agents other then static sparks. In 1941 the *National Fire Protection Association*[3] made certain recommendations for safe practice based on available information. Some of these recommendations are:

Windows should be kept closed to avoid explosive pooling of anesthetic gases. Twelve air changes per hour and a humidity of 55 per cent are advised. If a higher humidity were compatible with the well being of the patient and personnel, it should be maintained. All electrical installations should comply with the standards set by the *National Electrical Code* for use in explosive situations. Cautery equipment should not be used in hazardous locations. To prevent static sparks, all bodies in an operating room should be conductive or coupled. It is essential that adequate grounding be provided for the floor and every object in the operating room. Conductive rubber should be used on shoes, leg tips, operating table coverings and all rubber parts of the anesthesia equipment. All furniture in contact with the floor should be metal. In the absence of complete grounding facilities, the simple method of intercoupling patient, operating table, anesthetist and gas machine at ground potential may be used.

The carbon dioxide absorption method of administering anesthetics in a closed system confines explosive gases and obviates contact with various sources of ignition. Explosions in a closed system are likely to be more serious. However, proper precautions will reduce this hazard to a minimum.

It should be realized that when a room and the occupants have been completely grounded there is always the possibility that the patient or the operator might receive a dangerous shock if a short circuit developed in any of the electrical equipment.

A comprehensive study of the explosion problem and of the general causes and prevention of operating room hazards is being conducted by the *University of Pittsburgh*, the A.S.H.V.E. Research Laboratory, and the *U. S. Bureau of Mines*. The first result of this investigation has been 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 replacement and since its flame quenching qualities are known 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 dilatation 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. In spite of this a recent paper[4] reports little more than 0.8 F variation in the rectal temperature during the course of the operation. The severe physiological effects, such as excessive sweating and rapid pulse, of high operating room temperatures on attendants and patients during the hot months

[3]Control of Physical Hazards of Anesthesia, by R. M. Tovell and A. W. Friend (*Canadian Medical Association Journal* 46:560, 1942).

[4]A.S.H.V.E. Research Report No. 1111—Air Conditioning Requirements of an Operating Room and Recovery Ward, by F. C. Houghten and W. Leigh Cook, Jr. (A.S.H.V.E. Transactions, Vol. 45, 1939, p. 161).

signify the need for proper cooling. A comparison of surgeons' statements who operate in both air conditioned and non-air conditioned rooms strongly indicates lesser fatigue; and the greater recuperative power of the patient is confirmed by the study[5].

Although the comfortable air conditions for the operatives are not identical with those for the patient a compromise is as a rule not difficult; with a relative humidity of 55 to 60 per cent, temperatures from 72 to 80 F are used. The work just cited, reported that 68 to 70 F effective temperature not only furnished comfort for the operating room workers but apparently prevented exhaustion of the patient as evidenced by rapid convalescence in the recovery ward. Additional heat may be furnished to the patient locally or by suitable covering according to body temperature in individual cases.

The control of air-borne infection falls into two categories, namely, those which prevent dispersal of infectious material into the air and those employed or proposed for reducing the infectivity of already contaminated atmospheres, by removing or killing the disease-producing agents. Among others, two of the important preventative measures are isolation of the infected patient and adequate masking of the hospital personnel[6]. The means most commonly employed for reducing air-borne infectious agents is ventilation.

In an investigation recently conducted at the University of Pittsburgh, in a cooperative research program with the Society, comparative studies were made on bacterial content of conditioned and non-conditioned operating rooms. From these studies[7] it was concluded that the bacterial content of conditioned operating rooms was considerably less than that of non-conditioned rooms. The degree of air contamination can be reduced by proper ventilation, but recontamination of the air by occupants of the operating room prevents reduction in the bacterial level to a point adequate for the prevention of wound infections[8]. Research is in progress on the use of filtered air flowing through a system of complete mechanical barriers which would protect the patient completely against infection by attendants and bacteria-containing air in the corridor or ward[9].

Operations may be postponed on allergic patients during asthmatic manifestations through fear of complications. The removal of air-borne allergens, therefore, is in some cases an important function of the air conditioning system in preparing patients for operation.

Central system air conditioning plants and unit air conditioners prove satisfactory in operating rooms when producing between 8 and 15 air changes per hour of filtered and properly conditioned air without recirculation during the course of anesthesia. A separate exhaust fan system is usually necessary to confine and remove the gases and odors. Double windows are desirable and often necessary to prevent condensation and frosting on the glass in cold weather and to minimize drafts. The high air flow of 8 to 15 air changes in operating rooms is desirable for three reasons: (1) to reduce the concentration of the anesthetic to well below the pharmacologic threshold in the vicinity of the operating personnel,

[5]Loc. Cit. Note 4.

[6]Air-Borne Infection, by O. H. Robertson (*Science*, 97:495, 1943).

[7]Report on Air Conditioning in Surgery, by W. Leigh Cook, Jr. (*Department of Industrial Hygiene, School of Medicine, University of Pittsburgh*, 1940).

[8]Unexplained Infections in Clean Operative Wounds, by Deryl Hart and S. E. Upchurch (*Annals of Surgery*, 114:936, 1941).

[9]The Control of Cross-Contamination by the Use of Mechanical Barriers, by J. A. Reyniers (*Aerobiology, American Association Advanced Science Symposium*, 17:254, 1942).