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Ciencia nazi: Los experimentos de hipotermia de Dachau

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Es ampliamente reconocido que los experimentos realizados con prisioneros en campos de concentración alemanes durante la Segunda Guerra Mundial fueron, de hecho, crímenes brutales cometidos bajo el pretexto de investigación médica. Sin embargo, existe controversia sobre el uso de los resultados obtenidos de dichos estudios. Entre los aproximadamente 30 proyectos conocidos, la controversia se ha centrado con mayor intensidad en los experimentos de hipotermia en humanos realizados en el campo de concentración de Dachau.¹ El debate entre científicos y especialistas en ética se ha extendido al público a través de la prensa escrita y la radiodifusión.²⁻⁶ Las posturas varían desde la prohibición total hasta la defensa del uso sin restricciones del material. En un extremo, Arnold Relman, editor jefe de la revista *New England Journal of Medicine*, ha señalado que los experimentos nazis "constituyen una violación tan flagrante de los estándares humanos que no son dignos de confianza" y ha declarado que la revista no permitirá citas del trabajo nazi.¹ En contraste, Robert Pozos, fisiólogo especializado en hipotermia, ha defendido el uso libre de los resultados, creyendo que pueden impulsar la investigación contemporánea sobre la hipotermia y salvar vidas.^{2,7} Para 1984, más de 45 publicaciones habían hecho referencia a los experimentos de Dachau.¹ Sin embargo, un volumen mucho mayor de literatura sobre hipotermia no ha hecho referencia a estos estudios controvertidos.

En el período inmediatamente posterior a la guerra, Andrew Ivy, médico-científico y representante de la Asociación Médica Estadounidense en los juicios por crímenes de guerra de Núremberg, declaró que los experimentos nazis en humanos carecían de valor médico.⁸ Leo Alexander, psiquiatra y asesor del Fiscal General Estadounidense para Crímenes de Guerra, informó inicialmente que el estudio de Dachau había producido datos creíbles, pero posteriormente rectificó y concluyó que los resultados no eran fiables.^{9,10} Más recientemente, varios investigadores han respaldado los datos de los experimentos de Dachau, ya sea explícita o implícitamente, citando los resultados.^{2,7,11-13} Según estas fuentes, el estudio generó datos no disponibles en ningún otro lugar sobre la respuesta de personas no anestesiadas a la hipotermia por inmersión, proporcionando información particularmente importante sobre temperaturas letales, reacciones específicas al enfriamiento y métodos de recalentamiento. Estos respaldos contribuyeron a la impresión de que el proyecto de hipotermia de Dachau representa buena ciencia a pesar de su ética reprobable. Sin embargo, existen dudas sobre la integridad científica del trabajo. Es necesario evaluar su rigor científico para esclarecer la fiabilidad de los resultados y la importancia de abordar el debate ético sobre su uso. Este artículo presenta un análisis crítico del protocolo experimental y de los resultados obtenidos, así como una revisión de las credenciales y la fiabilidad de los investigadores.

El estudio de hipotermia humana de Dachau

El proyecto de hipotermia por inmersión se llevó a cabo en el campo de concentración de Dachau entre agosto de 1942 y mayo de 1943. Su objetivo era establecer el tratamiento más eficaz para las víctimas de hipotermia por inmersión, en particular los miembros de la tripulación de la fuerza aérea alemana que habían sido derribados en las frías aguas del Mar del Norte.¹⁴ Los sujetos del experimento eran prisioneros civiles varones de diversas religiones y nacionalidades, así como prisioneros de guerra rusos. Su participación solía ser forzada, pero en ocasiones era «voluntaria» en respuesta a promesas, rara vez cumplidas, de liberación del campo o conmutación de la pena de muerte.¹⁴

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Durante los experimentos, los sujetos fueron sumergidos en un tanque de agua helada. Algunos estaban anestesiados, otros conscientes; muchos estaban desnudos, pero otros vestidos. También se probaron varios métodos diferentes para



recalentar a los sujetos. Supuestamente se monitorizaron las respuestas de la temperatura corporal, las manifestaciones clínicas y ciertas mediciones bioquímicas y fisiológicas, y se realizaron autopsias. (Las mediciones rectales de temperatura se presentan a lo largo de este artículo).

En un intento por ocultar las atrocidades, los registros originales e incriminatorios de la mayoría de los estudios realizados en los campos de concentración fueron destruidos antes de que las fuerzas aliadas capturaran los campos. Sin embargo, posteriormente se recuperó una gran cantidad de información relativa a las extensas comunicaciones entre los investigadores y Heinrich Himmler, el Reichsführer de las SS (policía especial nazi). Inmediatamente después de la guerra, Leo Alexander investigó los experimentos de hipotermia de Dachau y preparó un informe de 228 páginas que incluía 68 páginas de comentarios personales sobre los antecedentes y el contenido del estudio, así como una reproducción de un informe exhaustivo de 56 páginas dirigido a Himmler sobre los experimentos de Dachau, firmado por los doctores Holzloehner, Rascher y Finke y fechado el 21 de octubre de 1942.⁹ [Una comunicación aparte señala que el informe, al que en este documento se hace](#) referencia como el Informe exhaustivo de Dachau, había sido preparado por Rascher para su presentación en una conferencia médica para personal militar sobre hipotermia.¹⁵

Si bien el Informe Completo de Dachau no recoge todos los experimentos de inmersión realizados en Dachau, es el único relato original disponible sobre el proyecto e incluye información suficiente para evaluar el trabajo. De hecho, el informe Alexander, que contiene el Informe Completo de Dachau, es prácticamente la única referencia primaria citada en la bibliografía sobre el estudio de Dachau. También sirvió como principal fuente de material para el presente análisis, además de información relevante procedente de otros documentos y fuentes. Este análisis destaca datos representativos del Informe Completo de Dachau. Más adelante, hablaré con más detalle sobre el Dr. Rascher, el Reichsführer Himmler y los demás implicados en la dirección de los experimentos.

Dado que los experimentos de hipotermia de Dachau se realizaron hace casi 50 años, en este análisis he tenido cuidado de no juzgarlos con criterios actuales. Cabe destacar, sin embargo, que a pesar del vertiginoso crecimiento de la ciencia médica durante la segunda mitad del siglo, los principios básicos de la investigación científica no han cambiado significativamente.

Diseño experimental

Las descripciones del diseño, los materiales y los métodos de los experimentos en el Informe Completo de Dachau son incompletas y reflejan un enfoque desorganizado. A partir de la información fragmentaria proporcionada, solo se puede obtener una impresión del alcance del estudio. No se revela el tamaño de la población experimental ni el número de experimentos realizados. Solo a partir de testimonios de la posguerra se sabe de entre 360 y 400 experimentos realizados en entre 280 y 300 víctimas, lo que indica que algunas personas sufrieron más de una exposición.^{16,17} No se proporcionan variables básicas como la edad y el nivel de nutrición de los sujetos experimentales, y no se segregan los distintos subgrupos de estudio. No se especifica el número de sujetos que se sometieron a inmersión desnudos, vestidos, conscientes o anestesiados. Las temperaturas del baño se indican entre 2 y 12 °C, pero no hay un desglose por subgrupos, lo que imposibilita determinar el efecto de las diferentes temperaturas. No se especifican los parámetros finales del experimento: tiempo transcurrido en el baño, temperatura corporal específica, estado clínico del sujeto, fallecimiento, etc.

Se probaron al menos siete métodos diferentes para recalentar a los sujetos después de la inmersión. No se dispone de información sobre las características físicas de cada fuente de calor, la temperatura corporal inicial de las víctimas ni el tiempo transcurrido entre el cese del enfriamiento y el inicio del calentamiento. Para uno de los métodos probados, la temperatura del baño caliente se especificó solo para dos experimentos. Un asistente testificó posteriormente que algunas víctimas fueron arrojadas a agua hirviendo para recalentarlas.¹⁸

En el informe no se estipula la frecuencia ni el momento de la toma de datos. Los testimonios posteriores a la guerra revelaron que, siempre que fue posible, algunos ayudantes y víctimas alteraron las lecturas de temperatura y modificaron el momento de la toma de muestras de sangre en un intento por salvar vidas. Se desconoce la frecuencia de esta loable alteración de los datos.¹⁹

No se midió la presión arterial. La monitorización cardiológica se limitó a los ruidos cardíacos y al electrocardiograma, pero en las víctimas que presentaban escalofríos no se obtuvieron registros durante la inmersión ni después de sacarlas del baño. Por lo tanto, arritmias cardíacas peligrosas, e incluso fatales, pasaron desapercibidas durante los periodos sin monitorización.

En resumen, no se proporciona la información básica esencial para documentar un protocolo experimental ordenado y evaluar los resultados. Sin embargo, contamos con suficiente información para concluir que los métodos de estudio fueron claramente defectuosos.

Análisis de los resultados reportados

According to the Dachau Comprehensive Report, anesthesia and bath temperatures ranging from 2 to 12°C had no demonstrable effect on the rate of cooling. These surprising observations are at variance with generally accepted concepts and raise strong doubts about the experimental approach. For example, Keatinge noted that immersion in water at 5°C is tolerated by clothed men for 40 to 60 minutes, whereas raising the water temperature to 15°C increases the period of tolerance to four to five hours.²⁰ Moreover, the report contains no specific information about the effects of age, clothed as compared with unclothed immersion, or nutritional state on the rate of body cooling.

Cardiac arrhythmias are described in the Dachau Comprehensive Report as being slow, fast, or irregular, without reference to standard nomenclature. Ventricular fibrillation, known to be a common cause of death from hypothermia, and atrial fibrillation, the most frequent cardiac irregularity from hypothermia, are not even mentioned. The term atrial flutter, the only conventional designation mentioned, is used to label a tracing of atrial fibrillation. The unusual characterization of common cardiac arrhythmias and their misinterpretation suggest a lack of expertise in cardiac physiology.

According to the Dachau Comprehensive Report, the subjects' body temperatures continued to fall after they were removed from the cold bath, and it was postulated that this "after drop" might be responsible for death after rescue from cold water. The temperature curves in the Dachau Comprehensive Report, however, show the presence of the "after drop" to be variable.

The data for one of the more crucial aspects of the project, the assessment of the lethal temperature level, are incomplete and inconsistent. An assistant testified that the victims were cooled to 25°C.¹⁴ In a short Intermediate Report, Rascher noted that all those whose temperatures reached 28°C (an undisclosed number) died.²¹ However, the postscript to the Dachau Comprehensive Report maintains that "with few exceptions" the lethal temperature was 26 to 27°C. In a further inconsistency, the Dachau Comprehensive Report notes that in six fatal experiments the terminal temperature ranged between 24.2 and 25.7°C. Even more puzzling is the claim in the table cited to support this point that in these victims death was observed to occur between 25.7 and 29.2°C. The mortality rate for this fatal range of hypothermia is not supplied, so the lethality of the lethal temperature remains undefined. The temperatures reached in the majority of the 80 to 90 victims who died are not reported. Moreover, because the demographic characteristics, nutritional state, and general health of this cohort are not described, it is impossible to determine whether the results apply to populations outside a concentration camp.

The Dachau Comprehensive Report states that in seven experiments the victims died 53 to 106 minutes after the start of cooling. Alexander reports, however, that a review of Rascher's experimental records and statements by his close associates disclosed that it took between 80 minutes and six hours of immersion to kill the naked victims, whereas the clothed men died after six to seven hours of cooling.¹⁰

The information on the lethality of the experiments is also inconsistent. In the Dachau Comprehensive Report, Rascher writes in one place that the hypothermia study was not designed to produce fatalities, and in another presents data on seven lethal experiments, and he refers to 13 deaths. In fact, two assistants testified that at least 80 to 90 victims died during the experiments, and only two were known to have survived the war, both of whom became "mental cases."^{16,17} The sequence is reminiscent of Rascher's disclosures on mortality in another study, on high altitude, which contained a similar chain of discrepancies.⁹

Firm conclusions about the efficacy of several techniques of rewarming are offered, despite a paucity of supporting data. Detailed results presented in the form of time-based temperature curves are reported for only three groups of experiments. The graphs reveal that body-temperature recovery was fastest with immersion in warm water, but that rewarming and presumably survival were achieved with the other methods, too. The description of one set of experiments and the accompanying temperature curve in the Dachau Comprehensive Report show the quality of the reporting (Fig. 1). The text states that a method of rewarming with a combination of a warm bath and a body massage was tested, but in the supporting figure treatment with a light box is added at the end of the study. The number of experiments and the demographic characteristics of the victims in this subgroup are not specified. Nor are the temperature of the bath and the intensity of the electric heat source, or the frequency and timing of the measurements of temperature. Although no warming was instituted for approximately 12 minutes after the victims were removed from the ice-water bath, the temperature curve shows no "after drop" such as that previously described as being regularly observed. The duration of resuscitation in a warm bath is 10 minutes, according to the text, but it lasts 20 minutes in the figure.

The conclusion is drawn that immersion in a warm bath for rewarming is the best method of treatment, and preferential use of this technique is

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FIGURE 1

recommended. However, since survival rates — the ultimate criterion of the effectiveness of a rewarming technique — are not given in the Dachau Comprehensive Report, no judgment about the merits of the various resuscitative techniques is warranted, and the recommendation that a warm bath is the best therapy cannot be justified on the basis of the data. The credibility of the results has been compromised further by the postwar disclosure that most victims who were thrown into a tub of boiling water for rewarming died, making it probable that in fact rewarming in a warm bath had the highest mortality.¹⁸ Incidentally, the role of immersion resuscitation remains controversial to this day.²²

The Dachau Comprehensive Report maintains, without any supporting data, that warm-bath rewarming had no undesirable side effects. With the grossly inadequate techniques of hemodynamic and electrocardiographic monitoring used at Dachau, circulatory failure and cardiac arrhythmias, the two most likely untoward reactions, could not be evaluated accurately. Therefore, the statement about the lack of harm is not justified.

According to the Dachau Comprehensive Report, death from cooling was caused by heart failure due to peripheral vasoconstriction and cold-induced structural myocardial injury. However, there is no mention of clinical signs of cardiac failure or evidence of myocardial damage at autopsy. Extensive experimental and clinical experience has clearly shown that contrary to the claim from Dachau, death from hypothermia is usually due to ventricular fibrillation, and cold does not injure the heart but instead protects it. Indeed, selective myocardial cooling is routinely used to preserve the myocardium during cardiac surgery. Appropriate electrocardiographic monitoring and histologic examination of myocardial tissue in the Dachau victims could have identified the true mechanism of death.

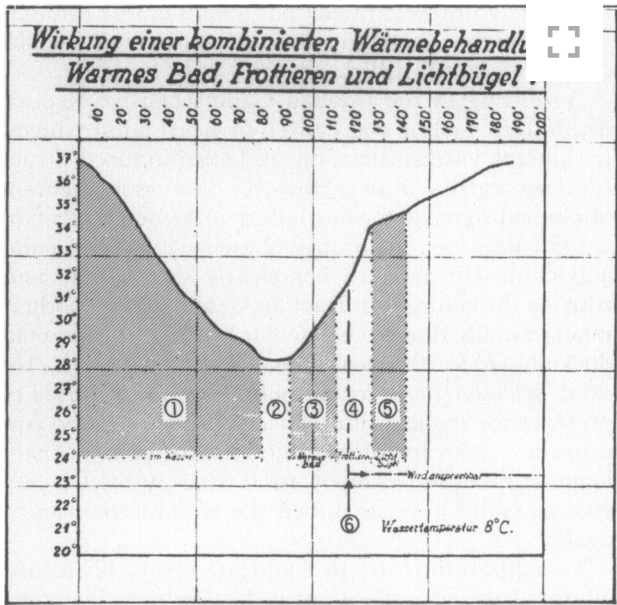
To support the concept that death invariably resulted from cardiac and not respiratory failure, the report advances the claim that breathing continued for as long as 20 minutes after "clinical standstill of the ventricle." This sequence of events is at variance with the time-honored observation that spontaneous respiration does not continue for long after the cessation of cardiac function, and it suggests that the investigators lacked the means or competence to recognize cardiac arrest. Another possibility is that the phenomenon of persistent breathing after cardiac arrest was fabricated.

The concept that local application of cold to the occiput and dorsal neck accelerates cooling was advanced by Himmler and is demonstrated convincingly in the Dachau Comprehensive Report with temperature curves from one set of experiments. Rascher also maintained that death and cerebral bleeding occurred only when the occiput and neck were submerged in the ice water, implying that immersion hypothermia does not result in death if the structures above the neck are kept out of the water. Although the scalp is an efficient heat-exchanging surface,²³ I could find no evidence in the rich literature on induced or accidental immersion hypothermia that this relatively small area has such a pivotal role in the cooling response. The observation was probably fabricated; Gagge and Herrington remarked that the Dachau results may have been "exaggerated" to support Himmler's theory.²⁴

The statement in the Dachau Comprehensive Report that cooling was complicated by cerebral edema and hemorrhage is at variance with the vast experimental and clinical experience on record. In animals, hypothermia shrinks rather than swells the brain.²⁵ Cerebral edema has not been observed in cases of accidental hypothermia or surface or core-induced hypothermia for cardiac surgery.²⁶ The last of these techniques is used in more than 250,000 operations annually in the United States alone without concern about the development of cerebral edema from hypothermia. Similarly, cerebral hemorrhage has not been observed as a result of experimental or clinical hypothermia. Thus, this report from Dachau probably represents a fabrication of data. It is also possible that brain injuries were inflicted by beatings or were sustained during the desperate struggles of the victims in the ice tank.

Background and Organization

The hypothermia project was proposed by Air Force Field Marshal Erhard Milch and approved by Himmler.¹⁴ Because Rascher's qualifications as an investigator were limited, two presumed experts, Drs. Holzloehner and Finke, were recruited to help with the experiments.^{9,14,27} However, Rascher took charge of the project despite his lack of qualifications, whereas the two experienced investigators functioned essentially as part-time consultants, apparently without the power to ensure acceptable scientific standards.^{9,14} Two months after the start of the project, Holzloehner and Finke thought that the work had been completed and withdrew. Rascher continued alone, directing another 350 experiments with the explanation that he needed additional material to complete a thesis required to support his application for a university appointment.¹⁶



Reproduction of Figure 10 from the Dachau Comprehensive Report.

Reichsführer Himmler, the other principal behind the project, had absolute authority over the concentration camps. Although educated in agriculture, the Reichsführer fancied himself a medical scientist and was intimately involved in the administrative and scientific aspects of the studies of humans. All human experimentation within the concentration-camp system required Himmler's approval.² He outlined the objectives of the projects and at times even the experimental approach.¹⁹ When his scientific suggestions were not pursued, Himmler pressured the investigators into carrying out his proposals.^{9,14,28,29} The Reichsführer expressed special interest in the hypothermia project and traveled to Dachau several times to witness experiments.^{9,18} Thus, the study represents a private venture by two unqualified ideologues, conducted in a prison setting quite alien to the standards of an academic environment. With Himmler's aid, Rascher thwarted repeated attempts by the medical establishment of the military to influence, participate in, or wrest control of the project.¹⁴

The Principal Investigator

Sigmund Rascher was born in 1909. He started his medical studies in 1930 and joined both the Nazi party and the storm troopers (the SA) three years later. After a volunteer internship, Rascher served for three years as an unpaid surgical assistant. He was barred temporarily from the University of Munich for suspected Communist sympathies.^{9,19} In 1939, the young doctor denounced his physician father, joined the SS, and was inducted into the *Luftwaffe*.^{19,29} A liaison with and eventual marriage to Nini Diehl, a widow 15 years his senior who was a one-time cabaret singer but also the former secretary and possibly mistress of the Reichsführer, gained Rascher direct access to Himmler. A strange partnership evolved between the junior medical officer and one of the highest officials of the Third Reich. One week after their first meeting, Rascher presented a "Report on the Development and Solution to Some of the Reichsführer's Assigned Tasks During a Discussion Held on April 24, 1939."¹⁹ The title of this paper foretold the character of the ensuing relationship between the two men. Because of Rascher's servile and ingratiating approach to Himmler, his "connections were so strong that practically every superior trembled in fear of the intriguing Rascher who consequently held a position of enormous power."¹⁴

Rascher's short investigative career included a leading role in the infamous high-altitude experiments on humans at Dachau, which resulted in 70 to 80 deaths.^{8,9} He was also involved in testing a plant extract as a cure for cancer. The genesis of this project illustrates Rascher's style and influence. Professor Blome, the deputy health minister and plenipotentiary for cancer research, favored testing the extract in mice. Rascher insisted on experiments in humans. Himmler sided with Rascher. A Human Cancer Testing Station was set up at Dachau. The deputy health minister collaborated on the project, held approximately 20 meetings with Rascher, and visited the junior officer at Dachau several times.³⁰

Another of Rascher's major research efforts focused on the introduction of a pectin-based preparation, Polygal, to promote blood clotting. He predicted that the prophylactic use of Polygal tablets would reduce bleeding from wounds sustained in combat or during surgical procedures. The agent was also recommended for the control of spontaneous gastrointestinal and pulmonary hemorrhages. Combat wounds were simulated by the amputation of the viable extremities of camp prisoners without anesthesia or by shooting the prisoners through the neck and chest.¹⁸

Rascher also claimed that oral premedication with Polygal minimized bleeding during major surgical procedures, rendering hemostatic clips or ligatures unnecessary and shortening operating times.³¹ He published an enthusiastic article about his clinical experience with Polygal, without specifying the nature of some of the trials in humans. The paper concluded, "The tests of this medicine 'Polygal 10' showed no failures under the most varied circumstances."³² Rascher also formed a company to manufacture Polygal and used prisoners to work in the factory.³³ A prisoner who was later liberated testified that Rascher's enthusiasm for Polygal's antiinfectious properties was probably sparked by news of the introduction of penicillin by the Allies and by his eagerness to reap fame and receive the award established for inventing a German equivalent. He initiated experiments in humans apparently without any preliminary laboratory testing. In one experiment, pus was injected into the legs of prisoners. The experimental group was given Polygal. The controls received no treatment. Information filtered to Dr. Kurt Plotner, Rascher's physician rival, that the controls were given large, deep subcutaneous inoculations, whereas the victims in the experiments received smaller volumes of pus injected intracutaneously. Plotner reportedly investigated the matter and discovered that the Polygal used was saline colored with a fluorescent dye.⁹

The frequent references to Rascher in top-level documents indicate that this junior medical officer attracted extraordinary attention from Germany's highest officials.^{9,14} His work was reported even to Hitler, who was pleased with the accounts.³⁴ Rascher was not well regarded in professional circles,^{14,19} however, and his superiors repeatedly expressed reservations about his performance.^{14,19} In one encounter, Professor Karl Gebhardt, a general in the SS and Himmler's personal physician, told Rascher in connection with his experiments on hypothermia through exposure to cold air that "the report was unscientific; if a student of the second term dared submit a treatise of the kind [Gebhardt] would throw him out."³⁵ Despite Himmler's strong support, Rascher was rejected for faculty positions at several

universities. A book by German scientists on the accomplishments of German aviation medicine during the war devoted an entire chapter to hypothermia but failed to mention Rascher's name or his work.³⁶

Rascher collected human skin for making saddles, riding breeches, ladies' handbags, and other personal items. He sold the finished products to colleagues. Although Rascher's private ventures rivaled his scientific exploits in grotesqueness, the story that emerges as the most fateful deception of his life involved his claim to have had three children, who were not in fact his own. In an attempt to please Himmler by proving that the growth of the Aryan population could be accelerated through an extension of the childbearing age, Rascher made it known that his wife had given birth to three children in quick succession after turning 48 years old. During her fourth "pregnancy," Mrs. Rascher was arrested for attempting to kidnap an infant. The ensuing investigation disclosed that the other three Rascher children had not been born to Mrs. Rascher but had been bought or abducted.³⁴ Himmler felt betrayed, and in April 1944 his protégé was arrested. Besides complicity in the kidnapping, Dr. Rascher was accused of financial irregularities, the murder of a German assistant, and scientific fraud.¹⁹ Dr. and Mrs. Rascher were subsequently executed, presumably on Himmler's orders.

Discussion

This review of the Dachau hypothermia experiments reveals critical shortcomings in scientific content and credibility. The project was conducted without an orderly experimental protocol, with inadequate methods and an erratic execution. The report is riddled with inconsistencies. There is also evidence of data falsification and suggestions of fabrication. Many conclusions are not supported by the facts presented. The flawed science is compounded by evidence that the director of the project showed a consistent pattern of dishonesty and deception in his professional as well as his personal life, thereby stripping the study of the last vestige of credibility. On analysis, the Dachau hypothermia study has all the ingredients of a scientific fraud, and rejection of the data on purely scientific grounds is inevitable. They cannot advance science or save human lives.

In the light of these findings, attempts to use the data from the Dachau experiments have been puzzling. The persistence of the claim that the work offers usable or valuable information is difficult to understand. One probable reason is the extremely limited availability of the Alexander report and the tendency of investigators to use secondary citations without consulting the primary source. Wider circulation of the Alexander report would thoroughly expose the true nature of the work and put an end to the myth of good science at Dachau. Future citations are inappropriate on scientific grounds.

Inferior science does not generally come to the attention of the ethicist because it is usually discarded by scientists. Ethical dialogues deal with work of sound scientific but controversial moral content, and the mere fact that a debate is conducted implies that the subject under consideration has scientific merit. If the shortcomings of the Dachau hypothermia study had been fully appreciated, the ethical dialogue probably would never have begun. Continuing it runs the risk of implying that these grotesque Nazi medical exercises yielded results worthy of consideration and possibly of benefit to humanity. The present analysis clearly shows that nothing could be further from the truth. Although the Dachau experiments opened the dialogue about an important ethical issue, the discontinuation of debate about these experiments should not bring an end to exploration of the larger subject—the implications of the use of ethically tainted data. But the Dachau study is an inappropriate example for that purpose.

NOTES

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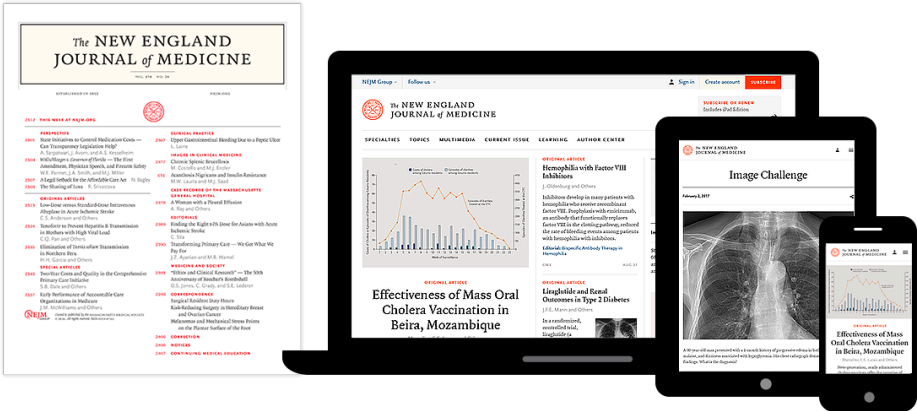
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