follows

2 *Reaffirms* the sovereignty of individual Member States, recognizes the primary role of each state in caring for the victims of disasters occurring in its territory and stresses that all relief operations should be carried out and co-ordinated in a manner consistent with the priorities and needs of the countries concerned,

8 *Decides* that, in response to a request for disaster relief from a disaster-stricken State and, as necessary, in particular in disaster-prone countries, the United Nations resident co-ordinator shall, with the full concurrence, consent and participation of the Government, convene meetings of the concerned organs, organizations and bodies of the United Nations system to plan, monitor and take immediate action to provide assistance, the International Committee of the Red Cross, the League of the Red Cross and Red Crescent Societies and appropriate voluntary organizations may be invited to participate in such meetings with the approval of the host country,

FIGURE 10

Communications circuits



* See figure 11 for elaboration of communications at disaster site

(*e*) The delays in communication which would be acceptable;

(*f*) The volume of communication (number and length of messages),

(*g*) Whether two-way communication is essential;

(*h*) Whether equipment will:

(i) Have adequate reliability in adverse operational conditions;

(ii) Require additional maintenance facilities;

(iii) Require further operator training;

(*i*) The degree of compatibility needed between equipment for each specific task;

(*j*) The number of trained personnel available to operate and maintain the equipment; and

(*k*) The costs involved.

These elements are common to all decisions affecting communications equipment for emergency use.

It is of course quite possible that even within the area of the disaster site, the types of equipment needed will vary according to the tasks being performed. Almost certainly there will be several different nets operating simultaneously (figure 11.) Provision should be made for off-duty personnel to be called in. two-way and one-way voice paging systems, and one-way "bleepers" generally have sufficient range to cover the necessary area, although broadcasts over the radio, if still functioning, could be used as a supplementary system. Two-way voice will be required for other circuits, possibly supplemented by teleprinter to national centres outside the area of the disaster site. It is emphasized that figure 11 is a "typical" diagram. Different organizational structures may produce different communications needs

It will be noted that in figure 11 it is implied that direct communication between, for example, a first-aid team and a traffic control unit should not be foreseen. The reason for this is the simple avoidance of confusion and conflicting priorities A first-aid team may want police assistance to clear the way for an ambulance with a badly-injured patient, but the police priority may be to assist fire appliances to reach a large fire at a chemicals factory in which many lives will be at risk if an explosion occurs. Decisions between two conflicting requirements can only be made by those in possession of all the facts, and those people will be found in the L.E O.C.

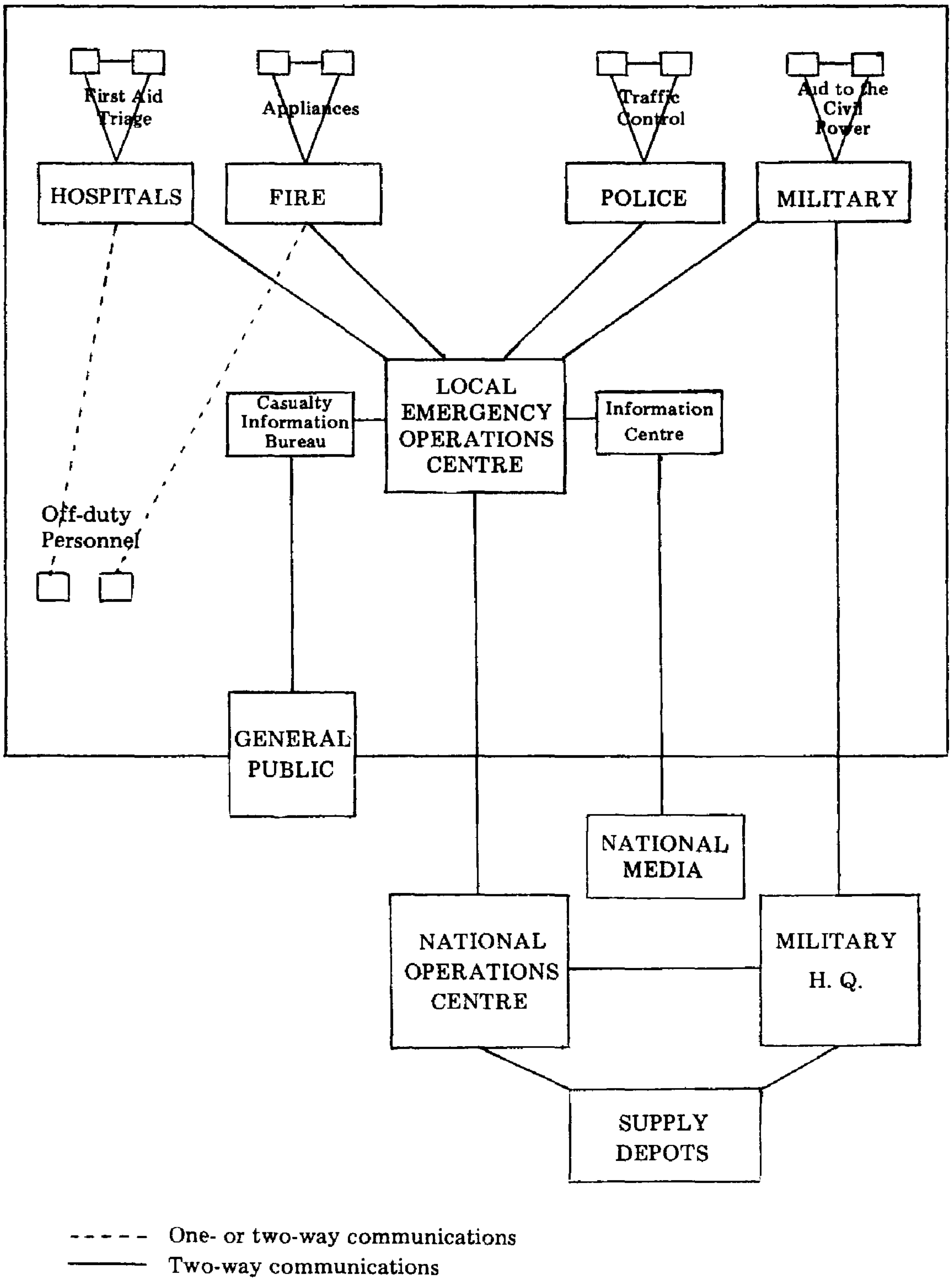
The nature of the communications links between the L.E.O.C. and the national operations centre will probably be dictated more by the distance to be covered than by any of the other factors listed above, relevant though they may be. Direct two-way voice (and preferably hard copy (telex) also) will be needed for the amount and kind of information to be transmitted over this sector.

For this sector too the planners will, if they are wise, make provision for public enquiries (a Casualty Information Bureau—see section 7 of this chapter) and for facilities for the news media (press and radio) because there will in a major disaster be considerable international interest in the event, its effects, and the relief operation. Normally, press coverage can be expected to disappear after a few days unless interest is re-aroused by, for example, serious aftershocks in the wake of an earthquake, or renewed and damaging volcanic activity. Press facilities should if possible be separate from those used operationally: if not, it may be practicable to allot particular periods for the use of operational circuits by reporters. The decision here will depend on the speed of developments and the acceptable degree of delay to operational messages This can be determined only by the L.E O.C director.

The selection of the best transmission system for a given situation depends on several factors, among them the technical and the economic. These are discussed in a handbook "Economic and Technical Aspects of the choice of Transmission Systems", published by the International Telecommunications Union

FIGURE 11

Communications at disaster site



Possibly the most generally available emergency communications system is high-frequency, single-sideband radio. These radio links generally use radio frequencies in the 3- to 30-MHz range; they depend on signals reflecting or refracting from various layers of the earth's ionosphere to achieve long-distance communication of the order of 500 to 2,000 kilometers. Such systems generally have the advantage of requiring no intermediate relay stations; for this reason they can be quite resistant to disruption in a disaster unless they have no alternative means of power supply. An HF-SSB communications link is very useful during earthquakes, floods, widespread fires, storms, and other disasters which cover a large area. It is probably the least expensive long-range communicating method; and since both mobile and fixed station equipment are commercially available, the system can be highly flexible. Antenna systems are relatively simple; setting up an emergency station antenna might consist of installing a wire on a convenient tree or building. Unfortunately, high frequency systems are subject to variations in the ionosphere, and several frequencies must be used to ensure that, in the majority of conditions, continuous communication will be possible at all times.

From the national capital to sources of international aid communications links will be needed by:

(*a*) Government to United Nations (multilateral aid);

(*b*) Government to individual donor governments (bilateral aid);

(*c*) Donor government embassy to home capital (bilateral aid);

(*d*) United Nations agency representatives to individual agency headquarters; and

(*e*) International NGO (and national Red Cross) representatives to own headquarters and League of Red Cross Societies.

Additionally, international links will be required by the news media, and no doubt demanded by the general public.

Unless the disaster has affected the capital itself, the ordinary circuits (commercial telephone and telex, diplomatic radio, and possibly facsimile document transmission) will probably remain in operation. However, they may be insufficient to carry the volume of traffic generated by a disaster: in some countries, they may well be insufficient for the needs of ordinary daily life.

It will, then, probably be necessary to reinforce, as well as to repair and restore, existing communications. Communication planners should not overlook the facilities which can be offered by private ("ham") operators, who may well have joined in a voluntary national organization or society through which negotiations can be conducted and arrangements made. The licence of the Radio Amateur Emergency Network (RAYNET) in the United Kingdom specifically authorizes disaster-related communications, and regional RAYNET groups have been formally included in emergency planning arrangements.

Other groups, such as mission stations or country medical services like the Royal Flying Doctor Service of Australia, have their own networks which can be mobilized for purposes other than those for which they were primarily established. In Haiti, for example, in Hurricane "Allen" (1980) virtually all the news reaching the capital from the hard-hit south-western part of the country was sent over a radio net operated by mission priests. The national Disaster Preparedness Plan of the Government of the Philippines lists no fewer than 15 public and private units or groups with their own point-to-point communications which can be utilized for emergency purposes.

A formalized working relationship between amateur radio operators and the civil engineering services was established in the Province of Quebec, Canada, in 1978. Under the agreement the Amateur Radio Club is committed to assisting the provincial authority in times of emergency. More recently, a new VHF network has been set up; this radiates from a central point near Quebec City. Here there are, among other things, four UHF (ultra-high-frequency) transmitter-receivers and a microcomputer. The computer switches the signals to ensure optimal flow and utilization of the network. Three independent regional systems are hooked up to this central one; these can be linked together for point-to-point communication or, in emergencies, for province-wide operation. A fourth system is reserved for special services such as the emergency network of the Bureau de la protection civile du Québec.

Without national and international regulation, communications throughout the world would soon become chaotic. Unfortunately, however, the same regulatory process has the potential to inhibit the installation and use of emergency, post-disaster facilities. To overcome this difficulty, action has been taken at the international level, most recently at the World Administrative Radio Conference of 1979. The texts of two resolutions and one recommendation are reproduced in Annex I A, B and C of this volume. They deal respectively with the use (*a*) of radio by the Red Cross; (*b*) of frequency bands allotted to the Amateur Services; and (*c*) of space radio communication systems. Ideal as these resolutions are, it still rests with individual governments to put them into practice.

COMMUNICATION OF WARNINGS

Essential as it is for adequate communications to be available in the wake of a disaster, the need for reliable links for the transmission of warnings is equally important and must not be overlooked. The Pan-Caribbean Disaster Preparedness and Prevention Project is developing an inter-island radio communication link-up to warn island governments in the Caribbean of hurricane developments in the Atlantic discovered by radar, satellite, and/or by tracking planes.

In order to maintain the operationality of the system twice-weekly contacts between the islands and the headquarters based in Antigua, West Indies, are routinely made. This helps to keep local operators alert, detects faults in the system and identifies non-function of individual island radio equipment. Intra-island networks are also being established between the meteorological offices on the islands, the emergency operation centres and selected vital services. Figure 12 illustrates diagrammatically the typical links which need to be safeguarded.

It will be realized that even for fast-developing disasters the warning period can vary from many days (for flooding on long rivers) to a few hours or less in the case of tsunamis. Reliability of communications here is of course essential, but the recognition of the importance of the content of the messages is vital, as is the subsequent taking of action upon them. In slowly developing disasters, the safeguarding of communications links from the area affected means more the education and encouragement of people on the spot to realize what is happening and the implications, and to report accordingly, than the simple physical integrity of the links themselves.

It will be seen from the diagrams in figure 12 how, in rapidly developing disasters, warning information flows into the area at risk, whereas for slowly developing disasters the reverse is true.

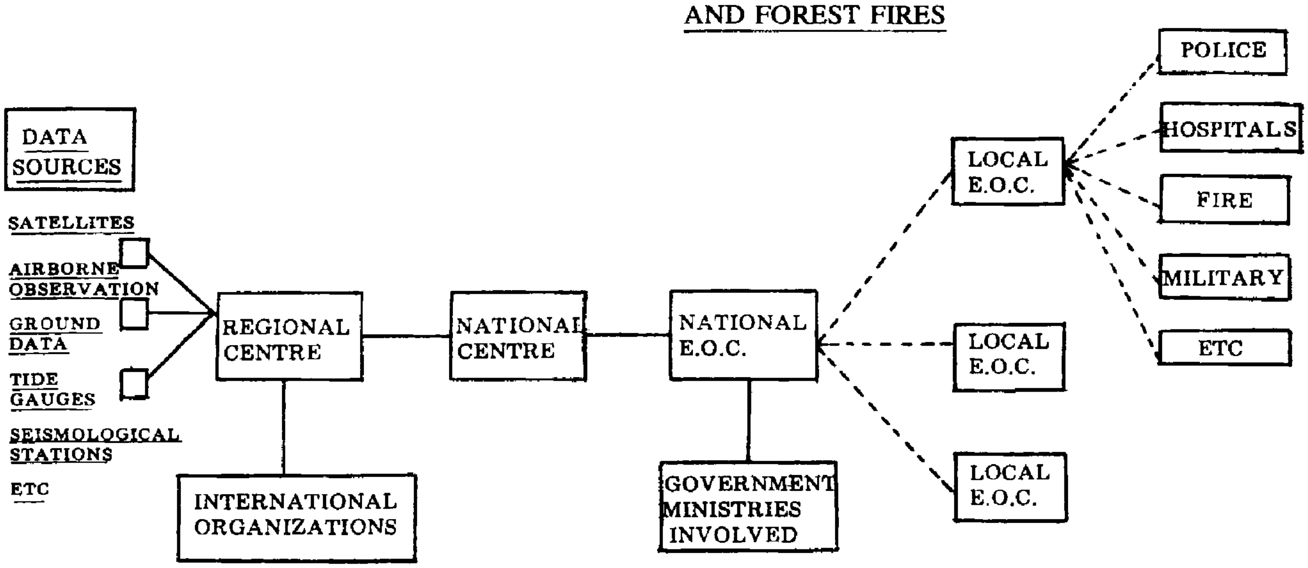
CONTINUING AND POST-EMERGENCY EVALUATION

With the rapid progress being made in the development of all forms of communications systems, it will be necessary to review plans regularly. Users of dedicated networks (e.g. police, fire services) who will be called upon to assist in disasters may be introducing new equipment, and this may in turn require a re-examination of capacities and capabilities in other systems.

Exercises and post-disaster evaluations will often be found to disclose weaknesses as well as strengths in the communications chain. Correcting the one and reinforcing the other are the obvious steps to be taken. But was it found that some equipment was not used? Why? Was there a demonstrated failure of communication because some equipment was not available? Did emergency power supplies work as expected? The identification of omissions is as important as identifying errors of commission. Unfortunately, there is little or no published information on the performance of communications equipment and the acceptability of existing systems in disaster emergencies.

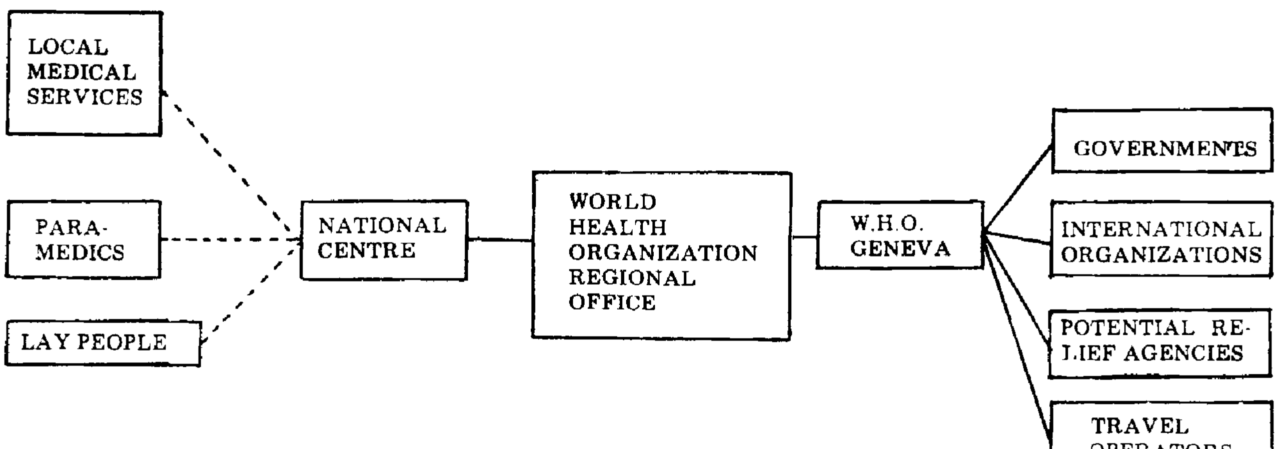
FIGURE 12

FAST DEVELOPING DISASTERS — SEVERE STORMS, TSUNAMIS, FLOODS, STORM SURGES AND FOREST FIRES

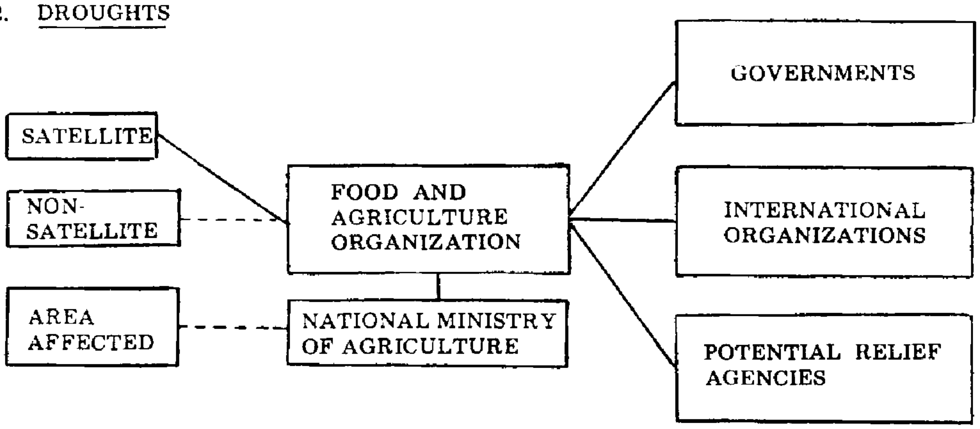


SLOWLY DEVELOPING DISASTERS

1. EPIDEMICS



2. DROUGHTS



INMARSAT,[32] which concerns itself with communications with and between ships at sea, has recently approved the use of its communications system for disasters—even disasters on land. This equipment is relatively bulky (it requires a helicopter to fly in the 1.5-metre dish antenna and the associated volume of electronic equipment).

Through the use of a French-built device called ARGOS which is aboard the American TIROS-N satellite, it is possible to locate, within a few kilometres, small radio beacons which are carried aboard many aircraft and ships. Experiments have begun using these emergency locator ARGOS beacons in which a pre-coded numerical message is entered into the digital information stream transmitted by the beacons. This information is picked up within a few hours by the satellite and transmitted to Toulouse, France, where it is encoded and then transmitted via telex to UNDRO, Geneva.

The advantage of this system is that the beacon, which weighs about two kilograms including battery power supply, is readily portable and easy to use. These advantages, however, are offset to some extent because the messages which can be sent are limited to a selection from several hundred (which will appear in a standard lexicon) and the system provides only for one-way communication. The experiment will determine the degree and the circumstances under which the use of such a system may be advantageous

6. Predictions, Forecasts and Warnings

It is axiomatic that if a timely warning can be given of an impending or probable event which may bring disastrous consequences in its train, then it will be possible to reduce the severity of those consequences. The degree to which this reduction can be effected will depend upon the interplay of three main elements, viz., the accuracy of the warning; the length of time between the warning's being issued and the expected onset of the event; and the state of pre-disaster planning and readiness. Included within this last is a sub-element, that is the degree to which the public respond to the warning and take correct precautionary action.

The first two of these elements are not necessarily mutually exclusive. For example, flood warnings can be issued by hydrological services hours and sometimes days in advance of a flood on major tributaries. Forecasts of flood crests at downstream points on main rivers can, depending on the length of the rivers and the size of the drainage areas, be made even longer in advance. The different methods which can be adopted for issuing flood warnings are described in more detail in chapter III, section 2, of this volume.

An emergency organization should of course welcome even general or imprecise warnings whenever they can be given, provided the degree of imprecision is appreciated.[33] To some extent, this degree will depend on the sophistication of the equipment available to the appropriate technical service and the skill of the members of that service in interpreting the data available. It is obvious that attempts to impose a longer period of warning than would be scientifically or technically justified would inevitably result in an excessive number of unnecessary warnings which would tend to lower public confidence in the whole emergency organization.

These questions were considered at some length in a report entitled "The Quantitative Evaluation of the Risk of Disaster from Tropical Cyclones" issued by the World Meteorological Organization in 1976. The authors emphasize strongly the connection between the capability of the forecasting service and the point at which preparedness measures should be implemented. Some may be able to be put into effect

[32] International Marine Satellite Organization, Market Towers, 1 Nine Elms Lane, London SW8 5NQ, England

[33] Prediction errors are inherent in every forecast that is issued The average error in a 24-hour forecast of the position of a tropical cyclone centre is about 200 km Errors likewise arise in the prediction of landfall and in the size of area to be affected by the tropical cyclone These considerations are, of course, largely operational, but provision for the errors likely to occur has to be reflected in the total cost of preparedness.

during a warning period, but others may have to be instituted at the beginning of the cyclone season, or included in even longer-term action. An example is given, although it should be recognized that the times may vary from one country to another:

(*a*) *Every 12 hours* an extended projection of the storm track for periods up to 72 hours ahead is made available by the forecasting service so that all the authorities responsible may initiate certain preparedness measures;

(*b*) *At least 36 hours ahead* the forecasting service shall nominate the coastal sector along which a tropical cyclone watch should be mounted. This would also be the signal for further preparatory action to be taken;

(*c*) *12-18 hours before the tropical cyclone's landfall* the forecasting service shall issue warnings specifying the areas concerned, the expected wind strengths and rainfall conditions, the likely points of storm surge, etc. The hydrological service shall issue warnings in regard to river flooding and the possibility of flash floods.

Applications of these principles can be found in the work of the World Meteorological Organization's Tropical Cyclone Project. Of proven worth are the regional activities which consist principally of the programmes pursued by groups of countries acting in concert to improve their warning systems. In Region IV (North and Central America) there is a long history of collaborative action specifically designed to protect people and property from tropical cyclones, and in 1977 a working group (the RA IV Hurricane Committee) was established to promote these activities within the framework of the Tropical Cyclone Project.

At its first session, held in San Juan, Puerto Rico, in 1978, the Hurricane Committee took a novel approach to its problem by drawing up a Hurricane Operational Plan, which has since been approved by the countries of Regional Association IV. The Plan defines the observing, forecasting and warning responsibilities of all co-operating countries. It was felt that a plan of this kind was essential if the most effective co-operation were to take place between the countries in preparing for and issuing meteorological forecasts and warnings of all tropical cyclones affecting their area.[34]

Meteorological information can of course be useful in other ways besides the forecasting of storms and floods. Rainfall, when reported in certain areas, is or can be an indication that locusts will start to breed, and if this information reaches agencies like the Desert Locust Control Organization in sufficient time, preparatory measures can be taken for the spraying of breeding areas or for immediate action in places which are attacked. Because of the paucity of meteorological stations in locust breeding areas, experiments have been made by the Food and Agriculture Organization in the use of meteorological satellites to provide rainfall data. These experiments have been successful, but so far they have not been able to cover all the locust-prone areas of the world.

Frost is another hazard which can be forecast, and timely warnings to farmers can often prevent heavy crop losses.

For some kinds of event it will be quite impracticable to indicate when an event is going to, or is most likely to, occur. General warnings that a high forest or bush fire risk exists may be given after a prolonged period of drought coupled with exceptionally warm weather, but apart from the normally remote contingency of natural conditions producing spontaneous combustion, some external impetus—a carelessly discarded cigarette, for example—will be needed to initiate the event. Similarly, some precautionary measures might be taken if seismological activity were to be detected in an area in which a major dam was located, or if forecasts were made of unusually heavy rains in the catchment area of the reservoir

Volcanic eruptions may sometimes be presaged by earthquake activity and ground deformation, but

[34] World Weather Watch, Regional Association IV (North and Central America) Hurricane Operational Plan WMO, No 524 (1979)

unless some definite relationships have been established for a particular volcano, it will not be possible to use these indications to predict the timing of an eruption with any real hope of accuracy. Their usefulness may be increased when they are combined with other indications, such as increased steam emission or temperatures, or changes in chemical composition of volcanic gas emissions.

For earthquakes themselves, no accurate warning system has yet been devised. The term commonly used in connection with earthquakes is "prediction"; that is, a probabilistic statement that accumulated observations seem to signal more or less clearly the occurrence of an earthquake of a specified magnitude at a specified location and time. A "warning" here is a notification that steps should be taken to deal with an impending danger. It is the result of a successive evaluation of precursory phenomena. Because the inaccuracy in the time window is large, the issue of both predictions and warnings raises wide-ranging questions of public policy which go far beyond the competence of the emergency planner, and special advisory committees are established to evaluate all observations and to advise local or central governments. The planner will know if his area is likely to experience earthquakes, and will act accordingly: and he will do well to remember that a major destructive earthquake is unlikely to recur in the same segment of a fault until several decades or more have elapsed since the previous event—the time needed for sufficient stress to build up. In the main seismic regions, it is the recently quiet zones ("seismic gaps") which present the greatest danger of future large earthquakes. In these zones of anomalously low seismic energy release, there may be a progressive buildup of small to moderate earthquakes, days or weeks before a major earthquake occurs again. Monitoring these zones by the various geophysical methods available therefore seems now to be one of the priorities for seismologists. It can be seen, however, that "prediction" is limited to relatively large areas in which earthquakes are liable to occur within a period that it is not yet possible to determine.

The current state of knowledge permits much more precise warnings to be given for tsunamis. Even though their frequency is comparatively low, and lower still in relation to any particular location, it has been estimated that since 1850 more than 70,000 lives have been lost in the Pacific due to tsunamis; and it is a fact that several million people live or work in tsunami hazard zones in that area. Moreover, their number is increasing.

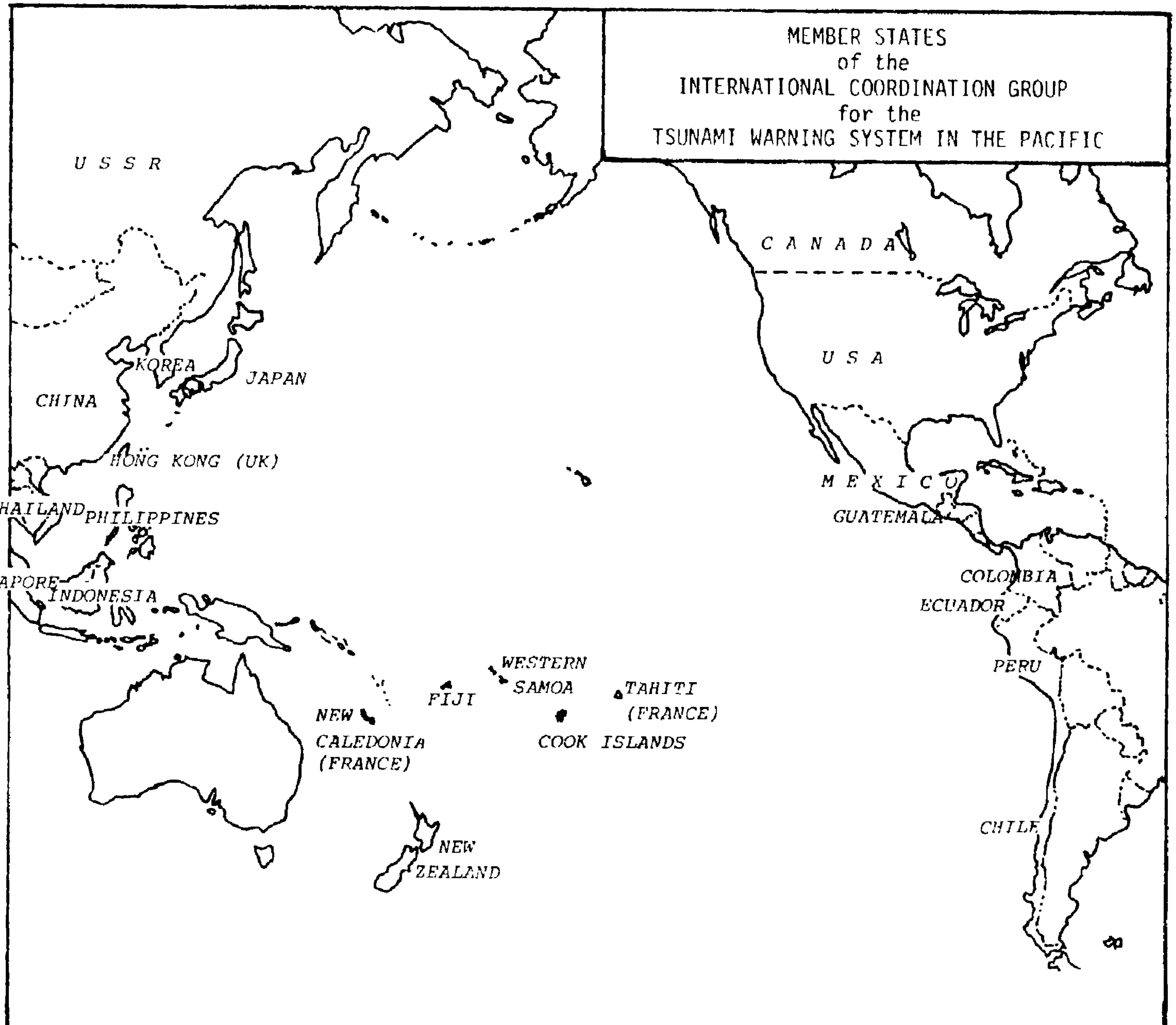
Regional warning systems have been established in the northern part of the Pacific basin by the U.S.A., Japan and the U.S.S.R., to give some measure of protection against the effects of locally-generated tsunamis. These monitoring systems are real-time links from seismometers and tide gauges to the respective centres. Local tsunami warnings in these systems may be issued on the basis of earthquake information alone.

The Pacific Tsunami Warning Center in Honolulu operates the International Tsunami Warning System. It receives information about major earthquakes in the Pacific region, evaluates the earthquake's tsunami potential in terms of epicentre and Richter scale magnitude, determines through tide gauge measurements if a tsunami has been generated, and issues appropriate warnings and information to minimize the hazards. The international monitoring system is at present composed of 24 seismic stations and 53 tide stations throughout the Pacific Ocean. The system employs teletypewriter and voice communication links to acquire data and disseminate information to countries in the region. Transmission times range from 10 minutes to one hour, depending on the efficiency of communications relay points. The time of receipt of tsunami wave reports at Honolulu varies with the travel time of the tsunami from its origin to the tide gauges, the dependability of equipment and observers, and the communications links.

In general, warnings delivered by these systems include earthquake locations ($\pm$ 50 km), earthquake Richter scale magnitude ($\pm$ 0.3), tsunami arrival time ($\pm$ 20 minutes), and reports of wave heights as recorded by the tide gauges. The earthquake parameters and tsunami arrival times throughout the Pacific are usually disseminated from Honolulu to the 52 international warning points within one hour after the occurrence of the earthquake.

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU), at its eighth session held in Suva, Fiji, in April 1982 recommended that watches and warnings be issued on a

FIGURE 13



MEMBER STATES
of the
INTERNATIONAL COORDINATION GROUP
for the
TSUNAMI WARNING SYSTEM IN THE PACIFIC
U S S R
CHINA
KOREA
JAPAN
HONG KONG (UK)
THAILAND
PHILIPPINES
SINGAPORE
INDONESIA
NEW CALEDONIA (FRANCE)
FIJI
WESTERN SAMOA
COOK ISLANDS
TAHITI (FRANCE)
NEW ZEALAND
C A N A D A
U S A
M E X I C O
GUATEMALA
COLOMBIA
ECUADOR
PERU
CHILE

time-stepped basis and that "the initial warning cover areas within three hours' tsunami travel time of the epicentre and the initial watch cover areas within three to six hours' tsunami travel time of the epicentre. Both areas are to be expanded every hour until it is determined that a danger to the entire Pacific exists or that no further danger exists."[35, 36]

SLOWLY DEVELOPING DISASTERS

For droughts and other kinds of agricultural disaster involving crop loss or crop failure, as well as for the effects on food supplies of man-made disasters, the Global Information and Early Warning System on Food and Agriculture operated by the Food and Agriculture Organization (FAO) of the United Nations provides its member States—which include potential food aid donors—with reports of varying degrees of urgency and comprehensiveness. These include:

(*a*) *Food Outlook*, which is published monthly and contains a concise analysis of up-to-date information affecting the situation and outlook for basic foodstuffs throughout the world. It covers cereals, sugar, oilseeds, oil and fats, cassava, pulses, milk and milk products, meat and fertilizers.

(*b*) A series of "Special Reports" with a restricted readership, including *Foodcrops and Shortages* which is issued monthly to governments. It gives an up-to-date account of crop conditions and production prospects in both developing and developed countries. It identifies countries where current crop conditions give cause for concern as well as those which already suffer from abnormal food shortages. A special report on the cereal import requirements of low-income, food-deficit countries is issued four times a year to bilateral and multilateral food aid donors.

(*c*) "Special Alerts" which are issued whenever the food supply situation threatens to deteriorate in a specific country or a group of countries which may need assistance in coping with the situation. These alerts, which are sent to potential food aid donors, are the primary vehicle for early warning of potential food shortages, to facilitate prompt remedial action. In cases of regional food shortages involving a large number of countries, special reports are issued. For instance, the System reported regularly to donors on the food supply and import position in the 26 drought-affected African countries during the African food emergency in 1980/81.

(*d*) *Sahel Weather and Crop Situation* reports which, as their title indicates, are limited to conditions in drought-prone countries south of the Sahara. They are issued every twenty days during the period from June to October.

The information contained in the last two kinds of report is also issued by telex, because it is particularly time-sensitive.

The System itself draws on sources as diverse as satellite imagery and local market trends, and forms a remarkable example of the value of a central synthesizing point for information from all over the world.

The Climate Impact Statements issued by the National Oceanic and Atmospheric Administration (NOAA) of the United States have a much more limited distribution, but supplement the other information available and form a useful source, particularly for potential donors.

So far as epidemics are concerned, the World Health Organization (WHO)'s *Weekly Epidemiological Bulletin* serves the same purpose in its field as does the FAO system. Epidemics as a subject are treated more fully in section 9 of this chapter.

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[35] Resolution ITSU-VIII.3, Establishment of Tsunami Warning Procedures.

[36] To assist in implementing this recommendation, a feasibility study was undertaken at the Pacific Marine Experimental Laboratory, Seattle, Washington, U.S.A. Its text can be found in National Oceanic and Atmospheric Administration Technical Memorandum ERL PMEL-37 (December 1982).

7. Public warnings and information

Although, as noted as the beginning of section 6 of this chapter, timely and accurate warnings coupled with an effective and efficient state of disaster preparedness make it *possible* to reduce the severity of the consequences of an event, no warning will be of any value unless it is acted upon. It is assumed that the emergency manager will take the necessary steps to disseminate the warning to the public, as well as setting in train all his own arrangements according to the nature of the case.

From the point of view of the public, the warning will be most effective if it is:

(*a*) Issued by a person or organization in whom public confidence is placed,

(*b*) As specific as practicable in its information concerning the magnitude of the event, the place at which it is expected, and the time when it will occur; and

(*c*) Susceptible to independent confirmation

In emergencies which call for a response by the public, the degree of reliability which is accorded to the source of information and instruction is known to be a major factor in determining the quality and speed of the public's response. Especially is this so in emergencies in which the individual cannot perceive the danger through his own senses, as for example where impending industrial, or even radiation, accidents can be foreseen by the competent authorities but where, to the layman's eye, everything in the vicinity of the plants appears absolutely normal. The credibility of the source of public warnings about emergencies must be protected if mutual understanding and confidence are to be achieved: this is not only a matter of positive action, but a matter of the avoidance of actions, such as the issuing of demonstrably inaccurate information, or issuing accurate information too slowly, which would tend to diminish credibility.

A concise and useful summary of how warnings should be framed and used is given in volume 10, "Public Information Aspects", in the present series. Warnings should:

(*a*) Be *specific,* i.e. they should give specific local information about the threat which will not allow listeners conveniently to forget them. Sirens, or the sound of church bells, for example, are non-specific and are easily imagined to be something else, or not very important, unless an adequate information and education campaign has already been effectively conducted;[37] [38]

(*b*) Be *urgent* (they should get people moving and not allow time for rationalizing the warning away);

(*c*) Spell out the *consequences* of not heeding the warning (probably in explicit detail) so that people cannot casually dismiss them; and

(*d*) Be absolutely clear about the *probability of occurrence,* since people tend to pay little attention to something labelled "a probability". It should be remembered that one warning is not enough, so that they should be *continuous,* because people also need to be kept up-to-date about what is happening and to be given instructions appropriate to the development of the situation.

This concise guidance is given in somewhat greater detail in a new publication[39] and its application is illustrated in figures 14 (*a*) (*b*) and (*c*), which are taken from that report.

Some sectors of the population may have to be given warnings different in nature from others. Island or coastal territories subject to storms will have to take special precautions for the benefit of inshore and

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[37] For the greater part of the 1939-1945 war, the routine ringing of church bells in the United Kingdom was forbidden: the sound of bells was reserved as the warning signal for invasion and this was well understood

[38] The emphasis is on "effectively" In 1981 a flood warning exercise in London was preceded by an extensive and expensive publicity campaign A post-exercise survey showed that 50 per cent of those interviewed did not hear the warning, 30 per cent of those who did, did not realize its meaning, and 60 per cent did not know what to do

[39] Human Response to Tropical Cyclone Warnings and their Content", report of Project No 12 in the Tropical Cyclone Programme, published by the World Meteorological Organization, Geneva, 1983.

coastal boat traffic (figure 15) In another category fall the disabled, who may not be able to see or hear warnings, or act upon them if they do [40]

In one specific case the authenticity (if not necessarily the scientific accuracy) of the warning is guaranteed by law. Under the procedures laid down in the Large-Scale Earthquake Countermeasures Act (Law No. 73 of 6 July 1978) of Japan, the formal Earthquake Warning Statement is issued by the Prime Minister with the authority of the Cabinet. The steps which lead up to this Statement, and the action already taken to alert emergency organizations, are shown diagrammatically in figure 16.

Planners must guard against the natural human tendency not to want to believe that conditions will change for the worse. Some people may go further, and actively seek reasons why they should not respond to warnings. When the "warning" cannot be truly specific, as in the case of a prediction of an earthquake, the issue of credibility becomes of even greater importance, particularly when there is no agreement between scientists about the accuracy of the prediction.

Community Warning Broadcast (Australia)

The following preplanned messages are to be broadcast by radio/TV when a specific cyclone threatens The frequency and timing of the broadcasts are decided at the time Suggested texts are given which may require changes depending on specific circumstances

FIGURE 14 (*a*)

1 *Message No* 1.

2 *When broadcast* On "Cyclone Watch "

3 *Frequency*: At least six-hourly with every "Cyclone Watch" issue.

4 *Suggested text*. To be broadcast following the actual "Cyclone Watch" message.

"This is a message from the Port Hedland Counter-Disaster Committee Although the cyclone is not as yet a direct threat to the community, certain precautionary measures should be taken at this time These are

(*a*) Ensure your transistor radio and torch light are working. Keep spare fresh batteries.

(*b*) Check your house roof is sound

(*c*) Clear property of loose items which could cause damage by being blown around in a high wind

(*d*) Collect tinned food, water containers, first-aid kit and medicines.

(*e*) If a cyclone shelter is located on your property, ensure its readiness

(*f*) Fuel car

(*g*) Listen to your radio and television for further warnings

It would be a kind gesture if you just checked with your immediate neighbours that they are aware of the situation.

Should you be new or a visitor in the area ask around what you should do, or ring or .... for further information."

[40] This subject is treated more fully in "Disasters and the Disabled", published by UNDRO. Geneva, 1982

FIGURE 14 (*b*)

1. *Message No.* 2.
2. *When broadcast*: On "Cyclone Warning."
3. *Frequency*: At least three-hourly with every "Cyclone Warning" issued.
4. *Suggested text*: To be broadcast immediately following the "Cyclone Warning" broadcast.

"This is a message from the Port Hedland Counter-Disaster Committee. Latest reports indicate that gale force winds caused by the cyclone off-shore are expected to hit Port Hedland within the next twenty-four hours. The cyclone could still change course, but just in case it does not, the following additional precautions should be taken;

(*a*) Board or tape windows.

(*b*) Store loose articles inside the house.

(*c*) Lock up pets.

(*d*) Fill water containers.

(*e*) Store essential items (food, water, first-aid kit, etc.) in strongest part of house where you will ultimately locate yourself and family. This could be the cyclone shelter if you have one.

(*f*) Do not wander out of the house, if possible.

(*g*) Listen to your radio/television for further warnings."

1. *Message No.* 3.
2. *When broadcast*: On "Cyclone Warning" when it is imminent, the cyclone is going to strike Port Hedland or parts thereof.
3. *Frequency*: At least hourly.
4. *Suggested text*: To be broadcast immediately following the hourly "Cyclone Warning" broadcast.

"This is a message from the Port Hedland Counter-Disaster Committee. The cyclone is going to hit us directly (or partially—whichever is applicable).

We advise that:

(*a*) You stay indoors.

(*b*) Shelter in the strongest part of the house, or your cyclone shelter if you have one.

(*c*) Protect yourself with mattresses, blankets. Anchor yourself to a strong fixture (such as water pipes) or get under a strong table.

(*d*) Beware the "calm eye." Remain indoors until you are advised that the cyclone has passed.

(*e*) Listen in to your transistor radio for further information."

FIGURE 14 (*c*)

1. *Message No.* 4.
2. *When broadcast*: On "Cyclone Watch/Warning" after impact and when cyclone is abating with winds less than 70 kmph.
3. *Frequency*: Hourly.
4. *Suggested text*: To be broadcast immediately following the "Cyclone Watch/Warning" message.

"This is a message from the Port Hedland Counter-Disaster Committee. The cyclone has passed over Port Hedland, however, the threat is not yet over. Survey and Reconnaissance Teams will be touring the area to assess damage and assistance required. You are advised to:

(*a*) Remain indoors.

(*b*) Listen in to your transistor radio for information and instructions.

(*c*) Do not jam the telephone exchange with information calls.

(*d*) If you are in need of emergency assistance (life and death matter), then ring ...., or contact the Survey and Reconnaissance Teams moving in your area.

(*e*) Your local Counter-Disaster Organisation is doing everything possible to assist you."

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1. *Message No.* 5.
2. *When broadcast*: On "All Clear."
3. *Frequency*: To be decided at the time.
4. *Suggested text*:

"This is a message from the Port Hedland Counter-Disaster Committee. This is the 'All Clear' signal. The cyclone has passed and is no more an immediate threat to Port Hedland, should you require any assistance you should report to the welfare centres located at:

(*a*) Cooke Point Youth Club.
Cooke Point,
Port Hedland.

(*b*) Salvation Army Community Centre
Kennedy Street,
South Hedland.

(*c*) Hedland High School Gymnasium,
....
South Hedland."

FIGURE 15

Hong Kong's tropical cyclone warning signals

SIGNAL		DISPLAY: Symbol during day	DISPLAY: Lights at night	MEANING
1	STAND BY		○ Wnite ○ White ○ White	A tropical cyclone is centred within about 400 nautical miles of Hong Kong and may later affect Hong Kong.
3	STRONG WIND		○ Green ○ White ○ Green	Strong wind expected or blowing, with a sustained speed of 22–33 knots and gusts which may exceed 60 knots.
8* NW	NW'LY GALE OR STORM		○ White ○ Green ○ Green	Gale or storm expected or blowing with a sustained speed of 34–63 knots from the quarter indicated and gusts which may exceed 100 knots.
8* SW	SW'LY GALE OR STORM		○ Green ○ White ○ White	
8* NE	NE'LY GALE OR STORM		○ Green ○ Green ○ White	
8* SE	SE'LY GALE OR STORM		○ White ○ White ○ Green	
9*	INCREASING GALE OR STORM		○ Green ○ Green ○ Green	Gale or storm expected to increase significantly in strength.
10*	HURRICANE		● Red ○ Green ● Red	Hurricane force wind expected or blowing with a sustained speed of 64 knots or more and with gusts that may exceed 120 knots.

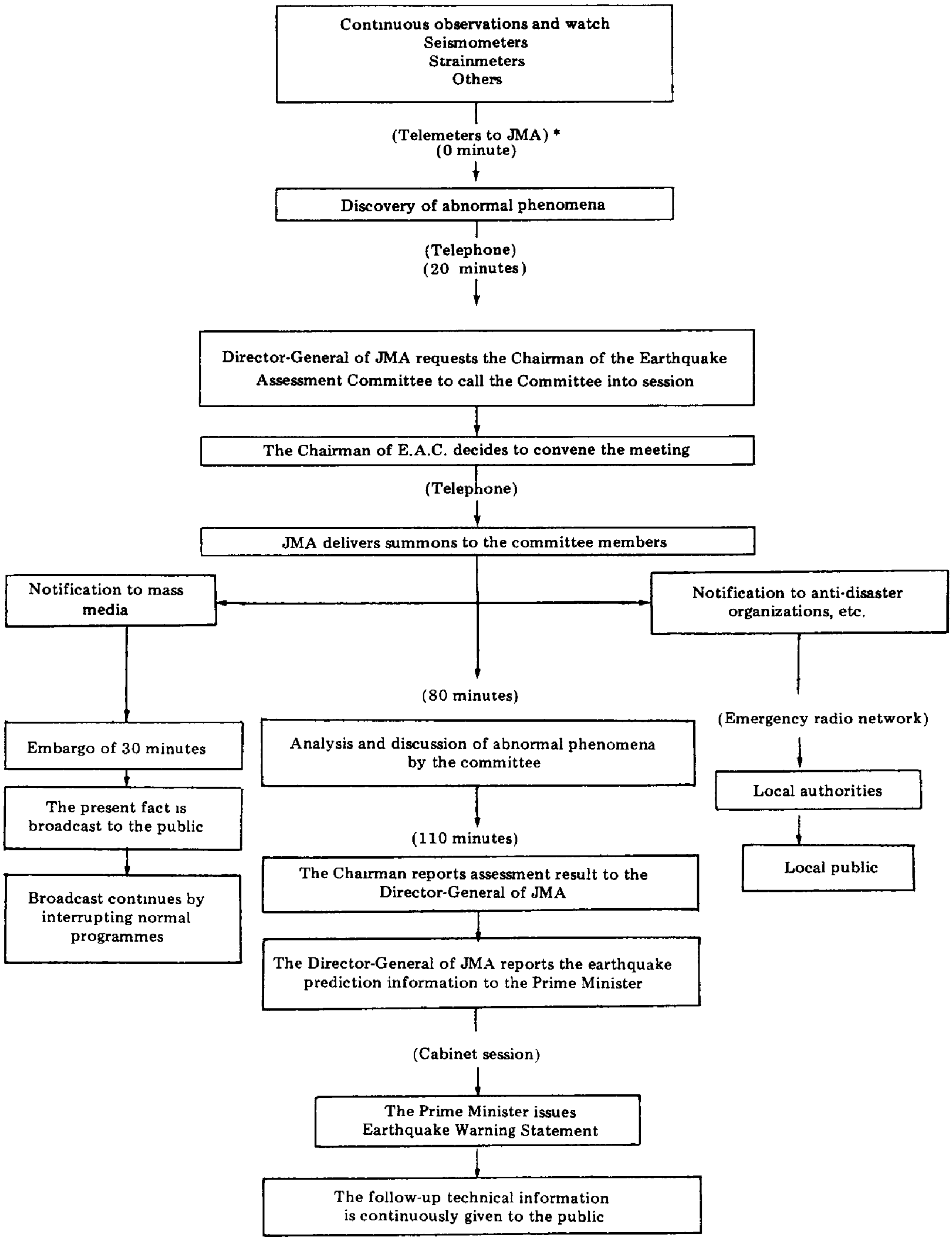
* International signals

FOOTNOTE:

The strong monsoon signal—the Black Ball—does not form part of the local tropical cyclone warning service and is used only in connection with a strong winter monsoon (usually from the north or east) or, more rarely, with a strong summer monsoon (usually from the southwest). It is displayed whenever a strong monsoon is expected within 12 hours or is known to be blowing over the waters of Hong Kong. The lights used at night for this signal are white, green, white. A strong monsoon is defined as a wind of 22 knots or more. Winds may sometimes reach 35 or even 40 knots in very exposed places. The strong monsoon signal is intended as a warning mainly for fishing boats and other small craft. When the signal is displayed they are advised not to leave sheltered waters.

FIGURE 16

Flow of earthquake prediction information



*JMA – Japan Meteorological Agency

(After Shigeji Suyehiro, Japan Meteorological Agency, 1982).

A study conducted in the United States recorded that

Generally, persons of high and low socio-economic status differed in their perceptions of preferred warning sources. Higher status citizens prefer government sources, while persons of lower socio-economic status preferred information from the Red Cross. When these results were compared to the existing structure for the dissemination of earthquake warnings in the United States, it appeared that there is inequity inherent in the current warning system. We infer from the analysis that high status groups will be more apt to respond adaptively to earthquake warnings than persons of lower social status because there is no current plan to incorporate private organizations like the Red Cross into the earthquake prediction warning system.[41]

There is a clear implication here for emergency planners who are concerned with the effective dissemination of warnings and/or public education. There is no such thing as an open-ended loop: all credible warning sources must be involved in the dissemination process.

The World Meteorological Organization's report already mentioned (see footnote 39) makes an extremely valuable contribution to the discussion on the warning system generally. It examines current practice in the development of warning messages in Australia, India, the Philippines, and the United States of America, and considers how more effective warning terminology might be developed for tropical cyclones. After detailing some case histories of public reaction to warnings, the report goes on to treat the question of the impact of cultures and levels of education on public response, and concludes with quite detailed guidelines for writing cyclone warning messages. Emergency planners would do well to study the report, for it contains lessons of general applicability, whatever type of disaster event is likely to occur in a given location.

PUBLIC INFORMATION IN THE POST-DISASTER PHASE

A disaster manager would be well advised to appoint, or to have seconded to his staff, an experienced public information/press relations officer who can act as chief spokesman during the relief operation. His duties will be directed to two different types of audience: (*a*) members of the public who have to be addressed as a group, either generally or as sub-groups (e.g., all teachers; all who live in a certain area; all car-owners), and (*b*) media representatives. This officer must be fully briefed not only on the progress of the operation itself but also on the implications of the events associated with it. If a state of emergency has been declared officially, then not only the fact but also its main effects must be described. The disaster may have thrown out of action certain facilities which people had earlier been advised to use: new instructions will be needed. If casualties have been heavy, people must be told to whom and where enquiries should be addressed.

The media representatives can of course be used to convey messages to the public, but they will also tend to be more demanding in their search for information which they can use to prepare their descriptive reports Accuracy and frankness in the spokesman's response to these queries will help to instil confidence in the emergency organization and at the same time go some way towards quashing the rumours which usually abound at such times.

Requests for information which are received from individual members of the general public may be handled by the chief spokesman's staff—who must naturally have been given a full briefing also—or referred to services more competent to deal with the *minutiae* of personal affairs. If services like the Red Cross Tracing Service, Citizens' Advice Bureaux, Legal Aid Centres, and local government offices are still operational they will be of great assistance. For example, the question of casualties brings to the fore one point of information which always attracts attention: the number of dead. From the point of view of the disaster manager, the size of the death toll is almost an irrelevance, for his concern is with the survivors. The numbers of dead are a problem only in so far as the bodies, if not removed, create a danger to health. The spokesman for the disaster manager must be able to say what arrangements are being made for recovery, identification and disposal of the dead, and especially to reassure and advise those who may require proof of death for legal or other purposes. This last is a matter which will require particular attention

[41] "Earthquake Prediction Response and Options for Public Policy", by D. S Mileti, J R. Hutton and J H Sorensen, Institute of Behavioral Science, University of Colorado, United States of America, 1981.

in countries which expect to welcome large numbers of foreign tourists. If it is possible to do so, a Casualty Information Bureau, linked to but separate from the Emergency Operations Centre, should be set up with its own communications which enquirers can use without interfering with emergency operations.

In order to avoid the usually hampering presence of media representatives in an Emergency Operations Centre, it is desirable that an Information Centre should be set up. This may be adjacent to the Operations Centre itself, if the latter is located in a capital or other large city, with reasonable communications out to newsrooms, etc., or at some distance away—provided, here too, that there are also good communications between the Operations and Information Centres. An example of the first arrangement is to be found in Canberra, Australia, where the (Federal) Natural Disasters Organization has a briefing room equipped with closed circuit television screens showing pictures from cameras in the Operations Room. Thus journalists can see the "state boards" and other displays and take notes in their own time, as well as during formal briefings, without disturbing the actual work.

The disaster manager must, then, be aware of what action he will need to take in the area of public information after a disaster. If he is to establish and maintain mutual understanding between his organization and the public, the public must receive accurate and authoritative information either from a single spokesman or, at the very least (if different sources have to be tapped), from spokesmen whose several announcements are not only accurate and authoritative, but also consistent and compatible with one another.

Probably the classic case where not one of the rules was observed—with consequent rapid loss of public confidence and a considerable increase in the problems faced by the disaster manager—was the Three Mile Island nuclear power station accident in 1979. The President's Commission's report[42] was scathing in its comments:

Our conclusion is "There were serious problems with the sources of information, with how this information was conveyed to the press, and also with the way the press reported what it heard ...

Some of the official news sources were themselves confused about the facts and there were major disagreements among officials. On the first day ... there was an attempt by the utility to minimize its significance, in spite of substantial evidence that (the accident) was serious. Later that week, the Nuclear Regulatory Commission (NRC) was the source of exaggerated stories. Due to misinformation, and in one case (the hydrogen bubble) through the commission of scientific errors, official sources would make statements about radiation already released (or about the imminent likelihood of releases of major amounts of radiation) that were not justified by the facts ... NRC was slow in confirming good news about the hydrogen bubble. On the other hand, the estimated extent of the damage to the core was not fully revealed to the public.

... Some of those who briefed the press lacked the technical expertise to explain the events and seemed to be cut off from those who could have provided this expertise. When those who did have the knowledge spoke, their statements were often couched in jargon that was very difficult for the press to understand ...

Another severe problem was that even personnel representing the major national news media often did not have sufficient scientific and engineering background to understand thoroughly what they heard, and did not have available to them people to explain the information. This problem was most serious in the reporting of the various releases of radiation and the explanation of the severity (or lack of severity) of these releases. Many of the stories were so garbled as to make them useless as a source of information."

Fortunately, circumstances so comparatively complex do not occur very often. None the less, the incident shows how essential it is for all concerned to be prepared to deal with them when they do.[43]

A useful summary of public information practice after disasters was published in the July/August 1981 issue of the magazine "International Civil Defence".[44] Some of its recommendations were perhaps

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[42] "Report of the President's Commission on the Accident at Three Mile Island", reprint published by Pergamon Press, Inc., New York, 1979.

[43] An extremely interesting examination of media reaction to, and behaviour during, disasters and other emergencies is contained in "Media Coverage of Disasters—the Same Old Story" by T. J. Scanlon and S. Alldred (Emergency Planning Digest, October/December 1982, published by Emergency Planning Canada, Ottawa.) It provides the emergency manager and his staff with some idea of the pressures under which media representatives operate, their needs, for facilities as well as news, the kinds of stories which may appear, and the assistance which the media can give to the authorities.

[44] Published by the International Civil Defence Organization, 10/12 chemin de Surville, 1213 Petit Lancy, Switzerland.