Emil Julius GUMBEL
b. 18 July 1891 - d. 10 September 1966

Summary. In spite of a scientific career disrupted by exile (to France in 1932, then to the United States in 1940) the German-born pacifist E.J. Gumbel was the principal architect of the statistical theory of extreme values.

Emil Julius Gumbel was born in Munich (München), Germany, into a family of Jewish origin thoroughly assimilated into the Bavarian middle class and aristocracy. He was a student at the prestigious Kaiser-Wilhelms-Gymnasium where he graduated with his Abitur in July 1910. He then pursued his studies in mathematics and political economy at the Ludwig-Maximilian University in Munich. He specialized in statistics and obtained an actuarial diploma in February 1913. For the following two semesters (summer 1913 and winter 1913/14) he worked as Georg von Mayr's (q.v.) assistant in his statistical and actuarial seminar, and he was then put in charge of tutorials in mathematical statistics. At the same time, Gumbel wrote his thesis under von Mayr, and on 24 July 1914, he received his doctorate in political economy with the highest grading. His thesis, *Die Berechnung des Bevölkerungsstandes durch Interpolation* appeared in 1916 in the supplements of E. Roesle's periodical *Archiv für soziale Hygiene und Demographie*.

Meanwhile, war had broken out and Gumbel, like many of his German contemporaries, threw himself passionately into it. Enrolled early as a volunteer, he rapidly became aware and disillusioned by the deceptions perpetrated in the name of German imperial power. Before he could venture onto the battlefield, Gumbel was initially exempted for reasons of health, and later, at the beginning of 1916, permanently excused from military service. In the meantime, he had installed himself in Berlin, where he worked in the Civil Service as an engineer in aeronautical workshops, and later at Telefunken, while militantly active as a pacifist, and again taking up studies (in physics) at Humboldt University. He there came in contact with Albert Einstein and Ladislaus von Bortkiewicz (q.v.) at the university and with Einstein also in the pacifist league *Bund Neues Vaterland*. Bortkiewicz, who was to give a decisive orientation to the career and statistical work of Gumbel, had succeeded Wilhelm Lexis (q.v.) as leader of the Continental Statistical School. Bortkiewicz and Lexis had views opposed to those of Georg von Mayr , who was reluctant to use the calculus of probabilities in dealing with statistical data.

By the end of the first world war, Gumbel had devoted his main efforts to the political struggle. He had placed his statistical expertise at the service of the pacifist and anti-nationalist cause, publishing pamphlets and enquiries on the assassinations carried out by the extreme right, and left largely unpunished by German justice. It was only in 1923 that Gumbel, with Bortkiewicz's help, received his Habilitation at Heidelberg, becoming a Privatdozent in mathematical statistics. The hostility of an increasing number of his colleagues and students to his ideas and his political activity was to plunge his university career into chaos. He was suspended several times, leaving Germany for Moscow in 1926 to work on the mathematical archives of Marx (MEGA project). Despite his nomination as professor extraordinarius, against the advice of his Faculty, Gumbel was eventually ousted from his position at Heidelberg on the eve of the Third Reich. He then found refuge in France, where he was invited to the Institut Henri Poincaré by Emile Borel (q.v.). In 1934 he was welcomed as a foreign assistant at the Institut de Science Financière et d'Assurances in Lyon. With the support of Maurice Fréchet (q.v.) he was appointed to the CNRS (The National Council for Scientific Research) in 1937. The possibility of a university career in France was not to be fulfilled, however, as war broke out again and forced him into a new exile in the USA, where he remained until his death.

Gumbel's support of Bortkiewicz's ideas became more apparent in the 1920's and 1930's. The most notable example of this is a work published by Gumbel in 1932, *Das Zufallsgesetz des Sterbens (The Statistical Law Governing Mortality)*, which brought to a close both his research on the subject and his activities in Germany; a few months later he was forced into exile. In fact, having spent much effort in rejecting all attempts to establish as demographic laws empirical mathematical formulae depending on interpolation, or on theoretically dubious fitted curves, Gumbel found himself defending the paradoxical idea of a mathematical law relating mortality to age. Its probabilistic nature revealed his debt to Bortkiewicz. It was essentially based on work of Lexis: who had adjusted mortality tables using a Gaussian distribution for those ages considered to be beyond normal. Gumbel extended the formula to the entire table, by considering as variables not the age at death, but the life expectancy at each age. He was then able to enunciate his probabilistic principle as "Unser Leben ist in Gottes Hand,[...] Das Schicksal zieht ein schwarzes Los aus der Urnen der Lebendigen. (Our life is in God's hand [...] Destiny draws a black ball from the ballot-boxes of those living." The statistics of mortality could then be treated as analogous to an urn model, a

model which was then considered to be the basis of the calculus of probabilities (as in K. Pearson's (q.v.) curves or "Laws"). Hence the word "Gesetz (Law)" in the title of Gumbel's work, which is an allusion to the famous *Das Gesetz der kleinen Zahlen* (1898) of Bortkiewicz.

Gumbel's French period is arguably his most fertile one, with his scientific activities hardly affected by political harassment. During the 1930's he remained an active militant anti-Nazi, together with other exiled intellectuals. When he came to France, he brought with him a new idea, that of extreme values, which was to occupy his thoughts for the rest of his life and ensure his enduring renown. Certain formulas of fit, for example those of de Moivre (q.v.) and Wittstein, consider a survival table as stopping at the age at which no further survivors remain. Around 1930, the Danish mathematician Steffensen rekindled discussion on the topic by pointing out the difficulties of such a hypothesis, in that statistical distributions most used by actuaries, among them mainly those of Gompertz-Makeham, and of Gauss-Lexis, only tend to zero asymptotically. Gumbel's innovation consisted in the redefinition of the limiting age, on the basis of the calculus of probabilities. He introduced a new random variable, the "oldest age" of a generation, whose mode was to be called "final age" and whose expectation only designated the "limiting age". The new distribution differs in general from that describing the population. By approximating the size of the population, the distribution of the maximum age may be modelled by one of the asymptotic laws of extreme values. Having used his ideas on different tables, Gumbel collected his contributions in a 1937 monograph of the series in mathematical statistics edited by G. Darmois (q.v.) entitled *La durée extrême de la vie humaine.*

In developing his "theory of the maximum value", Gumbel rediscovered, extended and correlated several publications on extremes carried out at the turn of the century by various authors who were apparently unaware of each other's work. Some belonged to the Continental School such as Bortkiewicz and R. von Mises (q.v.), to whom one might add the Pole Jerzy Neyman (q.v.), and the American E.L. Dodd. Another contingent consisted of British biometricians, F. Galton (q.v.), K. Pearson, L.H.C. Tippett and R.A. Fisher (q.v.). Finally, the Frenchmen J. Bertrand (q.v.), J. Haag, and especially M. Fréchet and the Italian B.de Finetti also made substantial contributions to the extreme value problem. The theoretical structure was completed in 1943 with the statement and proof of the theorem on the limit of extremes, in central limit style, by B.V. Gnedenko, There are only three kinds of limit laws possible for the maximum value, all characterized by their "max-stability":

the distribution of the maximum value, apart from a change of scale and unit, remains the same as that of the sample from which it comes. This relates the statistical theory of extremes to that of the addition of random variables, as for example in Paul Lévy's work. One of the three limiting distributions had been found by M. Fréchet in 1926. The second was named after Weibull (1887-1979), a Swedish engineer , who applied it to problems of confidence from the mid 1930's. Finally, Gumbel stressed the theoretical and practical interest of the last distribution, which was logically given his name. This, apart from a change of scale, has distribution function $G(x) = exp(exp(-x)), x \geq 0$.

Gumbel, by his interdisciplinary and transnational skills, his polyglot abilities, and his applied mathematician's flair, was able to bring to light and exploit a body of theoretical work and prove its practical use by applying his results to several areas. The first was demography, followed by cases of radioactivity in collaboration with the Curies, and finally and most importantly the fields of hydrology and meteorology. From 1937 on, first in France and after 1940 in the USA, he became an expert forecaster of river floods, and later of their drought levels, and other extreme climatic phenomena.

Unable to find a university position in the USA, Gumbel acted as a consultant to different government organizations, even including NATO. It was only in 1953 that he was appointed to a chair at Columbia University. He was also elected to the membership of the ISI, with the support of M. Fréchet among others.

His contributions are summarized in his book *Statistics of Extremes*. This was published in New York in 1958 and is the first treatise devoted entirely to this field. It was widely disseminated, mainly to engineers, with further editions in 1960 and up to 1979, while a Japanese translation appeared in 1963 and a Russian edition under the direction of Gnedenko in 1965.

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Sébastien Hertz