SKULL BUSTING FOR SAFETY

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A dedicated group of people in Northern California have been stirring up a storm in an attempt to catch up with the British. Not, as such a statement often implies, in an attempt to build a "backyard bomb" to compete with foreign sports cars on the road racing circuits, but in the less dramatic and more important effort of making the use of these road racing circuits safer for the driver.

Less than a year ago, one of the most popular sports car drivers in Northern California died in a race accident, due to head injuries resulting from the failure of his helmet to give adequate protection. This helmet was one of the most widely used brands to be found at a race course, and the initial reaction to this accident was to accept it as "inevitable". The Technical Committee of the San Francisco Region of S.C.C.A., however, was blessed with a chief who makes his living as an attorney, and his legal training and background made the investigation of the helmet failure more than a cursory affair. It was quickly realised, during this investigation, that there was no worthwhile data to be easily found on "just what is a safe crash helmet", and that the technical specifications which were available for the competency of a helmet were sadly inadequate. Meanwhile, as a tribute to the driver who had been killed, the San Francisco Region established the Pete Snell Memorial Fund; the trustees of this fund decided to dedicate it to the study of crash helmets, and to the development of standards and tests which might be applied to make such headgear better.

All of those concerned recognized the impossibility of perfect protection of the head under all circumstances possible in racing accidents. It was felt despite this, that if a crash helmet was worth wearing at all, a premise which now even the most daring of racing drivers accept, it should be one designed for maximum protection, not one built merely to protect against uncomfortable bumps. Very early in this study, perhaps the most startling finding of all became sadly apparent. Almost none of the people concerned with the use, manufacture or sale of helmets in this country had any worthwhile, scientific data concerning a helmet's efficiency. The prevailing methods of selection by the driver seemed to be based upon cost, or appearance, or superstition, or the fact that the driver had a friend "who rolled his machine 11 times at 130 miles per hour at the Bent Cup Races, and lived through it!" The manufacturers, by the same token, almost without exception, were either unfamiliar with any testing procedures, or used methods of so-called testing of extremely dubious value.

The "Testimonial" type of test deserves special mention. Even brief consideration reveals the vast number of completely uncontrolled variables involved in any accident. The magnitude of impact forces, angles of contact, degree and duration of contact, acceleration of the head, relative mass and density and resiliency of the impacting objects. All these are factors of great importance in determining the result of an accident, but in most accidents are virtually impossible to determine, and indeed are usually not even considered. Perhaps with a team of physicists and engineers, armed with high speed motion picture cameras set up at different angles at the site of an accident useful information about helmet protection might be gained, and some of the variables eliminated. This sort of set-up will not likely be found at a race track however, and in the absence of such analysis, the "accident testimonial" is dangerously misleading and patently worthless.

Despite this appalling lack of generally available knowledge, it was found that there have been well-designed, scientific testing programmes in existence for some years. Of note are those of the Road Research Laboratory, the Royal Air Force in England, and the Institute of Transportation and Traffic Engineering of the University of California at Los Angeles. In the field of establishing standards, the British at present are well in the lead, for in 1956 a revised set of standards was published which established criteria far superior to any used here, including those used by the U.S. Air Force for the protection of its pilots.

The Snell Study Plan was set up to cover several phases of helmet testing, the first of which has now been completed. The first step was designed to compare the efficiency of protection provided by the more popular brands of helmets on the U.S. civilian market against a single severe impact. This was a "maximum stress" type of test, deliberately set to approximate the upper limits of impact force at which if the head could be protected, survival might reasonably be expected. This type of test was selected as the first step in order to as quickly as possible eliminate the need for further tests on those helmets which were found to be grossly inadequate, and of use only in protecting against minor, uncomfortable blows. The test impact thus chosen was set to provide 500 ft. lbs. force, determined to be that incurred by an "average weight" head (and helmet) mass striking a fixed surface at a velocity of approximately 34 miles per hour. The test further differed from studies done elsewhere in two respects. Firstly, the site of impact was selected to be the temple area; this was chosen after analysis of both American and British accident statistics had shown temple blows to be both more common, and even more important, more apt to be fatal than blows in other areas of the skull. Most tests previously have used the crown of the head as the test site; blows here are not only less common but also far less often of serious nature in actual accidents. This is demonstrated in photograph No. 1, of a helmet actually worn in a fatal accident. Secondly, the test procedure differed in that the helmets were tested on human cadavers. This made possible a much more reasonable comparison with actual accident situations than if a rigid, "artificial head and neck" were used, since it was felt that the resiliency of the human neck structures might well be an important factor in the cushioning of blows. This use of a cadaver head also made for a readily measurable end result, since both direct examination and X-ray of the skull for fracture could be used to determine the effect of the impact.

Photographic records were made of both the helmets and the skull X-ray after impact; these demonstrate better than many pages of written description the lack of protection provided by all but one of the helmets. The helmets were then taken apart and their constructional characteristics tabulated, as indicated in the accompanying table. Obvious defects determined from this examination are also included in the table.

Of special interest are the very severe fractures shown in the X-ray of the Gentex helmet test. These result from a feature of particularly poor design - the use of the projecting wingnut and bolt and small wooden stop block used for the face shield. Such projections served to concentrate most of the striking force on to one small area, preventing its distribution, and allowing a far greater force per square inch to be developed than any helmet could possibly withstand. Also worthy of note is the complete lack of protection offered against fracture by the Cromwell helmet, as shown by the very severe fractures in the X-ray, even though the shell of the helmet itself remained unbroken. This is an excellent demonstration of how impact forces may be transmitted through the shell, without significant change in the shell itself, when there is no energy-absorbing liner material utilized. Similar "protection" might be gained by the old-fashioned leather helmet used years ago. The more dramatic protection in all of these tests was provided by the Toptex helmet. This could not be attributed to a superior shell, for its shell did not differ significantly from the other Fibreglass shells. The vital difference lies in the use of a unique type of liner. This was the only helmet to use a completely non-resilient, energy absorbing type of liner material, which absorbed rather than transmitted most of the impact force. The use of such non-resilient lining material is felt by the Snell Study to be of the utmost importance in protection against severe impact, both from theoretical considerations of basic physics and from the practical demonstration provided by these impact tests. This type of liner, utilizing the principle of energy absorption, has now been recognized by the British to be markedly superior, and is the type which their recently revised standards recommended.

As a result of this first phase of the Snell Study, it became immediately apparent that no helmet available on the open, civilian market could completely meet the minimum standards required. (The Toptex helmet, which passed the impact test with flying colours, was a police motorcyclist model, and was fitted with an inadequate chin strap and fastener.) These findings were made available to the manufacturers who had co-operated with the study, and have evoked extreme interest on their part. One of the manufacturers immediately stopped production of the model tested, and both that firm and several of the others are now working on a new type, incorporating improved design features, particularly that of a non-resilient type liner. Several such pilot models have already been submitted to the Snell Study for further evaluation.

With these improved models the next phase of the Snell Study plan will begin. This will include measurement of acceleration of helmet contents after blows of known magnitude using electronic recording apparatus, tests to measure abrasion resistance and penetration resistance of the shells, and measurements of strength of head harness, chin straps and fastening devices. This co-operation on the part of most of the American helmet manufacturers has been one of the most gratifying features of the entire testing programme thus far, for it expresses in the best possible way the desire of all concerned to make less likely the repetition of the type of accident which started the Snell Study on its way. With such co-operation, it would be reasonable to expect that a far superior type racing helmet will soon be available for the racing driver. If this stirring up of a storm by the friends of Pete Snell can attain such a goal, the Snell Memorial will indeed have become a living tribute.