First of all, I would like to express my thanks for the invitation to this meeting. It is a great honor for me to be able to report on the experience we have had with rescue helicopters in the Federal Republic of Germany.

We are dealing here with a very bloody subject. A year ago at a lecture given by the Royal Aeronautical Society in London, three people got sick merely by looking at some of the pictures shown by Dr. Burghart. But this is a hard fact of everyday life.

Owing to the increase of road accidents, measures towards the improvement of accident rescue services have gained in priority. This development is partly due to discoveries made by doctors treating emergency cases, namely that 10 - 15% of the fatally injured could have been saved if they had been afforded help faster and more efficiently. In view of the 200,000 deaths resulting from emergency cases annually in the Federal Republic of Germany, this means that the lives of at least 2,000 people could be saved. The economic loss which could thus be avoided runs into the billions.
Plans for improvement of the rescue services made years ago did not at first take the helicopter into consideration at all. Opinions on its use were very divided. This was mainly due to the fact that little experience had been gathered on the requirements for a rescue helicopter system. Rescue flights carried out by military or police helicopters were too few between to fully answer questions on medical, operational, organizational and financial demands.

For this reason, the ADAC started an extensive research program in Munich in 1968. The program was carried out in three phases:

1. The first phase was devoted to the suitability of helicopters as a means of rescue from a medical point of view. Emphasis was laid on discovering whether transportation by air has a negative effect on a patient. This led to specific requirements concerning the aircraft. It came to light, for instance, that the types of aircraft we used in our preliminary tests in 1968 could no longer be considered.

The new development of the BO 105 offered great hope. Messerschmitt-Bölkow-Blohm followed our project with great interest and was willing to apply the knowledge we gained from tests to the construction of helicopters. As a result, a helicopter was constructed whose technical design was primarily oriented towards the requirements of modern emergency medicine. The German Standards Committee took over the list of requirements developed in the course of the pilot tests and will, in the course of this year, set up a standard for rescue helicopters.

2. The second phase dealt with the determination and definition of the organizational side of operations, aiming at full integration of air rescue in the existing network of rescue services on the ground. The result was a document drawn up by a joint Government/Länder Committee, which deals with the principles of rescue services, containing directives in accordance with our wishes.
3. In the third and last phase, the two most difficult problems had to be solved. These were:

a) Financing expenditure and
b) Creation of a legal basis for air rescue service and inclusion of the Government and social security.

Due to high costs, it is not possible to run the helicopter rescue service along commercial lines. For this reason, tests made by the ADAC were aimed at fixing minimum costs and obtaining government subsidies.

The excellent experience we have had with the BO 105 and the success of air rescue from a medical point of view gave wings to this development. Shortly after the first BO 105 was put into operation in November 1970 in Munich, it was followed by further rescue helicopters of the same type. Today we have a network of altogether 8 operation centers in Munich, Ludwigshafen, Frankfurt, Cologne, Kassel, Hannover, Dortmund, and Bremen. Thus all important traffic agglomerations are covered.

The Federal Ministry of the Interior bears the main burden for investment costs of this program. The ADAC supported the program with a large appeal to the public for financial support and with the donations, another BO 105 rescue helicopter has been acquired.

The rescue helicopters are stationed at large hospitals in the towns I have mentioned. This was necessary so that a qualified specialist would be readily available when the helicopter took off on a mission. Our experience has shown that airports or other airstrips outside clinics are not suitable as landing stations since taking on doctors leads to delays.

Operations run daily from 6:00 A.M. (in the winter at sunrise) until 30 minutes after sunset. In exceptional cases, missions are also carried out at night, weather permitting.
Take-off is possible in a maximum of two minutes. The range for missions is about 50 km, a limit which remains flexible. The average distance to the scene of emergency is around 30 km, involving a flight time of 8 minutes.

The rescue helicopter can be alerted by anyone. For this purpose, the ADAC distributes stickers to motorists with the emergency telephone number of the helicopters. They serve not only as a personal reminder, but because of their striking color, act as a sign to other helpers in case of accident. The stickers are sealed on the car in a readily visible spot. However, in practice, most calls come from the police. Police stations are in fact obliged to call the helicopter when reports of accidents involving injured persons are received. This also applies to cases in which it is not clear how serious the injuries are, as a police officer who has little medical training is not able to judge the seriousness of the injuries. Diagnosis is therefore ruled out as a criterion for helicopter operations. The alarm call for the rescue helicopter can only then be dropped if it is certain that the injuries suffered are only slight. Missions are also flown regardless of the question of cost.

Each alarm from the police runs to the radio center of the rescue services which coordinates all vehicles in the helicopter's area of operation. From there, the pilot receives the alarm. The radio equipment in the rescue helicopters runs on the same frequencies as the police and rescue service. During the flight, the doctor can speak both to the radio control room and the police patrol car. If the rescue helicopter picks up a patient, the doctor informs the radio center to which hospital the helicopter will fly. The radio center then informs the hospital in question immediately by telephone and gives the expected landing time and diagnosis.

An ambulance is, however, always sent to the emergency location at the same time as the helicopter, contributing to optimum use of the helicopter. In less urgent cases, the doctor in the heli-
copter can send the patient to the next hospital by ambulance, thereby avoiding unnecessary blockage of the helicopter. If the ambulance arrives at the scene of emergency before the helicopter, then it must wait until the latter arrives. The pilot informs the ambulance crew of his arrival over radio-telephone.

The flight crew consists of a team of three: pilot, doctor and medical assistant. The doctor is either a surgeon or an anaesthetist and belongs to the hospital at which the helicopter is stationed. The medical assistant is provided by one of the rescue organizations, for instance the German Red Cross. The pilot is fully trained in First Aid so that he too can help. The crew changes weekly.

Each rescue helicopter carries out about 1,000 missions with 550 flight hours a year. Since 1970, a total of 12,556 rescue flights have been flown.

5,092 patients were transported to hospitals and another 7,282 were attended to at the scene of the accident by rescue helicopter doctors. An average of three missions is flown daily. The maximum is 10 missions.

Seen in terms of percent, the missions were apportioned as follows:

- Traffic accidents: 66%
- Accidents at work: 10%
- Heart attacks and poisoning: 9%
- Accidents from sports: 3%
- Miscellaneous: 12%

In 41% of the flights, patients were transported. In 33% of the flights, First Aid was rendered by the doctor without transportation by helicopter. 24% of the flights were superfluous.
Poor weather conditions in winter have scarcely influenced the operation of this service. The aircraft availability of the BO 105 has been a positive factor, as it amounted to an average of 90%. For this reason, it was only necessary to use other helicopters on a few days of the year.

Helicopter missions cost nothing for those with social security or health insurance, making up 95% of the population of the Federal Republic. The ADAC has made contracts with the social insurance institutions regarding reimbursement of expenses. Accordingly, the insurance pays a lump sum of DM 850,- for the transportation of a patient and DM 400,- for a flight where treatment is given, but the patient is not actually transported. At present, these returns do not cover costs, Up to now, the ADAC and rescue organizations have met the deficit.

The pilot and the doctor make detailed reports on all rescue flights. With the help of computers, the ADAC has scientifically evaluated the statistical material thus compiled so that elementary conclusions on the use of helicopters are now possible. I should like to go into further detail on the most important points:

1. The functions of the rescue helicopter can be divided into the following categories:
   a) Transportation of the doctor and the medical assistant to the scene of emergency to ensure optimum and speedy preliminary treatment to prepare the patient for transport without any risk;

   b) Transportation of victims from the scene of the emergency to the hospital. This is called primary transportation.

   c) Transportation of a victim who has received preliminary treatment from one hospital to another which is better suited for final treatment of the particular case. This
is known as secondary transportation.

d) Transportation of life-saving medicines, stored blood or organs for transplantation;

e) Search flights are also carried out above lakes or in the mountains.

2. Organizational requirements are as follows:

a) The rescue helicopter must be ready to fly daily. While it is out of operation due to maintenance, other helicopters must be made available. It is not possible to combine the rescue service with the police or the military.

b) The rescue helicopter is not to be an independent institution; it must be an integral part of rescue services with a uniform emergency call system.

c) The helicopter must therefore be allocated to the rescue control center responsible for operations in the area where it is stationed. This center is to head operations and coordinate missions flown with other means of rescue. Rescue control centers outside the area can request the helicopter from the appropriate center.

d) Police stations and rescue services in the respective area served by a helicopter must be given exact instructions on the procedure for raising the alarm.

e) The use of the rescue helicopter is not to depend on a medical diagnosis or on an agreement made beforehand as to the bearer of the costs involved.

f) The range of action for emergency missions for primary transportation which is considered expedient is 50 - 70 km.
g) The rescue helicopter is to be stationed at a hospital. Organizational measures including those within the hospital must ensure that the rescue helicopter can take off within 2 minutes of the alarm being raised.

h) The rescue helicopter and its crew are to be integrated in the regional emergency call system. The necessary telephone and radio connections must be provided. Both crew and helicopter must be equipped with a multi-channel radio set so that rescue service, disaster control and police frequencies can be tuned in.

3. Aeronautical requirements are as follows:

Not every helicopter is suitable for rescue operations. Only those with turbine engines and sufficient room for treatment in the cabin can be considered at all.

Helicopters in the medium-weight class with rotors which are small in diameter are preferable, as landings must be possible in a very limited space.

Further requirements include:
* cruising speed to exceed 200 km/h
* noise level less than 80 dB (decibels)
* vibration at full rotor power not to exceed 30 Hertz
* heating of cabin to 18°C Centigrade within 10 minutes
* high elevation of main and tail rotors
* twin engines with sufficient margin of power
* little maintenance required.

The BO 105 meets these requirements. Moreover, it has the added advantages of providing very comfortable transportation (that is, no vibrations) for the patient, creating little noise in the area of the hospital and being technically reliable.
Rescue operations place particularly heavy demands on the helicopter due to frequent take-offs and landings (in Munich in 1974) and the extremely brief flying times (an average on 8 - 10 minutes).

As for medical requirements, the high cost of the rescue helicopter flights can only be justified if the very best form of aid is rendered. A decisive criterion for this is the treatment at the scene of the accident. Only a doctor is in a position to carry out the most qualified rescue measures. Therefore the presence of a doctor is absolutely indispensable. In this way, the rescue helicopter becomes the extended "arm" of the hospital.

I would like to mention a few other important points here:

a) The rescue helicopter must be able to accommodate 2 emergency patients. The stretchers should be placed side by side so that treatment may be continued during the flight.

b) The doctor should be seated at the head of the stretcher and access must be possible at least to the middle of the stretcher.

c) Medical equipment must be within easy reach of the doctor and the medical assistant so that patients can receive continual treatment during the flight.

d) Uniform stretchers must be used so that the removal of a patient from one stretcher to another is not necessary when changing from ambulance to helicopter and vice versa.

We come now to the financial requirements. Rescue services are a public task and investment costs should therefore be met by the Government. Costs of upkeep (that is, maintenance, personnal,
insurance, medical material) are to be covered by the social
insurance institutions. The patient should not be put to any
financial disadvantage by the use of the helicopter.

These basic principles have been put into practice for the
most part with the rescue helicopters run by the ADAC. Es-
pecially favorable for us is the fact that the Federal Ministry
of the Interior only calculates DM 700,- per flight hour for
its BO 105 rescue helicopters and assumes all the personnel
costs for the pilots.

Assuming an average of 1,000 missions per year and 550
flying hours, this makes around DM 394,000 for operating
costs. In addition, material and personnel costs amount to
DM 167,000,--. Altogether, a rescue helicopter thus costs
DM 560,000 annually. According to our experience, only 70% of
the 1,000 missions per year qualify for reimbursement of ex-
penses involved. At least DM 800,- must therefore be calculated
for each rescue mission in order to cover the operational ex-
penses completely. The ADAC will modify the existing contract
stipulations with the health insurance companies accordingly.

In the meantime, other rescue helicopter bases have been
set up according to the Munich model. Four of these - in Ulm,
Koblenz, Hamburg and Aachen - are under the management of the
Federal Armed Forces. Another two are run by private organi-
zations, and are situated in Stuttgart and Traunstein near
Salzburg. The ADAC has ascertained that 35 bases are necessary
for an unbroken network over the whole of the Federal Republic.
In addition to the 8 bases run by the ADAC and the Federal Min-
istry of the Interior, 5 new ones will be put into operation this
year. Expansion of air rescue services in the Federal Republic
should be completed by the year 1980.