factors in recovery is an environment in which the patient can lose heat by radiation and evaporation, namely, a cool room with dehumidified air.

The patient in shock, or the patient who has had a severe hemorrhage, may have an inadequate volume of circulating blood and be unable to maintain an adequate skin circulation. This may result in heat storage or fever. Patients with extensive skin burns may be unable to lose heat adequately from the limited uninvolved skin surface, and thus develop a fever. They need adequate fluid replacement, saline solution, plasma or blood to expand the circulating blood volume and thereby improve peripheral circulation. A cool environment is valuable in aiding heat loss after adequate skin circulation is established.

A hot, dry environment (89.6 F and 35 percent relative humidity) has been used over an extended period for the treatment of patients with rheumatoid arthritis, with reported improvement.[32]

OPERATING ROOMS

The widest application of air conditioning in hospitals is in operating rooms. Complete air conditioning of operating wards is important because winter humidification helps reduce the danger of anesthetic gases; summer cooling with some dehumidification tends to eliminate excessive fatigue and to protect the patient and operating personnel; and finally, filtering aids the removal of allergens from the operating room air.

Reducing Explosion Hazard

Explosion hazards in operating rooms increased with the introduction of anesthetic gases and apparatus. Ether administered by the old drop method gives rise to an explosive mixture, but in practice this method is still regarded as comparatively safe. When ether is mixed with pure oxygen, or nitrous oxide in certain concentrations, the explosion hazard may be as great as with ethylene-oxygen, or cyclopropane-oxygen mixtures.

Of the anesthetic gases nitrous oxide alone does not explode but supports combustion. Ether, vinyl ether, ethylene, and cyclopropane are as potentially dangerous as gasoline or illuminating gas in the home.[33] Chloroform does not explode violently in contact with flame, but decomposes to liberate phosgene. All of the anesthetic gases and vapors, except ethylene, are heavier than air. Although the incidence of injury or death from explosion is negligible compared with other hazards in the operating room, the dramatic features surrounding an explosion justify continued investigation to eliminate the hazard.

During the course of ethylene anesthesia, the mixture, usually 80 percent ethylene and 20 percent oxygen, is so rich that the danger of explosion is slight in the immediate vicinity of the face mask, but leakage of ethylene into the air may accumulate to any lower concentration, and thus introduce a serious hazard. The most dangerous period is at the end of the operation when the patient's lungs and the anesthesia apparatus are customarily *washed out* with oxygen with or without the addition of carbon dioxide. Even when this procedure is omitted, it is difficult in practice to avoid dilution of the anesthetic gas with air during the normal course of breathing following the administration. In either case the mixture would pass through the explosion range and extraordinary precaution is necessary for the safety of the patient and operating personnel.

In a study[34] of 230 anesthetic explosions and fires, 70 percent of the explosions and 60 percent of the deaths were caused by igniting agents other than static sparks. The *National Fire Protection Association*[35] made certain recommendations for safe practice based on available information in Pamphlet No. 56, Recommended Safe Practice for Hospital Operating Rooms (July 1952). These recommendations outline in some detail ways and means for eliminating or correcting hazardous conditions which experience and investigation have shown to contribute to the hazards in question. They are divided into three parts: Part I, General, deals with the nature of the hazards, Part II, Construction and Equipment, deals with physical standards for features incorporated into the construction and equipment of the surgical suite, and Part III, Administration, contains precautions to be observed by hospital personnel. The requirements and recommendations are interdependent and each will be ineffective unless coordinated with the other. To approach complete success in the prevention of anesthetic explosions, all persons—the surgical staff, the nursing staff, the maintenance staff and administrative personnel—must be educated and periodically reminded of the explosive nature of combustible anesthetic agents.

Experience has shown that neither high humidity nor intercoupling devices have eliminated the danger from static electric discharge. The removal of gas concentrations from the operating table area, by means of specially devised exhaust ventilation, should be thoroughly tested. Portable duct systems as installed aboard ship should be acceptable. Serious explosions can occur in a closed system, but proper precautions will reduce this hazard to a minimum.

A comprehensive study of the explosion problem and of the general causes and prevention of operating room hazards, by the *University of Pittsburgh*, the A.S.H.V.E. Research Laboratory, and the *U. S. Bureau of Mines* has led to a fruitful attempt to eliminate the explosive range of cyclopropane, one of the best but most difficult gases to handle. The use of helium as a diluent in the total gaseous mixture controls the oxygen concentration by displacement and, because of its flame quenching properties, it is the ideal gas for this purpose. In addition, a gaseous mixture containing helium is more difficult to ignite by electric discharges, and this quality also increases the safety factor of anesthetic administration.

Operating Room Conditions

Little is known about optimum air conditions for maintaining normal body temperatures during anesthesia and the immediate post-operative period. An anesthetized patient displays dilation of blood vessels in the skin resulting in profuse sweating and (it has been believed) inability to regulate body temperature. From this it was concluded that all anesthetized patients suffered considerable heat loss, although there may be little more than 0.8 F variation in the rectal temperature during the course of the operation.[36] The severe physiological effects, such as excessive sweating and rapid pulse, of high operating room temperatures on attendants and patients during the hot months signify the need for proper cooling. Statements of surgeons who operate in both air conditioned and non-air conditioned rooms strongly indicate that the recuperative power of the patient is greater when operated upon in air conditioned rooms.[36]

Although the comfortable air conditions for the operators are not identical with those for the patient, it is usually not difficult to compromise within a range of 55 to 60 percent relative humidity and 72 to 80 F temperature. The work just cited reported that 68 to 70 F effective temperature not only